Community

Shared Responsibility and Interwoven Functionality

Final Report
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Overview
{mesh}Community view community as a whole, rather than individual silos of functionality. Only through comprehensive solutions, applicable to all aspects of the community, can we create meaningful, lasting change.

{mesh}Community is a series of interrelated and interdependent systemic solutions that enhance communities, first by sharing responsibility; empowering all community citizens to participate actively in the operation and development of their community - and second, by interweaving functionalities. Ensuring creation, storage and delivery of community services and the certitude that utilities are efficient and sustainable.
Why Community?

Our communities today are already feeling the pressure of diminishing natural resources from oil to water. Some communities are already stressed by less limited resources while other communities blindly turn their heads to resource depletion.

Complicating the problem is population expansion which isn’t expected to peak for a number of decades. This expansion will put further stress on precious resources.
Yet not only is the population expanding, but political, social, economic and technological change are increasingly molding public expectations. These forces are creating **greater demand for improvements** in the quality of life, regardless of an individual’s current standard of living. Those living in deplorable conditions clamor for the simplest amenities. Those with better living conditions demand the improvements they see elsewhere or perceive possible.

Making matters worse, global warming has brought **more frequent and violent natural disasters**. From these climatic changes our communities are faced with significant loss of life and damage to existing infrastructure. In the direst circumstances some communities are unable even to maintain sufficient stability to improve their citizen’s quality of life.
What should Community be?

Community should be an adaptive system, adaptive to a variety of conditions at implementation, adaptive over time to changing needs of users. It should accommodate through variability the social, cultural and economic needs/desires of developed and developing country users. Energy, utility and infrastructural technologies should be used appropriately to maximize efficiency and self-sufficiency. We need to mitigate against the damage caused and be able to respond efficiently in the wake of extreme weather and climate conditions. Finally, community should build on the goal of interaction provide the tools to help individuals and families to grow together in work, play, learning and living.
What is relevant?

**Population Growth**  
Population growth continues to soar around the world. Population increase are putting heavy demands on available resources.

**Population Movements**  
A combination of forces is creating a movement of people from rural to urban environments. The result is a need for community systems that can adaptively create services as well as re-create what is possible from existing parts of the urban environment.

**Energy Resources**  
World oil resources are beginning to dwindle. Estimates for final peak production vary from 2005 to a just a few decades from now. The world economy is deeply committed to oil as fuel and hydrocarbon material resource. Energy needs will have to be met by other resources in the near future.

**Water Resources**  
Water supplies are already becoming precious resources in many parts of the world. As these are strained by greater demand, new efficiencies in water distribution, use, purification and reuse will be mandatory to maintain communities.

**Global Warming**  
The increased energy injected into weather and climate systems by global warming is beginning to affect the destructiveness of weather and climate events. Stronger and more frequent tornadoes, hurricanes and other cyclonic storms will be one result. Longer and more intense droughts and flooding will be another. Barring a cataclysmic worldwide event, the growing severity of environmental conditions will require new approaches to individual housing and community structures, both to ensure preservation in bad weather and to maintain system function in the face of infrastructural pressures.

**Increasing expectations**  
The growing availability of television and Internet in remote areas is providing people with daily reminders of living conditions, products and services in commonplace use elsewhere in the world. These encounters create expectations that fuel demand and willingness to change.

**Internet Penetration**  
Computer use and Internet access grow exponentially every year. Information of encyclopedic detail can be obtained more and more easily, and complex, sophisticated processes can be used remotely. Access to high-quality communications and sophisticated computer tools are increasingly available to individuals and groups anywhere.

**Emerging Technologies**  
The pace of technological change continues to accelerate, bringing new science to commercial and industrial uses at an ever quickening pace. Major technological innovations will be appearing in the new fields of molecular nanotechnology, robotics and bioengineering/genetics.

**New Relationships**  
Greater public mobility and access to information is changing the nature of association for many individuals and organizations. Organizations that once operated in isolation are now players in a common environment. Sometimes the emerging relationships are competitive, sometimes cooperative.

**Economic Upheaval**  
Wars, droughts, environmental disasters and perceived opportunities in other locations are inducing people to abandon or supplement previous occupations with new ways to make a living. Entrepreneurial styles of working are finding new currency in a world where wages and funding are limited, but desires are fed by ubiquitous televised reminders of what is available.

There are a series of relevant trends that communities are facing regardless of their geographic, cultural, or socioeconomic status. These conditions cannot be overlooked; they need to be at the forefront of our planning efforts.
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Cutting across the solutions that this system proposes are six core themes that support both philosophical beliefs and the implementation of specific community infrastructure, utilities, and service offerings.

**Managed Information**
{mesh}Community values the implicit and explicit knowledge of individuals, groups, businesses, government, and other communities. Collecting, analyzing, and making information available are crucial community responsibilities. Finally, communities must ensure access to this information regardless of status, location, situation.

**Sustained Resources**
{mesh}Community encourages the responsible, sustainable use of resources and the appreciation of those resources. Meshed networks of infrastructure and utilities allow communities to make more efficient use of limited resources by promoting distributed utility generation and distribution, and increasing resource recovery, reuse, and recycling.

**Fail-safe Redundancy**
{mesh}Community provide communities with delivery systems that have the redundancy needed to maintain safe operation in the face of errors, damage, or disasters.

**Empowered Citizenry**
{mesh}Community empowers individuals to have a greater sense of community. It recognizes that individuals can make a valuable contribution to the community and enables them to participate with an increased sense of personal responsibility.

**Spectrum Adaptation**
{mesh}Community is appropriate across a variety of spectrums including socioeconomic status, level of development, and geographic location. Systems of solutions also need to enable the community to grow over time, as elements provide an immediate impact, but also one that is able to upgrade over time.

**Integrating Functionality**
{mesh}Community make community functions a more integral part of a citizen’s daily life. Increasing the access and availability of services, and distributing functionalities throughout the community.
Community

Shared Responsibility and Interwoven Functionality

DisasterNet
Citizen Planner
One Channel Communications
Gaia Information Enabler
Hermes Wayfinding
Revitalizer

Water Source
Distributed Energy Grid
Organic Transportation
Service Matrix
Emergency Response Network
Apollon Health Services
Enlightenment System
Community

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System Workshop | Fall 2004
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Preface

The Problem

Created in Copenhagen, Denmark to recognize worldwide design achievements, the INDEX: Awards celebrate the capacity of design thinking to affect quality of life positively at local, national and global levels. Among the five categories recognized by the awards, Community became a subject for inter-professional study in the Institute of Design’s fall 2004 Systems and Systematic Design course partly through the inspiration afforded by the Awards.

Recognition by the internationally acclaimed INDEX: Awards confers credibility and guarantees widespread dissemination of the concepts recognized. For this project, that would accelerate the communication of new ways to deal with some of the most egregious problems introduced by population growth, as well as ways to introduce advances in technology at many levels to communities around the world.

Using a computer-supported planning process called Structured Planning (summarized later in this Preface), teams undertook an extensive project to seek out, develop, and integrate inventive concepts in an adaptive system that could be implemented worldwide under a wide variety of economic, environmental and cultural conditions. Particular attention was to be given to the climatic changes to be expected from global warming and the resource exhaustion (notably, water) being hastened by burgeoning population growth.

The Project

Two project sub-teams of three members each were formed to carry out the project. The first team was given responsibility for community infrastructure and utilities; the second took on the services and functionality necessary in the community to support human activities.

Charters were issued to each team setting the context of the project and its goals. The Charters acted as initiating briefs. Following are some sections from them:
Background

Political, social, economic and technological change are increasingly molding public expectations, creating greater demand for improvement in the quality of life. Complicating the problem, population expansion, with the relentless consumption of resources it brings, continues in all but a few developed countries. Yet, developed countries and developing countries -- rich and poor alike -- feel the quality-of-life pressure. The problem affects all because it is a problem of quality relative to what exists. Those living in deplorable conditions clamor for the simplest amenities. Those with better living conditions demand the improvements they see elsewhere or perceive possible. For all, strides in science and technology are a constant reminder that a better life is possible, and should be attainable.

Visionary models of “ideal communities” have long been the pet experiments of utopian cults, city and regional planners and new-town developers, pressing the boundaries of the technologically possible and socially acceptable to show what could be -- if people would “follow the rules” and social, economic and political realities would remain favorable. While the experiments seldom work for very long, some of the ideas are usually accepted and a slow evolution of thinking continues to change the ways that the general public views the possibilities of community.

The difference today is that the press of exponential population growth is joining with environmental changes to make living conditions a matter of mandatory concern, rather than a special project of liberal governments and the socially conscious. Diminishing natural resources from oil to water will directly affect quality of life and are already beginning to be felt seriously in some parts of the world. Dealing with them will require new approaches to the use of utilities. Another new factor, increased energy in weather and climatic systems, is creating more frequent and more violent natural disasters. Brought about by global warming, these will require stronger, more protective construction, smarter patterns of home and community design, and resilient systems able to survive unexpectedly disruptive natural events.

At the same time, the post-industrial technological revolution is bringing extraordinary new capabilities in engineering, communication, command and control, materials -- engineered and bioengineered -- and information technologies. The means are emerging to deal with the needs that are evolving. Both are significant in scope and potential impact. The increased urgency today reflects both the extensive destructiveness of the forces precipitating need and the power of the technologies supporting solution.

It is time to commit to communities designed as adaptive systems and to develop plans for components that can fit widely varying needs within different environmental, economic, social and cultural niches. The problem is not finding a single solution to a specific problem, but creating a general system concept capable of particularized solutions to a wide range of problems. Yesterday’s experimental ideal community needs to become the community that works, now, implemented appropriately today, but continuously adapting to the conditions of tomorrow.
Relevant Trends

Trends initiated by emerging technologies, changing environmental conditions, and evolving social needs and interests have real impact on the needs and aspirations of individuals, families and communities. Among such trends are:

**Population Growth**
Population growth continues to soar around the world. Particularly in developing countries, but also in countries with significant immigration (such as the United States), rates of population increase are putting heavy demands on available resources. Although estimates for a final asymptote have decreased, world population is still expected to top 9 billion by 2050.

**Population Movements**
A combination of forces is creating a movement of people from rural to urban environments. In the developing countries, it is the perception that better jobs are in the cities. In the developed countries, it is the renaissance of the city as a cultural center coupled with the progression of societies from agriculture to manufacturing to service to information economies. The result is a need for community systems that can adaptively create services as well as re-create what is possible from existing parts of the urban environment.

**Energy Resources**
World oil resources are beginning to dwindle. Estimates for final peak production vary from 2005 to a just a few decades from now. The world economy is deeply committed to oil as fuel and hydrocarbon material resource. Energy needs will have to be met by other resources in the near future.

**Water Resources**
Water supplies are already becoming precious resources in many parts of the world. As these are strained by greater demand, new efficiencies in water distribution, use, purification and reuse will be mandatory to maintain communities.

**Global Warming**
The increased energy injected into weather and climate systems by global warming is beginning to affect the destructiveness of weather and climate events. Stronger and more frequent tornadoes, hurricanes and other cyclonic storms will be one result. Longer and more intense droughts and flooding will be another. Barring a cataclysmic worldwide event, the growing severity of environmental conditions will require new approaches to individual housing and community structures, both to ensure preservation in bad weather and to maintain system function in the face of infrastructural pressures.

**Increasing expectations**
The growing availability of television and Internet in remote areas is providing people with daily reminders of living conditions, products and services in commonplace use elsewhere in the world. These encounters create expectations that fuel demand and willingness to change.

**Growing Globalization**
Nations are less and less independent entities. International corporations and global trade are creating a one-world economy in which there are potential markets for virtually anything of value. Diversities of culture offer niche markets, but also provide specialized sources of products.
Internet Penetration
Computer use and Internet access grow exponentially every year. Information of encyclopedic detail can be obtained more and more easily, and complex, sophisticated processes can be used remotely. Access to high-quality communications and sophisticated computer tools are increasingly available to individuals and groups anywhere.

Emerging Technologies
The pace of technological change continues to accelerate, bringing new science to commercial and industrial uses at an ever quickening pace. Major technological innovations will be appearing in the new fields of molecular nanotechnology, robotics and bioengineering/genetics.

New Relationships
Greater public mobility and access to information is changing the nature of association for many individuals and organizations. Organizations that once operated in isolation are now players in a common environment. Sometimes the emerging relationships are competitive, sometimes cooperative.

Economic Upheaval
Wars, droughts, environmental disasters and perceived opportunities in other locations are inducing people to abandon or supplement previous occupations with new ways to make a living. Entrepreneurial styles of working are finding new currency in a world where wages and funding are limited, but desires are fed by ubiquitous televised reminders of what is available.
Project Statement

Using Structured Planning methodology, conduct an advanced planning project to develop infrastructure, utilities, services and functionality for a community system able to respond to the needs and technological resources of contemporary world societies.

The system should:
• Treat community as an adaptive system, adaptive to a variety of conditions at implementation, adaptive over time to changing needs of users;
• Accommodate through variability the social, cultural and economic needs/desires of developed and developing country users;
• Utilize energy, utility and infrastructural technologies appropriately to maximize efficiency and self-sufficiency;
• Employ materials, structures, technologies and design concepts best able to economically provide reliable service under extreme weather and climate conditions;
• Recognize and employ computer and communication technologies appropriate to the aspirations and expected capabilities of communities; and
• Build on the goal of interaction to give the community the tools to help individuals and families to grow together in work, play, learning and living.

Goals
As general guidelines the proposed community system should:
• Explore a full range of possibilities, paying especial attention to appropriate technologies and user needs and desires.
• Consider both high- and low-tech proposals as they are appropriate.
• Include ideas for processes, tools, systems and products -- including procedures, services, activities, organizational concepts and any relevant relationships among them.
• Explore revolutionary as well as evolutionary ideas.
• Consider the educational process through which individuals and groups learn to use the system and its components.
• Accommodate all users of the system, from distribution to retirement and provide for them in the design. Thoroughness is a step toward system integrity.
• Consider potential costs, pricing and funding thoughtfully; the proposal should not incorporate unnecessary frills, but it should not sacrifice quality for low cost.
• Treat the design problem as design from the inside out; user needs come first, with every attempt possible made to satisfy them in some way, even when tough design decisions must be made.
• Conceive the properties and features of the system as means to build trust between buyers, sellers, installers, maintainers, users and suppliers.

Overall, the solution should:
• Assume that the proposal can be acted upon as it is conceived. Do not underpropose on the assumption that a concept might be politically opposed.
• Demonstrate what might be achieved. The value of the proposal is in its ideas, not its direct attainability. Ideas that might not be fully attainable under today’s conditions may be incrementally achieved tomorrow -- if they are known.
The Process

The semester-long Systems and Systematic Design course is a project-based course in which teams of graduate students, deliberately of mixed international origins and different academic backgrounds, apply the computer-supported Structured Planning process to complex design and planning problems. The goal for each project is to develop information thoroughly, propose innovative solutions that take maximum advantage of the information, and integrate these ideas into system concepts that can both be evaluated in their own right and (in a real situation) be the comprehensive project specifications for a follow-on detail design phase of development.

Course Issues:

Complexity. What is the nature of “systems” concepts, where products, processes, services and settings are organized to act together to achieve multiple goals? What can be done to assure that a concept is as complete as possible, covering many functions and attaining a high degree of “wholeness” and organic reliability?

Design and planning methods. What is Structured Planning and how can its tool-kit of methods be used to collect, structure and handle information in projects of greater complexity than can be comfortably dealt with intuitively? How can such methods be used by a team to extend the effectiveness of all?

Teamwork. How do individuals with different cultural origins and different academic backgrounds work together successfully on teams? What roles are there to be played and what difficulties must be overcome?

Structured Planning:
Structured Planning, the systematic planning process taught in the course, is a process for finding, structuring, using and communicating the information necessary for design and planning activities. It is a front-end process for developing concepts thoroughly and cohesively.

A number of projects have been undertaken with it and used to further its development. Among nearly 100 of these, an early published project for Chicago's transit authority (CTA) was Getting Around: Making the City Accessible to Its Residents (1972). In 1983, the House of the Future project won the Grand Prize in the Japan Design Foundation's First International Design Competition. In 1985, the design of a habitation module for Space Station was undertaken for NASA. In 1987, the Aquatecture project won the Grand Prize again in the Japan Design Foundation's Third International Design Competition. In 1991, Project Phoenix on global warming was honored as Environmental Category Grand Winner in Popular Science magazine's "100 Greatest Achievements in Science and Technology" for the year. In 1993, two award winning projects, NanoPlastics and Aerotecture, were widely publicized in Europe and Japan. In 1995, the National Parks project developed plans for the future of the U. S. National Park Service, and in 2001, Access to Justice, a project sponsored by the National Center for State Courts, was implemented for use in state courts across the United States. As the process has evolved, it has become an increasingly useful planning tool for products, systems, services, processes and organizations. It is now being used commercially.
A diagram of the process, shown below in two figures, outlines the activities that make up Structured Planning and the working documents and final products that are produced along the way. The following general description follows the diagram. Where products of the process are discussed here in the abstract, it is possible to see specific examples produced for this project in the appendices that accompany this report.

![Diagram of Structured Planning process](image-url)
I Project Definition

The Structured Planning process begins with Project Initiation and the production of a Charter. This is a “brief” that serves as an initial communication vehicle between client and planners. It contains background, context, basic goals, a project statement that cuts to the heart of the planning task, resources to be used, and an initial set of issues to be investigated.

Defining Statements are mini “white papers” produced in the Framework Development portion of Project Definition. They focus the project within the direction of the Charter, concentrating on the issues and arguing specific directions that the project should follow with regard to them. Together with the Charter, they define the project.

II Action Analysis

Any system can be viewed as a complex entity working with its users in different ways appropriate to its modes of operation. To plan effectively, a planning team must recognize these Modes, identify Activities that occur within them, and isolate the Functions that the users and system are intended to perform within each Activity. The result of the Activity Analyses conducted is a Function Structure.

Half of the purpose of Action Analysis is the enumeration of Functions. The other half is the development of information about these Functions that reveals insight about what happens as they are performed. During Action Analysis, insights are sought about why things go wrong in performing some Functions, and how other Functions manage to be performed well. These insights are uncovered in the Design Factor Description procedure and developed in documents that become part of a qualitative knowledge base. Activity Analyses record information at the Activity level; Design Factors document insights and ideas associated with Functions.

To capture as fully as possible the ideas suggested on Design Factors, Solution Element documents are written in the Solution Element Description portion of Action Analysis. These are one-page documents designed to capture enough detail about ideas to give them substance when they are needed later. They have three important sections: “Description” — a short explanation, “Properties” — what the idea is, and Features — what the idea does. The Solution Element form is the tool used for committing ideas to paper.

The product of Action Analysis is three sets of critical information: a set of Functions (the Function Structure), a set of insights (Design Factors) and a set of preliminary ideas (Solution Elements).

III Information Structuring

Paradoxically, as useful as the Function Structure is for establishing coverage, it is not the best form of organization for developing concepts. Reorganizing information for use in concept development is the job of two computer programs, RELATN and VTCON.

The controlling factor for whether two Functions are associated from the planning standpoint is not whether they are categorically “related” in some manner, but whether a significant number of their potential solutions are of concern to both. Which Solution Elements are of concern to each Function is established in an Interaction Analysis procedure. The RELATN program then uses this information in a Graph Construction process to establish links between Functions.

Another program, VTCON, completes the information structuring process. The graph establishes paths through the Functions by linking them when they are related, but, unlike a road map, a graph is not naturally arranged nicely for visual comprehension. In the Hierarchy Construction activity, VTCON finds clusters of highly interlinked Functions and organizes them into a semi-lattice hierarchy, a very general form of hierarchy most appropriate for planning. The hierarchy is called an Information Structure.
The process is then reversed as a top-down, structured brainstorming procedure: Ends/Means Synthesis. In this process, the planning team asks of high level nodes, “what means do we need to meet this end?” As means are established, they are treated in turn as new ends for which means must be found, until the means become concrete enough to be described as final elements of the system (System Elements). Solution Elements originally conceived for the Functions involved are constantly reviewed as possible end products. New ideas, however, are encouraged, and original ideas are modified or combined in the light of the means that evolve.

During Solution Evaluation, features of the System Elements are evaluated for their contribution to fulfillment of Functions in their part of the Information Structure. If there are unfulfilled Functions, this is the signal to return to the Ends/Means process for additional development.

System Element Interaction compares System Element with System Element in a search for additional synergies that can contribute to systemic qualities. More than simply recognizing relationships, the planning team proactively seeks out ways for System Elements to work together — to the extent of modifying one, the other, or both. Changes are incorporated in the properties and features of the individual System Elements.
The last task, System Element Description, completes the write-up of System Elements as specifications, including a succinct description, all relevant properties and features, and extensive Discussion and Scenario sections that contain detailed expositions of the ideas in both conceptual and operational terms.

V Communication
Because the result of the Structured Planning process is a complex system, usually with a number of System Elements, a Communication Structure is frequently included as an aid to understanding. This is created during Concept Organization by the VTCON program from an assessment of how important the System Elements are to each other’s operation. Using this structure, the reader can understand the system and navigate its concepts with greater efficiency.

The product of the Structured Planning process, assembled in the Project Completion section, is a Conceptual Plan, made up of an Overview that provides background and introduces the system, the System Elements that describe the ideas and their relationships, and Appendices that contain all relevant support information, including the Defining Statements, Design Factors, Function Structure and Information Structure.

The last task, System Element Description, completes the write-up of System Elements as specifications, including a succinct description, all relevant properties and features, and extensive Discussion and Scenario sections that contain detailed expositions of the ideas in both conceptual and operational terms.
The Teams

The design/planning teams for this project consisted of six Institute of Design graduate students from: India, the Republic of South Korea and the USA. Individual members hold degrees in seven different fields of design and other disciplines.

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Our communities are increasing diverse; economically, geographically, and culturally. Additionally, our communities are growing and changing at a rapid rate. We need to find flexible, adaptable ways to deliver key services to these all types of citizens who are clamoring for improved access and quality.

Communities need the ability to deliver services in ways that match the nature of their population. Issues of mobility, access, and economic means create scenarios where no one delivery technique is appropriate. Service Matrix provides communities with a continuum of delivery solutions to enable access to resources, encourage growth and well-being and promote commerce.
PODs

Discussion
There are many communities that are unable to provide sufficient infrastructure to supply services, such as water or power, to individual residences. Socioeconomic standing and population density are two restrictions that communities may face. Citizens in these circumstances spend an inordinate amount of time struggling to provide basic standards of living. PODs seek to provide these communities with access points to critical services, utilities, and information. While distribution is still not at the household level, creating POD Centers within a community brings these elements closer to citizens. Allowing them not just improved quality of life but enabling them to allocate time previously devoted to resource collection to other activities.

A single POD is a cylindrical, self-powered, off-the-grid module that provides a specific type of utility or service delivery. It may contain communication equipment, a water filtration system, or waste collection. PODs operate on power generated from a combination of solar panels and wind-harnessing technology. They are for use in areas without an power-delivery infrastructure.

PODs increase exponentially in functionality when placed in clusters, as small as groups of three, and as large as the community requires. Clusters of PODs together form one-stop service and utility centers where citizens may fulfill a range of needs. Multiple clusters may be placed within a community, distributing these services that are accessible to all citizens. There are a range of services that can be provided by the POD system. Communities have the ability to customize their PODs and POD clusters to meet their needs.
Element Discussion

wastePOD is a centralized collection point for organic and non-organic waste and reusables. This POD is actually made up of three sub-PODs, for organic, non-organic, and reusable waste. The wastePOD attempts to prevent communities from polluting the surrounding environment while extolling the benefits of existing resources as something other than waste. Citizens are responsible for bringing their trash to the wastePOD and sorting it so that it can be best used. Organic waste is placed into a composting structure. With proper aeration and movement the waste is able to be reused as fertilizer for community gardens. Non-organic waste is placed into a compacting structure. This waste is picked up regularly using the system of LittleTrucks (described in the Revitalized section). These trucks are ideal for navigating areas without traditional infrastructure and wide roadways. Reusables are placed in a separate POD. They are simply left there to allow other citizens to take them as needed. Educational and instructional materials are posted to help citizens learn what types of materials are considered reusable, from glass jars to building materials to raw materials.

commPOD is a communications and information access and distribution point. These PODs contain a wireless connection to the community’s communication infrastructure allowing off-grid access for citizens who otherwise would not have a means of communication. The POD contains phone and internet access, and other appropriate means of communication if necessary. The commPOD is equipped with a dedicated emergency contact functionality. Additionally, these PODs would contain means to broadcast or post community bulletins, public safety, either through LED display screens. The commPOD also facilitates access to information about community services, such as the transportation network, Service Matrix schedule, or Enlightenment services.

waterPOD provides a means of water collection and distribution. Based on an idea from Candace Brooks developed at the Institute of Design, rainwater is collected through a non-porous roof-covering and funneled into individual PODs. The water is stored there and filtered to the degree necessary. The waterPOD also has sub-POD capabilities with different PODs enabling residents to receive clean water for drinking and cooking, a location for bathing equipped with hand-pumped showers, and a laundering facility for clothes and linens.

gardenPOD assists communities in building public community gardens to grow edible plants, provide environmental education opportunities, and help maintain ecosystem balance. gardenPODs would serve to demarcate the area between the PODs or even around PODs, for garden use. Overhanging mesh screens, hung between PODs, allows both light and rain to filter through but traps in humidity, preventing evaporation from drying the soil below. Between PODs barrier screens can be drawn to provide protection from animals and pedestrians. Similar to the waterPOD, the gardenPOD has the ability to collect water for watering plants. This water though does not need to be filtered, so the POD would only serve as a collection and access point.

powerPOD serves as a battery distribution and recharging station. These car-battery sized batteries allow citizens to have access to electrical power within their residence. Each powerPOD has the ability to charge dozens of these portable batteries. The powerPOD harnesses energy from the wind, using tri-blade windmills, or sun, using solar-collection panels. Energy is converted to electricity and recharges the batteries. Citizens come to the powerPOD, collect a battery, insert their old battery into the POD and take the battery back to their residence for use. The batteries have built in outlets for electrical devices to be connected to, requiring no additional hardware. After the charge runs out citizens simply return the battery to the POD for recharging, selecting an already recharged battery to

<table>
<thead>
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<th>Features</th>
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<td>Provides communities with access points to critical services, utilities, and information</td>
<td>Cylindrical, self-powered module</td>
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<td>Enables communities to better allocate time previously devoted to resource collection to other activities</td>
<td>Communication equipment</td>
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<td>Provides a specific type of utility or service delivery</td>
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<tr>
<td>Co-locates multiple necessary resources</td>
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WaterPOD cluster

PODs

Collection
Use Area
Storage
Overview
MobileAccess is another solution for communities unable to build sufficient infrastructure to deliver services. It is ideal in under-developed or developing communities. Urban communities also benefit from this service in under served areas. This mobile service delivery concept delivers services directly to citizens who otherwise would not have access. The MobileAccess concept relies on a series of larger vehicles equipped with modular communications, computing, and storage elements in addition to the more specific elements needed to carry out educational, medical, commerce, disaster recovery and cultural services.

These vehicles are deployed periodically or as-needed, to a given section of the community and supply the temporary infrastructure necessary to carry out service delivery. This infrastructure includes, but is not limited to, booths, walls, tents, projection screens, and stages. These vehicles allow the interior to be customized by exchanging the different types of elements needed, which are stored at a central facility. Additionally, the vehicles serve as a source of electrical power, having a series of large fuel cells that can be recharged at the central facility.

Communities with limited resources are able to spend them wisely, by investing in a flexible infrastructure that can serve many purposes, rather than single-purpose buildings and structures. MobileAccess provides services that these communities and citizens otherwise would not have access to. The community as a whole benefits because it has the flexibility to focus resources on issues and activities that are more important, but with the ability to quickly reallocate these resources.
Element Discussion

Mobile Culture enables cultural activities to occur throughout the community without requiring a pre-built infrastructure. Often communities contain a series of large-scale buildings, housing cultural opportunities such as museums or performance venues. Yet much of the community is located far from these facilities with no means of access. The Mobile Culture vehicle contains the elements needed to deliver a range of cultural services. Temporary stages can be created for music concerts, plays, and other performances or other public demonstrations. Large projection screens allow films, announcements, or real-time events to be broadcast. Finally a series of mobile kiosk-like displays allow temporary exhibition to be created. These can accommodate flat, printed materials and photographs, or objects and artifacts shown within a protective case.

Mobile Street provides the infrastructure for a community marketplace. This allows any community to have a robust commerce environment. Mobile Street provides a structured series of booths, tables, and tents where farmers, local artisans, food vendors, and others with services for sale can market their wares. The focus is on bringing together local vendors and buyers, strengthening the community economic infrastructure and access to goods. The Mobile Street vehicle would arrive at a remote, or under served, section of the community early in the day. Citizens would come out to unload the vehicle and set up needed booths and such. Where necessary connections to the Mobile Access power source can be established as well.

Mobile Classroom is an education facility that can travel to various areas within the community. This service is coordinated through Enlightenment (see Enlightenment section for more detailed description).

Mobile Help is a means for communities to establish hubs of service delivery in the wake of incidents, emergencies or disasters. Mobile Help provides organized short-term community stabilization and recovery. The Mobile Access vehicles operate as a command center from which supply distribution, grief counseling, medicine distribution and inoculation all can be provided.

Mobile Delivery provides rural, remote, and isolated communities shipping and delivery services to packages and goods. Senders located in community centers are able to send goods via the MobileAccess vehicles that are making trips to various communities to deliver other services. These packages and goods arrive at the community and are unloaded at a central drop-off point. Citizens are then able to distribute these packages to their intended recipients. Citizens in these remote communities are able to ship goods back to the community center in the same way. Because the system does not require dedicated vehicles or additional resources to operate it can be run at a very low cost.

Properties
- Temporary, mobile structure
- Assembly of physical elements; tents, walls, coverings
- Central materials storage facility

Features
- Offers community a flexible infrastructure, maximizing limited resources
- Provides opportunity for communities to come together
- Distributes services throughout community
Overview
The ServiceHub tries to better integrate government offices and services into community life. It provides closer, easier access to government offices, services, and events through the creation of localized physical nodes. ServiceHub is a small physical collection of branch government offices and public venues and attractions located at a key point within the community. No longer are these offerings centralized at one location (e.g., city hall), but localized and accessible throughout different areas of the community. This model is based on the Curitaba model as a way to integrate government function into daily life.

A given ServiceHub may offer unique or redundant types of services from other ServiceHubs. Unique services are offered when the services are more pertinent to that section of the community, or services in lower demand and need not be decentralized. Redundant services would be those accessed most frequently by citizens. Localizing such services would allow citizens access closer to where they live or work and with shorter lines and wait times than at a central facility.

The ServiceHub can house additional services that just governmental administrative functions. It can easily incorporate community centers, health centers, voting, and cultural facilities. By localizing these services they become integrated into the daily lives of the community, helping bridge the common divide between government and community.

ServiceHubs can be created in conjunction with other public services and venues, such as Transway Stations, the StationScape, Universities, or the Community Resource Management Center. This co-location of services further increases the usefulness of all services by providing a single, local, service delivery location for citizens.
Overview
Many communities today have found innovative means to keep true to traditional food preparation and serving methods even amidst technological advancements affecting their lifestyle and work habits. LunchBox is a meal preparation and delivery service that serves as a health conscious economic development program.

These cooking citizens have set a predetermined number of meals that they are able to make in a given day. The ordering system automatically removes them as a preparation choice once their allotment has been filled. This allows at-home cooks to make as many or as few meals as they are able to. Meals are then collected via a network of messengers, typically on bicycles, who deliver the meals throughout the city.

Properties
- Meal preparation and delivery service

Features
- Allows citizens in the workforce to have a healthy, home-cooked meals
- Provides a source of income for stay-at-home individuals
**Community**  
**Service Matrix**

**Scenario**  
Ravi, his wife, Indrani, and their two children, live comfortably within one of the more developed sections of his community in Mumbai, India. The family is well supported by his job at a local financial institution; they have sufficient access to community utilities, transportation and educational resources. For instance, last night Ravi realized that it was once again time to register his children for school. He planned to do so on his way to work today. As Ravi arrives via the ZoneBus at the Transway Station, instead of walking the last five blocks to work, he instead stops off at the ServiceHub. Co-located at the Transway Station, the ServiceHub is a collection of branch government offices and civic services, a public mall of sorts. Ravi was happy not to travel to the Department of Education, which is on the other side of town and would take most of the morning to complete the simple task of registering his children in the local school. Ravi passes transportation and taxation offices, along with public health facilities and community meeting spaces. Ravi was able to register his children, and only add twenty minutes to his commute that morning. Ravi is quite appreciative of the ServiceHub efforts and realizes that not all sections of his community are so lucky. As a developing community, Mumbai is home to a range of socioeconomic groups. Certainly ServiceHubs are not ideal for some of the poorer slums in the area, but Ravi is aware other efforts are underway there to provide access to utilities and services.

Ravi and Indrani recently visited her grandparents, who live in a remote area of Mumbai. While the community has not had easy access to many services, multiple POD cluster has recently been installed. At first what seemed like oddly foreign devices have come to represent an improved and optimistic way of helping stabilize their daily life. For instance, Indrani’s grandparents are now able to visit the POD cluster nearby to collect clean water instead of traveling to the river that is almost two miles away from their home. The waterPOD serves as a water collection, filtration, and delivery system. Indrani understands the difficulties with creating a full-scale infrastructure to bring water to her grandparents’ living structure, but appreciates how much closer, quicker, and cleaner water is now. Her grandparents also use other PODs in the cluster; the wastePOD is a far better means of collecting the area’s organic and non-organic waste than simply discarding it where there is space. Indrani can tell that the PODs have given her grandparents more time and an improved standard of living.

During that same visit Indrani & her grandmother had the opportunity to visit the Mobile Market that has started serving the community. Curious how this system works Indrani started speaking with Rajat, a textiles vendor. Rajat describes how his family relies on the Mobile Market to provide access to commerce. Living in the remote area that they do they are unable to access transportation to the community’s central markets. Ever since the Mobile Market started coming to his area of the community he has been engaging in commerce with other area individuals. Every two weeks the mobile community-owned vehicle arrives and brings with it a series of materials for individuals to set up tables, booths, and small tents in which they can sell their wares and services. Rajat and the other crafts people, farmers, and vendors arrive early to set up, knowing the crowds will gather shortly. Rajat’s wife uses the market to purchase food and other cooking supplies. Sometimes she is able to trade her family’s goods for others, sometimes she has to purchase these goods with the money the family receives for their textiles. Prior to the Mobile Market Rajat would spend sometimes two to three days away from the family selling his wares in the market’s downtown. Rajat has even heard that the success of Mobile Market might bring other mobile services to his remote area. It is not that Rajat lives in an area that is so poor or underdeveloped, but that rather it is remote. The community does not yet have the resources for a transportation infrastructure, but in the meantime Rajat thinks this model of bringing the services to his area is working well.
Our communities are experiencing increased threats of disaster, both natural and man-made. Increasing frequency and proximity of natural disasters are the result of unstable weather and climatic systems. Despite technological advances these events are unpredictable and unpreventable. Still we must find ways to reduce their impact and proactively create stability for our communities both before and in the wake of disasters.

DisasterNet is a comprehensive approach to protect communities from geological, meteorological, biological and man-made disasters. It includes including planning and mitigation, evacuation and public safety, and recovery activities.
**DisasterNet**

**Discussion**
DisasterNet is a comprehensive approach to protect communities from geological, meteorological, biological and man-made disaster. The system focuses on the entire range of activities, from planning to recovery. This approach acknowledges that disasters are occurring with greater frequency and in less predictable ways. DisasterNet enables communities to plan for and mitigate against the possibilities, protect from loss of life and damage to property, and respond quickly in the wake of disasters to stabilize and recover.

**Elements**
- **Disaster Knowledge Source**
  - Hazcomm-HF
  - BackCaster
  - Disaster Knowledge Base
- **Safe Certify**
  - SafeStructure
  - SafeHouse
- **EvacuNet**
  - Emergency Transportation Information System (ETIS)
  - Reverse Lanes
  - Roadway Sensor Stations
  - Dynamic Messaging
  - EvacuBus
  - Pedestrian Kit
  - MassEvac

**Community Recovery Agency**
- Disaster Assessment Tools
- Easy Assembly Structures
- Development Zones
- Sister Cities
- SupplyNet
- Stockpiler

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Overview
Preventing disasters is something that someday may be possible. Currently though our understanding of complex geological, seismological, and meteorological patterns and behaviors is still too limited. The ability to predict man-driven disasters, such as terrorism or nuclear accidents, is even more limited. This only increases the importance of planning and mitigation activities. By being knowledgeable and prepared, communities can minimize the loss of life, economic damage, and disturbance to everyday life. The Disaster Knowledge Source brings together predictive capabilities, Hazcomm-HF and Backcaster, with existing bodies of knowledge, KnowledgeBase, and enables communities to plan for disasters more effectively.

Disaster planning relies on the ability to understand and anticipate the impact of disasters. The Disaster Knowledge Source enables this through two key predictive methods, Hazcomm-HF and Backcaster. Hazcomm-HF, based on technology developed by the U.S. Federal Reconstruction Agency, anticipates the scope and depth of disaster-related damage based on historical data, scientific observation and forecasting, and community geological and development patterns. Combining these data sets the software is able to assess community vulnerability, offer mitigation actions, suggest development and growth plans that all reduce a community’s vulnerability.

Backcaster takes a different approach; instead of forecasting forward from historical data, it determines what is likely to happen based on a assumed outcome. For instance, forecasters predict the release of biological contaminants into the community. Backcaster then works backwards from this point, determining the events and actions that are most likely to led to this outcome. As these event possibilities are uncovered they are probabilistically studied to identify which are most likely. These scenarios are the result of careful interaction between the software being used and also the individuals running it. Suggested actions leading to the assumed outcome must be of decent relevance.

Properties
- Central data and information repository
- Data collection, analysis, and synthesis software
- Probabilistic evaluation method

Features
- Allows communities to understand the potential likelihood and impact of disasters on human life and economic and structural vulnerability
- Maintains accessible information on successful prevention, mitigation and recovery techniques
- Develops plans to mitigate damage, including evacuation, land use and development, and recovery plans
for the prediction method to work. The outcomes that are determined to be most likely can be passed along to other agencies and personnel in the form of whitepapers or interdepartmental communications. Combined with Hazcomm-HF, these methods cover the predictive spectrum.

The Disaster Knowledge Base is responsible for documentation, storage, and dissemination of information about the impact, mitigation, and recovery. This information is collected from communities around the world and includes whitepapers from related academic fields, studies of technological advances, best practice cases, and documentation from disaster sites. This information can be referenced and accessed to plan for disasters in concert with the results from the predictive methods.
Overview
SafeCertify is a program that certifies structures to be used for safety, shelter, and centers of operation during disasters. Additionally, encouraging sounder structures decreases the likelihood of damage and destruction, minimizing future rebuilding/rehabilitation costs.

While it may be ideal to remove all citizens from harm's way in the face of a disaster, full evacuation is rarely feasible. Those citizens who cannot escape, or choose not to, need to be protected from geological and meteorological damage. SafeCertify inspectors can review existing buildings or ones being constructed or rehabbed. The inspectors are checking to see if these buildings are resilient against disaster damage. Those buildings that pass become SafeStructures, for non-residential buildings, and SafeHouses, for residential buildings.

The community is informed whenever new SafeStructures and SafeHouses are certified. Citizens know which of these are closest and are familiar with the protocols by which the community would direct them to seek shelter there.

Too often, even structures in developed communities are not built to withstand the effects of disasters. In addition to creating safe structures, the SafeCertify program seeks to minimize the amount of physical and structural damage done to community buildings. Clean-up, rehabilitation and rebuilding are extremely costly and time-consuming. Efforts made to mitigate the damage are far less costly. By offering tax and insurance credits to building and residential homeowners who have brought their buildings up to code, SafeCertify is able to lessen the high economic costs that disasters can cause.

Properties
• Incentive-based system
• Program open to participation by all community residents and building owners

Features
• Vastly increases the number of disaster-resistant structures
• Protects citizens from harm during disasters
• Encourages individual responsibility for disaster mitigation activities
• Reduces community-borne economic costs associated with disaster recovery
• Builds community and citizen awareness for the importance of disaster mitigation activities
EvacuNet

Overview
In the face of oncoming meteorological and geological disasters, evacuation is the safest means to protect community residents. Though evacuation must be carried out in a planned, directed, and controlled manner to ensure the efficiency of evacuation activities. Citizens currently have little respect for evacuation means, often thinking of crowded highways and insufficient routing and information. This prevents citizens from trusting in the system and remaining in their homes and communities where danger is greatest. A successful and smooth evacuation model and execution system of it will serve, not just to protect individuals from the disaster in question, but to encourage use of the evacuation in the future. EvacuNet consists of predetermined evacuation routes, citizen instruction and direction, shelters of last resort, and the careful coordination of these elements.

Management of this complex network of evacuees, emergency personnel, vehicles, and structures is enabled by the Emergency Transportation Information System (ETIS), a multi-faceted software system. This computer modelling system enables communities to more effectively manage disaster response and evacuation activities. The system analyzes a variety of data; traffic patterns, tourism levels, occupancy and population demographics, to develop and manage community evacuation. Disaster management personnel will be able to provide real-time, end-to-end management of the disaster scenario, from preparations to evacuation to recovery and supply distribution.

Reverse Lanes are a means to increase the amount of pathways available for use during evacuation. Many individuals choose to remain behind, in the path of disasters, because they believe that the vehicular infrastructure is too limited. Common images show bumper-to-bumper traffic clogging arteries while traffic moving in the opposite direction is non-existent. Reverse Lanes reverses the direction of inbound traffic lanes, creating a contraflow, so that the outbound traffic, fleeing disaster, can make use of it. This additional

Properties
- Evacuation-enabling devices, protocols, and installations
- Management software

Features
- Provides means to inform and direct citizens to safety
- Transports citizens out of the community to safer area
- Ensures all types of communities have means to protect their citizens
- Creates a centralized information and management source for evacuation activities
- Increases the number and extent of pathways out of the community
traffic flow is routed through a series of pre-installed automatic gates and two-sided roadside signage. Protocols govern the deployment of human resources and use of the ETIS system for managing this increased traffic flow.

**Roadway Sensor Stations** help to maintain open, safe, and manageable pathways during a disaster by collecting and transmitting data about traffic patterns and roadway usage. Roadway Sensor Stations are installed along main pathways to detect state and phase changes in the road, surrounding physical area, and environmental and atmospheric conditions. These sensors send information back to the ETIS. During emergencies these sensors become increasingly important as traffic flows increase and time becomes a precious resource.

**Dynamic Messaging** enables real-time, on-the-spot information dissemination to citizens evacuating along roadways. Information about routing, lane opening/closing, destination, and shelter can all be provided. Citizens evacuating are able to stay informed and knowledgeable about what is going on and what to expect. When facing oncoming disasters too often information is not shared with all individuals, creating confusion and uncertainty. This information is provided along roadways through TransLED Signs. Additionally, message can be sent via dedicated radio frequencies or through the Reverse911 system.

**EvacuBus** repurposes the community transportation system to enable community evacuation. Using existing infrastructure according to pre-developed protocols, evacuation managers can quickly transport large groups to safety. Zone Buses are used to collect individuals from neighborhoods, focusing on individuals who have difficulty reaching safety, such as the elderly or physically disabled. Individuals are transported to Transway Stations where they can gain access to a Transway Hybrid Bus that will rapidly transport them from danger.
**PedestrianKit** can be used by First Responders and Integrated Responders to aid citizen movement toward safer areas. Information and routing directions are difficult to disseminate in communities with a limited communications infrastructure. These kits, placed throughout the community, contain signal and sound flares, that provide warning and instruction. The kits also include communication equipment to get in touch with disaster management personnel for ongoing instructions and status reporting.

**MassEvac** is a multi-person evacuation transportation system for under-developed areas without a strong transportation infrastructure, MassEvac provides a means to transport groups of individuals short distances away from damage sites or to better means of evacuation. This system builds on the use of waste/water scooters and trucks, MassEvac are sleds, carts, and other types of multi-person attachments designed to navigate unpaved roads and tight spaces.
Community Recovery Agency

Overview
Recovery activities need to take place during and after emergency activities. The Community Recovery Agency is responsible for non-emergency, but immediate needs regarding supplies, housing, utilities, and public structures and pathways. These activities help stabilize the community.

Sister Cities developed by the (Safe)Earth project at the Institute of Design, are a network of cities that have pre-determined agreements to provide disaster support and supplies. This reduces a community’s need to stockpile resources, distributing the responsibility across many cities, reducing the resource levels any one of them must maintain. Cities need to be within a specified geographic proximity but be unlikely to be affected by the same disaster.

SupplyNet is a network of commercial businesses that have agreed to provide and distribute supplies to disaster victims in times of need. The goal is to shorten lengthy response times associated with volunteer patchwork networks of citizens and relief organizations. Commercial businesses have existing distributing channels that can be leveraged during emergencies.

Stockpiler is a supply accumulation system that assesses community disaster supply needs, based on demographic, geographic and disaster likelihood. The system then tracks the accumulation, storage, and maintenance of these supplies. In the aftermath of disasters the system facilitates the access and distribution of supplies to affected residents.

Properties
- Management organization
- Supply distribution networks
- Structures and devices

Features
- Stabilizes community functionalities
- Allows emergency service deliver
- Ensures supplies will be available
- Assesses damage and hastens repair and rebuilding efforts
- Integrates disaster planning into community rebuilding efforts
**Community Recovery Agency**

**Disaster Assessment Tools** are used by CRA personnel to quickly assess people, areas, and structures in need of immediate assistance. A series of wirelessly connected PDAs, laptops, and database software allow personnel to record and transmit detailed information and geographic coordinates.

**Easy Assembly Structures** are self-erecting solutions for providing housing of displaced citizens, bases of operation, and supply distribution. These structures have minimal requirements for erection, dismantling, and transport. Structures provide protection from heat, cold, wind, rain, and snow and are fire-resistant and have the ability to attach lighting and power supplies.

**Development Zones** are residential planning strategies that encourage and facilitate responsible development in at-risk areas. Pre- and post-disaster, these strategies are used to limit rebuilding and additional growth in at-risk areas. Incentive and relocation costs are far less than repeated reconstruction efforts in areas known to be at risk.
Scenario
Jack has always known that living away from the hustle and bustle of the big cities was nice. Just like his family has done for generations, Jack and his family own and operate a farm in the countryside of central Australia. It is a beautiful area, not congested like large cities. He sees his neighbors regularly in town or passing on the roads, even if they do not live right next door. Life out here is not easy for Jack’s family though, if the economics of farming do not get you, then mother nature certainly will. The annual tornadoes and threats of wildfire have made trouble in the past.

It has been interesting lately, efforts are underway in the community to better protect their lives and livelihoods from these natural disasters. The community has started accumulating information about the trends and patterns of past disasters. Along with geographic surveys and demographic censuses this information is being entered into the new Hazcomm-HF system. Jack has been told that the system can help the community determine the potential likelihood of disasters, where they will strike, and what sort of impact they will have on economic, meteorological, and geological conditions. It has always been a struggle to know just how to prepare when Jack and his family have understood so little about these disasters.

In fact, Jack has been checking out the Disaster Knowledge Source a lot lately. With tornado season once again approaching he is trying to understand better ways to protect his home and family. He’s found all sorts of good information that is both pertinent to him and to his community as a whole. He has had a chance to implement some of the practices at local town meetings. Jack’s wife has been pushing to have their farm certified as a SafeHouse. Jack is eager to do it, but while protecting the family is certainly nice, he can’t help but think of the tax and insurance incentives that accompany this program. The incentives will allow him to rehab and strengthen his home so that it’ll withstand future disasters. He has read up on the program and was astounded to learn just how much cheaper it is to take mitigating actions, such as strengthening a home or commercial structure, rather than having to repair the damage afterwards.

Jack’s neighbor, Jacob, is on the community committee that has been looking at stabilizing their disaster resource levels. Jacob has been conducting an exhaustive resource inventory as a first step using Stockpiler. This program has been helpful to inventory what resources are available, determine what levels of resources will be needed when disaster strikes, and how best to close the gap between the two. While they have got some strengths, like the amount of available cattle, they are not a economically strong community and probably will need to seek out some SisterCity partnerships. These will allow the community to form alliances with other communities, not in danger of the same disasters as Jacob’s, to deliver supplies if Jacob’s community needs them. By the same token, Jacob’s community will aid its SisterCity however it can when a disaster strikes them. They are looking at a few cities just a couple hours away by plane, but on the coast, where they do not experience the tornadoes and wildfires that Jacob’s community does.

To further address their emergency resource needs Jacob’s committee is drawing together key commercial good suppliers and businesses through a program called SupplyNet. This programs creates a series of response protocols that leverage the infrastructure of the commercial businesses in the area. SupplyNet will allow Jacob’s community to have predetermined suppliers of resources at times of emergency need. These suppliers will be paid for their goods, but what helps so much is having this relationship predetermined. Every year it is very hard scrambling to get water, food, and other basic supplies delivered in a timely manner.

Jacob had hoped to have these protocols and agreements ready next week, but it looks like it’ll take a little longer. That is ok, it is just that it would have been nice to have that announcement when the city
Scenario Continued...
go through the pilot test of their newly implemented EvacuNet. The community is anxious to complete a round of testing on this new evacuation system and start to educate the public on its use. In past years it has been difficult getting word out to the citizens, organizing their evacuation, and ensuring that roads do not get overcrowded. Jacob is confident from what he has heard that EvacuNet will offer a comprehensive system of communication, transportation and operational protocols and physical infrastructure improvements to safeguard his community. While not all disasters are foreseeable, the wildfires this community experiences certainly can be anticipated.

Jacob has seen the improvement work occurring on the nearby highway to allow for the Reverse Lanes system, a transportation management technique that reverses the direction of one set of lanes, opening it up for evacuating traffic, effectively doubling the roadway’s capacity. Jacob has also seen the newly installed gates and two-way signage that would facilitate this system. Additionally he has seen testing of the Dynamic Messaging signs along the roadways that offer motorists updated disaster and evacuation information. He has been reading the community website a bit and understands that Reverse Lanes and the Dynamic Messaging system will be controlled by the Emergency Traffic Information System (ETIS), with information received from, among other sources, the Roadway Sensor Stations. It made a lot of sense to Jacob that having a single system synthesize various data, including traffic patterns, tourism levels, occupancy, population demographics, would be best for managing the evacuation. It always seemed like a patchwork of efforts in the past.

Of course such coordinated efforts really would not help Jacob, his family or his neighbors, without some way of warning them and getting information out to them. But it seems that EvacuNet has that covered too. Especially relevant for his rural, outlying area are the OffGrid Sirens. These are placed every few miles and emit a range of warning sounds and even instructions. The beauty for Jacob’s community is that they are self-powered, from sets of solar panels, and do not have to be connected to the electrical grid, which out here is not very developed. Additionally the OffGrid Sirens connect wirelessly to the communications network used to send and receive information from disaster management personnel located miles away. In addition Reverse911 will allow individuals and families, like Jacob’s and John’s, to receive standardized, recorded messages on their phone, email, pager, or fax, or even PDA. Reverse911 allows the community to send out a warning/emergency communication to all residents at once, even catering that message to smaller audiences based on geographic location. For instance since John and Jacob both live very close to the most likely wildfire zone, Reverse911 may send them a message letting them know they need to evacuate quickly, whereas residents on the other side of town may be alerted to the danger, but asked to stay clear of roads so others could try to reach safety.

He has also heard success stories from larger communities with the EvacuBus and MassEvac programs. The first he understands uses a cities existing public transportation infrastructure to expedite evacuation of its citizens. Jacob’s friends chuckled at the idea of that system here, but Jacob knows that someday his community too might have an extensive bus network and they come in handy given the speed of the wildfires.
Our communities find themselves responding to less traditional, larger scope threats. No longer can we keep our response forces isolated from each other, as threats multiply and resources are spread thin. Departmental response, communication, management, and training can no longer occur in isolation. As threats increase and resources are spread thin there are calls for all citizens to take responsibility.

Emergency responses need to be coordinated, efficient, and flexible. The following system elements enable an unprecedented level of coordination and communication while ensuring a timely response and effective resolution to a community’s emergency fire, medical and law enforcement needs.

**Elements**
- **First Responder Network**
  - First Response Personnel
  - First Responder Training
  - First Responder CommStat
  - OnSite Equipment

- **Integrated Responder Network**
  - Integrated Responder Training
  - BioMonitors
  - Wireless Communication Centers
  - Interoperable Communications
  - SiteLink

- **Integrated Response Station**
  - Integrated Response Protocols
  - Distributed Command Centers
  - IR Software Package

- **Emergency Sense**
  - Telematic Warning System
  - Video Surveillance
  - GunShot Sensors
Overview
Emergency personnel (fire, police and medical staff) have a tremendous responsibility on the scene of an accident. Often though they find themselves devoting time and resources to non-critical activities that do not directly help save lives or prevent destruction of property. Such activities may include crowd control, handling of minor injuries, or routing traffic. In addition to having a tremendous responsibility, emergency personnel are often stretched thin across a community, especially ones with more limited resources. At times of great crisis, these communities find themselves trying to put average, untrained citizens to work.

The First Responder Network provides communities with a supplemental response force to ease the burden on emergency response personnel and allows them to attend to critical issues while First Responders attend to non-critical activities. First Responders are a volunteer network of trained and certified citizens that can respond promptly to local emergencies, disasters and other public incidents. FRs will be contacted based on their geographic proximity to the emergency. They will reach emergency scenes before Integrated Responders and assist with issues such as crowd control, basic medical assistance, reporting back updated information, and securing the scene.

First Responders need to complete and pass First Responder Training that will prepare these citizens to respond to and cope with emergency situations. Training provides information on fires, search and rescue, medical emergencies, terrorist attacks, evacuation procedures, and other emergency responses. It provides advanced training on team skills, decision making, crisis management. Trainees will complete a series of strenuous, simulated activities to ensure that are properly trained to respond to emergencies.
First Responder Network

**First Responder CommStat** tracks and communicates with willing and certified citizens who have completed First Responder Training. Real-time tracking is enabled by GPS devices placed within the cellular phones and other communication devices owned by the First Responders. When an emergency strikes the system identifies the First Responders located in proximity to an emergency site. Emergency management personnel use the system to disseminate recorded messages to the First Responders via CommStat. These messages provide information about the emergency location, situation, and response that is being requested. Additionally, information is provided about the OnSite Equipment location.

**OnSite Equipment** emergency equipment kits are placed throughout the community at accessible, but secure locations. These locations may be on the exterior of buildings, in public venues or in transit stations. They provide First Responders with the equipment necessary to complete their required activities. The kits will include such things as identification means to clearly denote First Responders from average citizens, basic medical supplies, communications equipment, video equipment for transmitting images to emergency management personnel and local hospitals, and materials for crowd and vehicle control.

**Properties**
- Citizen response force
- Certified personnel
- Communication software
- Response equipment

**Features**
- Increases response force capacity
- Handles basic incident management functions, non-critical activities
- Provides basic medical, traffic and crowd control
- Reports incident status to management personnel
- Provides detailed training for citizen response force
- Allows emergency response personnel to focus on more complex, urgent activities
- Encourages citizens to take a more active, responsible, role in their community
Overview

Emergency response situations have grown increasingly complex as the scope and nature of incidents has become more unpredictable and multi-faceted. Though most communities still rely on the paradigm of separately-stationed police stations, fire departments and medical personnel. This creates clear divisions between these groups; different response protocols, different communication channels, divided chains of command.

The Integrated Response Network provides continuity between response functions through a single, multi-discipline response force, a shared physical location, interoperable communication systems, single management structure, and cross-training opportunities. Integrated Responders have replaced typical emergency response personnel. These responders share with their predecessors rigorous training and extensive knowledge, but differ in that they seek to provide a coordinated, comprehensive response through a unified structure. Individual Integrated Responders each still have specialized skill areas (e.g., fire, medical, law enforcement) but are viewed as members of a single team, rather than separate teams. Naming, branding, uniforms, vehicles all reinforce the idea of a coordinated response.

Integrated Response Training relies on cross-functional, cross-discipline, realistic scenario training. The use of virtual-reality simulators allow personnel to practice stressful, coordinated responses. Integrated Response Training also stresses iterative rounds of training and testing of protocols in which issues and errors are not just noted, but corrections are developed, implemented and retested until response is within tolerance levels. This ensures that the response being carried out, is the most effective possible.

Properties

• Dedicated professional response personnel
• Training courses
• Communication equipment
• Data gathering and monitoring system

Features

• Provides coordinated, comprehensive emergency response
• Increases ability of personnel to work together
• Ensures highest level of possible readiness through iterative testing
• Enables open communication between various departments and agencies
**Community**

**Integrated Response Network**

The **Wireless Communication Center** is part of all Integrated Response vehicles. It operates off the central wireless network, but also on mesh networks run off the individual vehicles as a fail-safe. They provide response and management personnel with real-time information; building schematics, GIS/GPS tracking, video and still imagery and data from **BioMonitors**. Each vehicle in essence becomes a mobile command center; not only are they each a source for dynamic information but also they allow management personnel to operate en route to the scene, from any vehicle on scene, providing a fail-safe if the off-site central authority is disrupted.

**SiteLink** is a voice, image, and data communications network that exists between the DCCs, on-site IRD personnel, and local medical facilities and other triage locations. Rather than linking through any central point, such as a DCC, SiteLink creates direct communication channel from the incident site to hospitals to transfer information about incoming wounded through data, video, and photographs. Also SiteLink enables hospital personnel to instruct and coach on-scene responders through the communications equipment installed in vehicles.

The **Interoperable Communication System** allows all responders, including First Responders and Integrated Responders, along with other community, regional, and national agencies and departments to communicate with one another. Presently most communities operate a unique communication system for each type of emergency department, creating confusion and inefficiently managing resources. The ICS brings public safety frequencies into contiguous bands that are designated solely for public safety purpose.

**BioMonitors** are a series of biometric and locator sensor placed within the uniforms and suits worn by Integrated Responders. The sensors collect information about the responders health status and physical location. The information is then transmitted back to the Wireless Command Center located within vehicles on the scene. From there the signal is routed back to the Integrated Response Station, where emergency management personnel can track the status of the response team, determining appropriate protocols. Tracking the responders helps protect the lives of responders by first monitoring their health status but also knowing their location at all times allows for coordinated deployment, more efficient response support, back-up and rescue.
Overview
The Integrated Response Station is an all-in-one local community emergency station where groups of Integrated Responders are stationed with all specialties represented, including fire, law enforcement, medical, terrorist, and natural disaster specialists. Unlike antiquated models that create separate locations for each speciality, the Integrated Response Station encourages cooperation, coordination and cross-learning by co-locating these resources. Multiple Integrated Response Stations will be located within a community, determined by its geographic and population conditions. These stations serve as a cohesive network of responders.

The Integrated Response Station also are responsible for handling incoming local emergency communications. The communications network routes emergency communications to the nearest Integrated Response Station. Should volume exceed manageable levels, the network of DCCs steps in to balance the load.

Integrated Response Protocols are critical to govern how this network combines not only all emergency response functionalities, but how they will work with other community, regional, and national emergency response groups. These protocols clarify issues of command hierarchy and communications interoperability that hamper large-scale emergency and disaster responses. Having clearly defined protocols allows emergency response efforts to be focused on the response rather than the logistical coordination of it. The stations become localized, not centralized, zones of responsibility, networked during these larger-scale community incidents.

Properties
- Physical building
- Hardware and software enabling technologies

Features
- Oversees a localized geographic area of the community
- Handles incoming local emergency communications
- Encourages cooperation, coordination and cross-learning by co-locating resources
- Clarifies issues of command hierarchy and communications interoperability
- Allows for shared real-time information gathering and analysis
- Creates redundancy and fail safe when outages or purposeful sabotage occurs at any one command center
- Provides prediction, data collection, resource tracking, communications management capabilities
Another issue addressed is that of centralized command and system redundancy. Current response networks tend to rely on a single, absolute control point, a command center, that controls all facets of every emergency response. This model is coming under scrutiny for its lack of fail-safe options. Within each Integrated Response Station, exists a **Distributed Command Center (DCC)** that oversees a localized geographic area of the community. Within each DCC emergency management personnel oversee the identification and assessment of emergencies, deployment of resources, and ongoing management of the emergency response. However each DCC is also linked to the other DCCs within the community and additionally those in neighboring communities. This allows for shared real-time information gathering and analysis; what is known by one DCC is known by all, allowing for a more complete understanding of the community’s public safety status. This linkage also allows other DCCs to be ready to be deployed, should they be needed, having been already updated with all relevant data. Additionally, the Distributed Command Centers create redundancy and fail-safe when outages or purposeful sabotage occurs at any one command center. Emergency identification and management can be transferred to another DCC.

Emergency networks also need to be able to manage the quantity and quality of information related to an emergency. Assigning adequate personnel to handle the situation correctly while appraising related parties of issues is challenging without sufficient information and a communication system capable of collecting, receiving and disseminating substantial amounts of data. The Integrated Response Station uses series of software, collectively known as the **IR Software Package**, to provide prediction, data collection, resource tracking, communications management capabilities. There are multiple components which make up this package:

- Geographic Information Systems (GIS) present complex data in a geographic, map-based format for use in tracking and routing resources, conducting simulations, and understanding structural characteristics of a community, area, or even structure. Geographic Positioning System (GPS) collects data about geographic location from GPS sensors located in/on resources. The Integrated Crisis Support System (ICSS) is a set of enabling technologies that empower emergency response managers to strategically manage and control local and regional responses to disaster. It allows personnel to monitor financial, human resource, and operational metrics. This single system helps build strategic relationships between different functional areas, as all information can be controlled through a single source. Finally ICSS provides graphical analysis of complex data that enables trend analysis and forecasting along with creation of various queries and reports.
Overview
For the most part emergencies are reported by individuals scattered throughout the community. There are emergencies though that given their location, or time or nature of occurrence will not be immediately detectable by citizens. EmergencySense creates a series of automatic incident detection means distributed throughout the community. This provides an alternate source for identifying emergency situations.

These sensors note changes in environmental, state and phase conditions through various means, including embedded microchips, infrared detection, and sound identification. These sensors are connected to or have installed as part and parcel a wireless communication system. Once an emergency is detected the sensor transmits a signal to the Integrated Command Center, and specifically to the Integrated Crisis Support System (ICSS). The ICSS acts as a central information repository that collects, interprets and presents the data to emergency response management.

This system includes the Telematic Warning System, a network of imbedded sensors in buildings, cars, and public areas that wirelessly transmit information. Specific incidents addressed include fire in buildings, crashed cars, and structural decomposition and sinkholes in roadways. It also collects information from VideoSurveillance systems installed on major and minor thoroughfares, these cameras provide real-time video and infrared observation and tracking. Finally, GunShot Sensors installed in high-risk, high-crime areas, detect and record gun shots, initiating emergency response and crime investigation.

Properties
• Imbedded sensors
• Communication devices

Features
• Identifies possible emergency scenarios
• Provides sufficient data for analysis and interpretation
• Monitors status of key community buildings, sites, and areas of high incidence
• Provides an alternate source of emergency identification than citizens and patrols
Scenario
A small fire has started in a commercial building in a mixed-use neighborhood containing residences, shops, and even small manufacturing facilities. Telematic Sensors embedded within the structure of the building have recorded the fire and transmitted an alert signal to the Integrated Response Station. At the station the Integrated Crisis Support System is receiving and analyzing data from the Telematic Sensors, presenting station personnel with suggested response protocols, including information about nearby First Responders and appropriate Integrated Responders. Alejandro, the director of emergency management, reviews the data, adjusts the response protocols and then gives the orders to alert the First Responders and Integrated Responders. Meanwhile at the other Integrated Response Stations, located throughout the community, the same data and information is being received about the emergency at hand and the response ordered. This allows them to stay abreast of the situation in case they are called upon to assist. Management personnel at these stations note that, according to IRD Protocol, Alejandro will be commanding the response and their assistance will be governed by him.

Bruce, a trained and certified First Responder, is identified from the First Responder Database. The database keeps real-time geographic location information about first responders. Bruce is one of twelve responders that are currently located within a half-mile of the site of the fire. Bruce is currently at work, but is not surprised to receive an urgent message on his cellular phone. As a First Responder he is aware that he will be voluntarily called upon to provide on-site emergency assistance to Integrated Responders. The message Bruce receives, details the location, issue, and response required. Bruce immediately leaves his job, letting his co-workers know that he has been summoned by the Emergency Response Network.

As he hurries to the scene of the fire, only 5 blocks away, he rechecks his cellular phone to get the code for the OnSite Equipment. He receives the alpha-numeric code and equipment location, which this time happens to be at the Transway Station halfway to the site. He accesses the OnSite Equipment and quickly checks that all necessary supplies are there. Standard medical equipment, communications devices, crowd and traffic control devices, and additional paraphernalia all are present.

Bruce reaches the scene of the fire and immediately starts to establish a proper perimeter, moving citizens away from the building and out of the way. He sees other First Responders directing traffic away from the scene to allow access for emergency vehicles and providing detailed information to emergency response managers and personnel who are managing the emergency or in route. Additional FRs are providing basic medical assistance to citizens who have fled the building and are suffering from a variety of issues, such as shock, smoke inhalation, and first and second degree burns.

Meanwhile the initial group of Integrated Responders has been dispatched. This group is headed up by Sheila, a longtime Integrated Responder who specializes in medical assistance. Her Integrated Response Team is made up of responders with fire and medical specialties. She knows all these individuals well, having worked with them many times before and also being stationed and housed at the same Integrated Response Station. While her specialty is medical assistance, she is very comfortable working with each of the other emergency disciplines, having received the cross-discipline Integrated Response Training. More than once has she needed to assume roles related to fire or law enforcement issues.

En route to the scene Sheila instructs the responders using the Wireless Command Center within the vehicle. This allows her and her team to review images and video that have been transmitted from the scene. They also review information about the First Responders that will already be at the scene and what they are responsible for. Finally, the personnel are able to review structural plans and schematics.
for the buildings that have been damaged. The center also allows emergency management personnel to stay in contact with personnel in route to the station and set up a framework for their coordinated response and how each group will support and strengthen the other.

Upon reaching the scene the Integrated Response personnel start to conduct the response. Having been through Integrated Response Training as a group the IRs are very comfortable working with each other, even though they each have areas of specialty. Their Interoperable Communications System further reinforces the teamwork, allowing all emergency response personnel, First Responders, Integrated Responders, and public safety groups, such as the national guard or personnel from other communities, to communicate on a dedicated, predetermined frequency.

While back at the Integrated Command Center Alejandro and his team continue to review incoming data. IR Monitors, built into the suits and uniforms of the IRs transmit GPS and biometric information, while cameras mounted on emergency response vehicles transmit live images and digital stills that give Alejandro's team a clearer picture of what is going on. Alejandro stays in contact with other Integrated Response Stations, letting them know that things are under control.

On-site, Bruce has successfully cordoned off the area and moves on to his second task, establishing SiteLink, an audio and video link to nearby hospitals. SiteLink will allow for hospitals to start triage activities before patients arrive, as information is provided to them about the nature and extent of the injured. Additionally SiteLink provides hospital staff to offer medical advice and assistance to personnel on the scene to treat injuries that they are not experienced with.
Unplanned efforts have created an overreliance on individual cars as the preferred mode of transit. Efforts to increase capacity only increase the amount of traffic.

The Organic Transportation network is an organizational system for a public transportation network which reduces reliance on individual cars. The organic Transportation network connects centers of activity in existing communities as well as organizes development in new areas to be dispersed along major transportation lines. This system supports community expansion in a controlled manner.
Organic Transportation

Discussion
Organic Transportation facilitates effective movement via public transportation between all areas of the community. It provides citizens with reliable, easy access to and from where they live, work, and play with the goal of reducing the reliance on individual vehicular transportation. Communities such as Portland, Paris, and Curitaba offer effective precursors for reducing individual modes of transportation.

Transportation is organized around the development of major public transportation arteries extending out from the community center. These arteries quickly move large quantities of people across significant distances. Radiating from the community center are concentric circles defining zones. Where these zones intersect the Arterial Transways main Transway Stations are defined, which are localized hubs of residential and commercial activity. The goal of these nodes is to disperse development along public transportation lines, rather than along highways or vehicular infrastructure.

There will be areas existing between Transway Stations that Arterial Transways do not reach. The system facilitates citizen movement from these zones to Transway Stations via the Feeder Transit system. Feeder Transit is a series of transit modes that are flexible and dynamic.
Overview
Arterial transportation is concerned with conveying a large number of people along major transportation thoroughfares to key destinations. This type of public transportation exists in many forms, subways and rail lines, for example. By its very nature, Public arterial transportation needs to encourage its use over other forms of transportation; it is not merely another option but the preferred option. An accessible, dedicated public arterial transportation system will greatly reduce the amount of vehicular traffic while conveying people quickly between major transit nodes. Since many complaints about public transportation are that vehicles stop too often and do not travel fast enough, the Transway Arterial Transit system focuses on intermediate to long distance, rather than block by block service. The system accounts for such short-distance travel with its Feeder Transit and TransConnect systems, providing local service.

The Transway Arterial Transit system works on the principle that public transportation is most quickly and efficiently operated when it has a dedicated infrastructure that does not compete with other forms of transit. However this kind of system often require an infrastructure that is costly and time-consuming to create. The Transway Arterial Transit model acknowledges this by creating a dedicated transportation system that does not require substantial infrastructure. This model relies on a series of buses operating in dedicated lanes, in a high speed, continuous mode along major arterial routes.

Properties
- Above ground infrastructure
- Single-purpose pathway
- Hybrid engine buses
- GPS locators on transit
- Communication displays on buses
- Low-riding buses
- Hybrid engine buses
- GPS locators on transit
- Communication displays on buses
- Low-riding buses

Features
- Enables rapid movement of citizens from center to periphery of community
- Provides a clear path for public transit
- Removes obstacles from the path of buses
- Allows community development to blossom
Transway Arterial Transit > **Transways**

**Element Discussion**
Transways are the infrastructure that the Transway Arterial System operates upon. Transways are single-purpose, ground level, bus lanes on which the Transway Hybrid Buses run. These bus lanes do not permit additional vehicular traffic, allowing service to run uninterrupted. The Transway also is a separate arterial model from highways or interstates. Transways are designed to operate between major nodes of residential and commercial activity. Local community pockets should not develop alongside eight-lane highways. Dedicated Transway lanes will provide less community interruption while encouraging use of the system through its convenient location. The Transway encourages additional centers of growth along an infrastructure that it can support.

A key benefit of ground-level Transway lanes operating Transway Hybrid Buses is that these lanes require less time and resources to construct. This is true in both new and existing communities. Existing communities can radically improve their transportation infrastructure by converting major thoroughfares between communities into dedicated Transway lanes at a fraction of the cost of below or above ground systems. The Transway model can be extended to the use of light rail or monorail systems, described later, in communities with significant resources.

**Properties**
- Above ground infrastructure
- Single-purpose pathway

**Features**
- Enables efficient travel for Transway Hybrid Buses
- Removes obstacles from the path of buses
- Allows community development to blossom
Element Discussion
Transway Hybrid Buses are public transportation vehicles operating at a higher rate of speed along the Transway between Transway Stations. Service is designed to be almost constant during peak hours. Despite heavy use, the hybrid nature of the buses limits the environmental impact they have. Compared to operation of individual cars, the impact is minimal. Buses are monitored with GPS sensors to ensure that operation is proceeding appropriately and to allow for rerouting to help balance demand or respond to emergencies.

When Transway Buses do intersect other transportation modes, at central community locations, the Transway Buses are given preferential treatment to allow for quicker travel. This also occurs at traffic lights.

The Transway bus is an expandable system, that can consist of a single bus or multiple sets of passenger compartments. For areas that experience higher-demand, additional compartments can be linked to the main bus, creating a tandem bus in effect. For many people waiting for service and watching vehicles packed with passengers discourages public transportation. This system helps ensure that passengers experience efficient, timely service. Only a single driver is necessary to operate the lead bus.

Communities can expand this mode of arterial transit to include other types of vehicles. Such a choice is dependent on the resources available within the community and the number of people needing service.

- **Monorail** - Although it requires additional infrastructure, a monorail is safe, environmentally friendly, and can be retrofitted to developed areas without a current transit system. This type of system is a subset of Automatic People Movers.
- **Light Rail** - This system can be beneficial when installed in low-density communities covering a large geographic area. It is best used when a primary motivation is to connect different communities, rather than moving people between the outskirts of a community to centralized destinations.
Transway Arterial Transit > **Transway Stations**

**Element Discussion**

Transway Stations are nodal transit points that service riders as loading/unloading points. These stations are placed at main nodes along the Transway, with significantly large intervals between nodes. Service to these nodes is provided by the localized Feeder Transit system. The goal is for Transway Hybrid Buses to enter the station, quickly load and unload passengers, and be back on the Transway.

The Transway Station is a bus station, in many ways modeled after a train station. The station has two ends, one for entering and one for exiting. Fare collection is also done at the station entrance, rather than when entering the vehicle, speeding boarding. All loading occurs at the front of the station. the station is at the same level as the vehicle floor to allow for easy entering and exiting for physically impaired citizens. Ramps or elevators are placed on the entrance and exit side of the station to allow for people with special needs to enter easily.

**Properties**

- Pickup/dropoff Station

**Features**

- Allows for payment before boarding
- Separates exiting and entering to speed boarding
- Provides information for boarding passengers
- Provides directions
- Provides Ramps for easy exiting and entering
- Provides protection from weather
Overview
Any transportation infrastructure needs to have an accessible and flexible localized transit network in addition to strong main arteries. Some citizens will live beyond walkable proximity to the Transway Lines which discourages use of this system. Additionally, while arterial service runs between major nodes, there will be citizens needing service to more localized destinations. Feeder Transit provides citizens access from various locations within the community to intra-community destinations and to the Transway Arterial System. Feeder Transit should help control car use and increase access to use of public transportation.

The Feeder Transit system allows the Transway Arterial System to focus on high speed operation between longer-distance nodes for citizens commuting for work or traveling long distances who otherwise would travel by car. Likewise by fulfilling those arterial functions, the Feeder Transit system is capable of offering more tailored, efficient, and appropriate service for shorter range, variable transportation needs.

Properties
• Transportation infrastructure

Features
• Provides citizens access from various locations within the community to access intra-community destinations
• Help control car use and increase access to use of public transportation
• Allows the Transway Arterial System to focus on high speed operation between longer-distance nodes
• Offering more tailored, efficient, and appropriate service for shorter range, variable transportation needs
ZoneBus operates as an on-demand flexible route and schedule public transportation service (Getting Around, Institute of Design, 1972). ZoneBuses are smaller than traditional buses, offering more intimate, social travel that is more fuel-efficient and environmentally friendly. Certain citizens will benefit tremendously from this localized on-demand service, such as the elderly, physically disabled, or those with substantial loads to transport.

ZoneBus has two different operating models for high-density and low-density communities. Within high-density communities they are designed to bring citizens to the center of their neighborhood node, the Transway Station, around which has built up centers of activity and commerce. Citizens will walk a short distance to local ZoneBus call box, placed every few blocks likely. Citizens would activate the call sensor. The request would be received and by analyzing additional call requests as well, a ZoneBus route would be created and bus sent to fulfill it. The citizen at the callbox would receive an automatic message stating the estimated time until the bus’ arrival. Return trips from the Transway Station, or center of the neighborhood, would require citizens to enter their destination into a transportation kiosk so that the dynamic-routing system can develop an ideal route for returning citizens to their residence.

Low-density areas can use ZoneBus as a door to door service to or from a major transit node. Citizens call or use the internet, to make their travel request. The ZoneBus picks them up at their residence, along with other citizens along the way, and delivers them to any destination within the community. Again, routes are dynamically managed in real-time to determine an effective route for maximizing the number of passengers that can be picked up while keeping overall travel time to a minimum. The flexible routes and allocations make best use of scarce resources while maximizing the public benefit.

ZoneBus offers greater transportation flexibility to both existing or new communities. Whether in highly urbanized areas or rural communities, ZoneBus can assist citizens by providing an alternate travel mode to private vehicular travel. And because the system requires limited infrastructure, it is applicable to even developing communities.
BikeShare is a community bike sharing system for use in high-density areas, regardless of level of development. The system is based on a community supply of bikes that are shared by all citizens as they need them. The quantity of bikes in the community allow the bikes to be free and viral. Bike Stations, possibly as low-tech as a series of bike racks, are placed throughout the community, focusing on the most common destinations, such as Transway Stations, community facilities, or shopping centers. Bikes are free to all citizens, who take a bike from a station when they need it and park it at a station near their destination. The BikeShare system reduces the demand for private transportation and even public transportation systems while fostering community through the use of shared resources and stimulating a healthier mode of transit for its citizens.

Community bikes are three-speed internal hub bikes which are easier to maintain since they have fewer moving parts and gears. The bikes are also shaft-driven which reduces the need for maintenance and lubrication. To easily identify bikes, BikeShare bikes are painted orange to clearly define the community bikes compared to individual citizens bikes.

**Properties**
- Steel frame bikes
- Shaft driven cranks
- Three speed internal hubs
- Quick release bike adjustments
- Rear carrying baskets

**Features**
- Easily maintainable bikes with fewer moving parts and a shaft driven crank which needs less maintenance and lubrication
- Fully adjustable to fit different sizes
- Carrying baskets provide hauling space for errands
Overview

Many developed, even urban, communities lack the connections between nodes in their existing infrastructure. While subways or rails may go between certain groups of nodal points, there is no an efficient way to get between nodes located on different sets of points. Citizens have difficulty moving between existing stations that are not on a shared bus or subway route. Additionally the movement that currently exists along those routes is slowed because it competes with existing transit. TransConnect, in concert with Transway Arterial Transit and Feeder Transit, allows citizens to access any community destination via a public, low-cost, transportation system.

TransConnect seeks to provide solutions for moving citizens quickly between nodal point that otherwise go unconnected. Connecting these points will prevent citizens from resorting to car travel. TransConnect is a series of elements that can be used within existing communities suffering from this issue or in new communities as an alternative linking system to Feeder Transit.

Properties

• Public transportation system

Features

• Enables citizens to move quickly between nodal point that otherwise go unconnected
• Alternative linking system to Feeder Transit
• Provides direct, quick, transportation
• Removes obstacles from the path of transit vehicles
Element Discussion

The problem with existing bus lanes is that other vehicles tend to use them thus reducing transit efficiency. Travel between existing nodes, as TransConnect is trying to stimulate, is often slowed by congested roadways. The BusPath solves that problem by creating a bus lane with reserved flow only for bus travel. By running in the opposite direction other traffic will not venture into that lane, leaving it free for expedited bus travel. Regardless of traffic congestion the bus lane remains open and public transit efficient.

The bus lane is designated with a curb as a divider that keeps other traffic from entering. The curb will also provide clear paths of movement for transit buses. Buses in the bus lane will not be effected by traffic congestion.

One benefit of this system is that it does not require the building of additional roadways or infrastructure. Communities are encouraged to remove parking from one side of the street; in its place the BusPath will operate. Many communities are removing parking spaces from community areas to discourage driving, increase sight lines to neighborhood stores and restaurants and generally make these areas more pedestrian friendly.
TransBlimp connects nodal points, or community centers, that are otherwise difficult to connect, possibly because of a lack of infrastructure or pre-built infrastructure. Connecting these otherwise unconnected centers of activity stimulates higher use of the public transportation system and increases citizen mobility. TransBlimp could operate from nodes along an existing transit system or other popular locations. Dirigible-like vehicle are beneficial because they require little infrastructure and don’t follow existing infrastructure constraints.

At existing transit nodes an additional platform is built that extends several stories above the existing station. Access to this platform will be through the existing transit stations and elevators will be used to lift passengers to the high platform. Platforms are raised to allow blimps to dock.

Initially blimps will be filled with helium, which is very expensive. In future TransBlimps, nanotechnology will be used to create a vacuum blimp. Currently no material is strong and light enough to allow for a floating vacuum. The TransBlimp is raised and lowered by pumping air in and out of the vacuum. (SafeEarth Project)
Overview
TransDirector is a community transportation information system that collects and disseminates information that enables management of the system and travelers to stay informed. The system tracks roadway use, vehicle and pedestrian movement, and public transit service in real time.

The system allows traffic management personnel to effectively route and direct traffic through a series of road sensors and video surveillance. Schedules for arriving and departing transit is based on current locating of modes of transit.

Individuals stay informed about travel times, effective routes, and travel alternatives. Directions for individual drivers and public transit riders are provided via TransLEDs with current information collected by the TransDirector. Travelers can get more detailed, real-time, information through the TransWeb internet-based interface. This can be accessed from individual homes or from TransKiosks placed throughout the community.

Properties
- GPS locators
- Data formatting and conversion software
- Public information access points

Features
- Conducts real-time monitoring of transit locations and vehicles
- Collects data on public transportation operation
- Keeps drivers informed of travel time, traffic situations, alternative routes
Element Discussion
TransLED are a series of dynamic message displays systems to inform people of the status of public transit and roadway conditions. TransLEDs are placed at Transway Stations, on Transway Vehicles and over roads to inform individual travelers and motorists. These message display systems are connected via a wireless network and receive direction from the TransDirector.

TransLEDs at Transway Stations display information both outside and inside the station. Outside message signage ensures that travelers are well informed before entering the station about when the next vehicle is arriving, direction it is headed, and travel alternatives. Information within the station keeps travellers informed about changing conditions, arrival times, and when the vehicle is expected to reach subsequent stations.

TransLEDs placed along roadways serve to inform motorists about travel and weather conditions, expected travel times, and emergency routing information. These signs can be placed alongside destination, directional, exit and other static informational signage. The TransDirector is able to oversee existing conditions and generate messages to update and inform motorists.

TransLEDs also will benefit riders on the Transway Hybrid Buses. Signage installed inside the bus will alert riders to a range of travel information; destination name and expected arrival time for not just the next destination but subsequent destinations as well, in addition to significant information about delays on other transit lines or issues at Transway Stations.
TransWeb is an online transit information service for citizens. Powered by information collected through the TransDirector the TransWeb can help citizens make better informed decisions, plan future transit, and better understand the capabilities of their transit system.

TransWeb allows citizens to check the status of the public transit system before they head to a station or contact the ZoneBus. By consulting the TransWeb they can make sure that public transit is on schedule, that roadways are clear, or that construction will not interrupt their journey. Real-time routing and expected arrival and departure times are provided for public transit.

Motorists also benefit from the TransWeb which displays a detailed series of maps of area roadways and bridges with current traffic movement conditions. Information is displayed for every quarter-mile of roadway. A color-coding system indicates just how congested the roadway is, from Clear to Barely Moving. This color-coded map allows citizens to easily understand conditions. Cameras displaying updated pictures of major roadways and thoroughfares. These images are updated every few minutes to keep travelers apprised of conditions. While updated messages note any route closures or construction information.

Citizens can also do longer range planning that encourages public transportation use, consulting the system to determine the best route to and from a given destination using various elements of the public transportation system. Routes are provided along with expected travel times, and travel alternatives.

Properties
- Transit information service
- Detailed series of maps

Features
- Helps citizens make better informed decisions, plan future transit, and better understand the capabilities of their transit system.
- Allows citizens to check the status of the public transit system
- Provides real-time routing and expected arrival and departure times for public transit
- Enables citizens to do longer range planning
Element Discussion
The TransKiosk is a transit information module that can be placed throughout the community where citizens might need transit information. Each kiosk contains an internet connection to the TransWeb. Citizens who are on the go, around and about the community can find out up-to-date information.

City visitors, including tourists and business travelers would also make good use of the system. TransKiosks would help them with wayfinding and trip planning.

An ideal locations for the TransKiosk is at Transway Stations, ServiceHubs, convention facilities and public attractions such as zoos or museums.

Properties
- Transit information module

Features
- Helps citizens find up-to-date information
- Help them with wayfinding and trip planning
- Can be located in Transway Stations or other public areas
Overview
StreetScape is a modular infrastructure system that organizes different modes of transit on the street along with other infrastructure needs such as utilities and sewage. The streetscape seeks to actively incorporate all modes of transit including pedestrians, bikes, individual cars and the dedicated Transway. The system believes that dedicating space to bicycles and public transit is critical. These modes are often not used because the lack of dedicated space either makes such transit inefficient or unsafe. The Streetscape has a number of components that can be integrated into individual communities as needed.

Starting from center and working outward there are: a dedicated Transway, a planted divider that collects rainwater, the street for individual cars, a raised curb, the Bike Lane with removable cover to utility ditch, another raised powered curb and the sidewalk. At the intersection the curbs and planters stop to create an uninterrupted intersection. All of these surfaces are on the same plane, except where raised curbs exist. The pedestrian walkway is not at a different level than the street and intersection to allow for easy access by the physically challenged.

Properties
- Single plane surface
- Raised curb dividers
- Planters, green space
- Lane dividers
- Removable bike lane cover
- Single utility ditch
- Buried transformers

Features
- Single plane surface allows for easy access
- Easily accessible utility infrastructure
- Buried infrastructure is protected from high winds and lighting strikes
- Buried transformers are used to heat the common utility ditch during cold weather
- Beautifies urban areas
- Reduces urban island effect
- Helps balance CO₂-O₂ levels
- Separate water collection pipes allow different types of treatment saving time and energy
Element Discussion

The common utility ditch is where community utility infrastructure can be run. The ditch is located directly beneath the bike lane, wide and deep enough to accommodate necessary piping and wire. Covering the ditch is a series of easily removable surfaces to allow construction and maintenance crews easy access to the pipes below. These surfaces are conducive to bicycle traffic.

The common utility ditch holds pipes for water, sewage, electricity, heat from the Cogeneration system and water runoff collection pipes. The sewage pipe is located on the bottom so it doesn’t contaminate the water supply. The ditch has a consistent layout of the pipes throughout the community. With a consistent layout within the ditch a universal connector can be used to connect to all of the utilities. The universal connector connects to all major utility pipes within the common utility ditch. The consistent layout and standard connection aids in maintenance because the parts and pieces are the same through the community. The Utility Ditch also allows water runoff from the street to be collected along with lightly used water from homes separately from sewage for lighter and less expensive processing.

Element Discussion

Properties
- Removable bike lane cover
- Single utility ditch
- Buried transformers

Features
- Buried infrastructure is protected from high winds and lighting strikes
- Buried transformers are used to heat the common utility ditch during cold weather
- Separate water collection pipes allow different types of treatment saving time and energy
Powered Curbs are part of the streetscape system that allows necessary streetscape elements to receive electrical power. Lighting, traffic signals, message signs, and other elements can be connected. Power is supplied via the electrical infrastructure located below in the Common Utility Ditch. Help buttons for emergencies are also able to connect to the powered curb where they are needed.

In the future, roadway surfaces will be photovoltaic collectors - once their efficiency levels are high enough to warrant this. These collectors will help power the powered curbs and excess electricity can be routed elsewhere.
Element Discussion

Streetscape Planters act as a divider between the Transway, the dedicated buslane, and the public roadway. This creates a necessary barrier to separate those modes of transit while also serving as a visually attractive element. However more importantly is the environmental affects of the Planters. First, they act as rainwater collection system to reduce the amount of water runoff that goes into the sewage system which only then has to be processed and returned to the environment. Second, the planters serve to reduce the impact of vehicular emissions, regulating the CO$_2$-O$_2$ balance. Finally, the Planters help to reduce the community’s island effect, the increase in temperature which occurs when natural surfaces are covered with asphalt, cement and structures.

These planters, along with other public environmental landscaping programs, serve as an economic development program. The planting, care, and maintenance of these planters creates an opportunity to hire and train unskilled and low-skilled workers. This program operates year-round, as in winter months, seasonal planting and decorations need to be maintained.
StreetScape
Scenario
As Taylor heads out the door to work he decides it is a little too cold to walk to the Transway Station. He decides to call the ZoneBus that will take him and other passengers to the Transway Station, the major node of transportation in his community. He calls the TransDirector to schedule a ZoneBus. He hurries to finish getting ready and runs out to the curb to be picked up. The Zonebus picks him up and takes him to the Transway Station after making a couple of additional stops to pick up passengers on different streets near his house. Along the way, Taylor notices his friend, Han, riding a BikeShare bike to the Transway Station. He thinks to himself that it must not be too cold if Han is riding his bike.

As he arrives at the Transway Station he proceeds to the “enter” side of the station, which is different from the “exit” side. He swipes his TransPass on his way in and is automatically charged him for his use of the Transway Bus. While in the Transway Station, Taylor stops to view the new StreetStall. Its displaying a new community planning initiative for a park as well as a culture event. Taylor is interested in the new planning effort and has some thoughtful suggestions. There are two ways for him to make comments, one is to go to the eCommunity or to add to the suggestion box provided. He has an issue with so much space taken up by the dog park - he doesn't own a dog! Taylor submits a comment about enlarging the soccer field and not including the dog park.

When the bus arrives it is riding in the dedicated Transway for Transway vehicles. The doors are at the same level as the platform and passengers exit the arriving bus from the rear, proceeding to the “exit” side of the station so that entering passengers do not have to fight through exiting ones. Taylor boards the bus and finds a seat in the middle of the bus. He notices that a person in a wheelchair is able to board the bus easily, as he locks his wheelchair in the designated space.

As the trip downtown progress the bus stops at several other Transway Stations where more people get on. During the trip Taylor checks the Transit LED to see how much longer until the next stop and more importantly, the final stop downtown, where he is getting off. He realizes that today is taking a few minutes longer than yesterday's 25 minute commute. The Transit LED displays that today’s trip is estimated at 27 minutes.

As he gets off the bus Taylor decides to run an errand before work. Still at the Transway Station, he picks up a BikeShare bike and enters the bike lane in the Streetscape. The bike lane he is using is placed between the sidewalk and the roadway. He is comforted that he will not have to worry about being struck by passing cars or having someone strike him while opening their car door. He passes a street light that is plugged into the Powered Curb as well as the community help button.

Taylor arrives at his laundermat five minutes away to pick up shirts. He parks his bike at the provided bike rack next to several other orange BikeShare bikes. When he comes out of the post office his bike has been taken and there is not another one available, but he knows that he can walk over a block to another BikeShare rack to pick up another bike. Taylor takes one bike from the bike rack and quickly adjusts the seat height to his liking. He places his shirt boxes in the provided rear baskets and continues to work.
Access to adequate water resources is a problem all communities will face, if they do not so already. Water is a scarce resource despite how many of our communities treat it. Key to understanding this problem is realizing that it is occurring across a wide spectrum - some communities do not have adequate access to water while at the other end of the spectrum communities with sufficient access employ non-sustainable methods.

Water Source is a series of water collection, storage, treatment, and delivery systems that can be used in developing countries and developed countries. The system more efficiently uses limited water resources. In more developed communities focus is placed on individual responsibility and awareness.

Elements
- **HomeKit**
  - Dual Water system
  - Rooftop Collection Gardens
  - Gutter collection Cisterns
- **AreaKit**
  - Area Collection Kit
  - Water Equity Assessment tools
  - Solar Desalination
  - Water Harvesting
  - Area Treatment Kit
  - UV disinfection
  - Marshland Processing Plants
  - Waste Powered treatment plant
  - Area Delivery Kit
  - Micro-irrigation system
  - StreetScape

DevelopKit
- Staged Growth
- Stage One: Individual Collection
- Stage Two: Facilitated Collection
- Stage Three: Community Delivery

Core Elements
- Wind Water Pumps
- Water Carts and bags
- Solar Desalination
- Flared Collection Barrels
- Related Elements
- Water Disinfection Bottles
- Filtered Water Pump
- Water Trucks & Water Scooters
- Oxen powered Desalinization
- Aboveground Pipes
AreaKit

Discussion
In addition to needing to better manage individual water usage, communities need to be more resourceful and responsible as a whole. AreaKit is a series of eco-effective methods for relatively developed and urban communities to better control their water collection, filtration, and delivery. These methods focus on techniques and technologies that minimize the necessary input resources, electrical power for instance, attempting, when possible to be self-sustaining.

Elements
- **AreaKit**
  - Area Collection Kit
  - Water Equity Assessment tools
  - Solar Desalination
  - Water Harvesting
  - Area Treatment Kit
  - UV disinfection
  - Marshland Processing Plants
  - Waste Powered treatment plant
  - Area Delivery Kit
  - Micro-irrigation system
  - StreetScape

- >>> Solids to CRMC
- >>> Marshland Processing Plants
- Greywater Treatment
- Waste Powercel Sewage Treatment
- UV Disinfection
- Collection Pump
- Solar Desalination
- Water Harvesting
- Home
**Overview**

The Area Collection Kit is a set of interchangeable collection methods that can be used singularly or in concert. This provides flexibility for communities to implement the type of solution that best fits their need.

**Solar Desalination (Reverse Osmosis)** allows communities located near sources of salt water can make that water usable through Solar Desalination. In this process pressurized salt water is passed through a membrane removing the salt from the water. The energy needed to pressurize the water is captured through solar power panels.

**Water Equity Assessment Tools** show the distribution of water sources, with quality information, within a specific area. This information is used to determine need, identifying under served areas, and specific need levels for localized community areas. These tools allow communities to compare water access between different areas to determine equitable distribution and to identify areas where resources should be invested to provide additional infrastructure and access.

**Wind water pumps** bring water up from underground wells, aquifers, and bore holes into storage filtering tanks. These pumps are self-powered, generating such power through use of a windmill collection. These tanks filter the water and prepare it to be delivered to the community. Groups of these pumps can be used at a single source to increase yield.

**Water Harvesting** is a system of water collection tanks that stores water runoff heavy storms. When large amounts of rain occur water is diverted to collection areas. Water is funneled to a series of collection points, including large cisterns, drained aquifers, and man-made wells. Funneling can be done via basic systems such as ditches, or through networks of pipes capturing water from building roofs. River overflow is another source of water collection. This water then can be used when water sources are low or water is scarce during some seasons.

**Properties**
- Large scale collection methods
- Renewable energy sources

**Features**
- New sources of water for the community
- Provides flexibility for collection from multiple sources
- Used renewable energy sources to power collection
Overview

The Area Treatment Kit is a set of interchangeable collection methods that can be used singularly or in concert to provide a spectrum of water treatment means.

**UV Disinfection** is a chemical-free water treatment method. UV light reactors send UV rays through the water to damage microbes DNA, which makes them unable to replicate and harm people. UV Disinfection and water treatment allows communities to treat water without using hazardous and dangerous chemicals as done now, commonly with chlorine. Many communities are seeking treatment methods more friendly to the ecosystem, with fewer by-products. Additionally UV Disinfection does not impart odors or flavor to the filtered water. UV Disinfection can also be used as a secondary or tertiary filtration method, to ensure properly filtered water.

**Marshland Processing Plants** are a system of man-made marshlands used to filter and purify waste water in order to reintroduce into the environment. Sewage that has had solids removed from the water is delivered to the marshland for processing. These marshlands can be introduced into any non-moving water source, such as ponds or lakes. In areas where climates are dry biospheres can be created maintain a warm moist environment for in which the marshland plants can grow. These areas provide secondary benefit as wildlife refuge and environmental education facilities.

**Waste-Powered Treatment Plant** are self-powered plants that operate on methane collected from sewage. As the treatment plant filters impurities and waste from community water the sewage can be collected. Fuel cells operate as a large-scale battery, but never need charging. The plant captures the methane that would otherwise be released into the atmosphere. The methane is instead diverted into a fuel cell where hydrogen is extracted from it and combined with oxygen which creates a chemical reaction from which energy can be collected.

Properties

- Natural environments for processing and treating water
- Chemical free treatment
- Powered by waster by-products

Features

- Provides a natural habitat to treat and filter water
- Uses treatment methods that don’t flavor water
- Powered by the waste products within the sewage to power treatment
Community Area Treatment Kit

Water from these treatment plants can be filtered to sufficient levels for either home use or merely for reintroduction into the environment. Unfortunately methane collection cannot be done in sufficient levels to power additional community needs.

Such treatments are in existence in a few communities, but their use needs to be expanded and alternative power generation means more duly noted. The beauty of this idea is that is a continuously operating, environmentally friendly source of power is based on a no-cost, constant input.
Overview
The Area Delivery Kit is a set of interchangeable methods for delivering water of applicable quality for different uses; drinking, home, or agriculture.

Micro-irrigation System allows for efficient watering of crops, green areas, parks and household gardens. Water is collected from rainfall and runoff using the aforementioned methods, stored, and then later available for micro-irrigation. The system includes buried pipes or close to the surface pipes that distribute water directly to the soil at regular intervals. This method ensures that minimal water is lost via evaporation or is misdirected to non-critical areas.

Access to water is the limiting factor for agricultural industries in developing areas and micro-irrigation serves as an efficient, cost-effective solution. However, the applicability of micro-irrigation extends to any community, since more responsible water use is critical. Micro-irrigation can be used instead of above-ground sprinkler systems at no greater cost.

StreetScape enables rainwater collection in more developed areas though runoff drains placed along the raised, Powered Curbs. The Utility Ditch collects water runoff and routes it to processing facilities which can perform the minimal necessary treatment necessary to reroute the water through the Dual Water System (see Organic Transportation section for more detailed description).

Properties
- Buried or close to the surface pipes
- Pipes are perforated

Features
- Delivers water direct to the ground was reduces the amount of water that evaporates during watering
- Efficient watering method
HomeKit

Discussion
Water is a scarce resource in many communities now, and will only become more scarce over the coming years. Enabling individual residences to better control their own water usage takes pressure off of the community infrastructure and area water sources. HomeKit is a system of home water collection, treatment and use methods that better conserve this scarce resource.

Home water management solutions are viewed by many as unnecessary and by others as impractical. The HomeKit seeks to encourage better home water management by providing clear, noticeable benefits along with ease of use. The HomeKits also seek to educate the public that there are a variety of water types, based on levels of contaminants, and that these have a variety of uses.

Elements
- **HomeKit**
  - Dual Water system
  - Rooftop Collection Gardens
  - Gutter collection buckets
Element Overview

Dual Water System provides homes with a sufficient supply of drinkable water, processed by the community, along with a lesser-processed source of water for activities toilet and outdoor water needs, that the residence is able to produce itself. This relies on the fact that water for secondary functions does not need the same level of processing and filtration. Community water systems currently treat all water the same, whether it be sewage, rainwater, or water used for such daily tasks as dish-washing or bathing. Subjecting all water to such processes is not efficient with regard to time and resources.

The water system also returns two types of water; sewage, which requires heavy processing, and water from lighter secondary uses such as sink drains and showers, which only require light processing. The lighter processing method routes that water into the rainwater runoff pipe in the Common Utility Ditch. This water is routed to Marshland Processing Plants, where it is filtered naturally and returned to the ecosystem. This method is less costly and less harmful to the environment.

Residences are able to collect their own water for secondary use through two main methods, Rooftop Gardens and Gutter Collection Cisterns.

Rooftop Gardens collect and treat water for residential use, in situations that do not require drinkable-quality water. On top of residential structures, single or multi-family, residents install gardens of local vegetation. These gardens are created in a layered approach, with a waterproof and root repellent layer being put down first. On top of that is a drainage layer, a filtering layer and finally a level of loose gravel or soil in which vegetation is planted.

Rainwater is collected by the garden and as it passes through the soil the water is filtered of impurities. There is an additional layer of
filtering material here that slows the collection of water, allowing for additional purification. This also ensures that sufficient water is able to be used by the vegetation. Water that reaches the drainage layer is funneled into a collection cistern.

Primary use for such water is in toilets and outdoor watering tasks. While some communities will view use of such water as “unclean”, scientifically such uses have been proven perfectly acceptable. On the other hand, certain communities are forced on a daily basis to use unclean, contaminated water for all of their daily uses, including drinking.

**Gutter Collection Cisterns** collect, store, and filter rainwater for home use. Rainwater is collected from along the roof in gutters, then transported through a series of downspouts to collection bins or cisterns which can be located inside or outside residences or underground. The collections bins serve storage and filtering functions.

Water can be directly accessed from the cistern via taps or pumps, if necessary. Also the cistern can be connected to the home’s Dual Water System. The collected water would be able to be pumped inside for use in showers and toilets.
Scenario
This AM Amy awoke at her usual time and heads to her bathroom to start her day. Amy is taking a shower in her newly renovated bathroom using water from the Dual Water System. Water for her shower has come from the AreaKit collection supply network. Without Amy knowing it, water has come from several different sources. Water levels in underground water reservoirs in Amy’s community have been low for several months because of a long standing drought. Water sensors, part of the Water Equity Assessment Tools, monitor ground water levels constantly.

Due to drought conditions more of the water in the community is being supplied by the Solar Powered Desalination Plant that is located near the ocean, but many miles from Amy. Other water being delivered to Amy’s shower is from the Water Harvesting reservoir. The reservoir collected rain from several rain showers last month. This water had been treated at the local UV Treatment Plant. Amy has noticed in the past few months that the quality of the water in her community has improved. She is unaware though that the community stopped using chlorine to disinfect their drinking water. Instead, the community had switched to a safer less toxic means of treating bacteria and viruses in water with UV light.

Earlier today it rained and Amy’s Rooftop Garden and Gutter Collection Cistern captured several hundred gallons of water. The water collected on the roof passed through the garden and the embedded filters into the Rainwater Cistern. This water is clean enough to use in Amy’s toilets and for use in the garden and lawn. Earlier today she watered her indoor plants with water from the Gutter Collection Bucket.

After her shower Amy uses the toilet, the water in which is also from the Rooftop Garden. The sewage water from the toilet will be delivered to the sewage pipe in the Common Utility Ditch. This water is then sent to the local sewage treatment plant. Along the way in this process, methane produced from the Amy’s sewage and others in the community is gathered. This methane is then converted into electricity at the processing plant to help power the plant. Excess electricity produced in the plant is sold back to the grid through the MeshMonitor network of the Distributed Energy grid.

At the local treatment plant the first step in treating Amy’s sewage is to separate the solids from the liquid in a screening process. The solids are collected and transported to the local Community Resource Management Center for composting and distribution as fertilizer. Sewage with the majority of the solids removed is delivered to a series of Marshland Treatment Plants. Here sewage is mixed with community runoff water and existing plant organisms. The marshland plants work to clean and filter the harmful material out of the water. Water is naturally cleansed through the plants and allows for a safe return of the water to underground water supplies.

The water for Amy’s shower is treated in different path. This water is collected and delivered to the grey water pipe in the Common Utility Ditch. The two types of water are processed differently at the AreaKit treatment plant. Grey water from showers, sinks, clothes washing equipment and rain runoff generally needs less processing time which translates into less electricity usage for processing and water returning to the environment.
DevelopKit

Discussion
Communities around the world have different levels of access to water and the infrastructure necessary to collect, treat and deliver to individual citizens. In some communities water is a scarce resource, with great time and effort dedicated to its collection. These communities need the greatest assistance in upgrading their water management abilities.

Elements
DevelopKit
Staged Growth
Stage One: Individual Collection
Stage Two: Facilitated Collection
Stage Three: Community Delivery
Core Elements
Wind Water Pumps
Water Carts and bags
Solar Desalination
Flared Collection Barrels
Related Elements
Water Disinfection Bottles
Filtered Water Pump
Water Trucks & Water Scooters
Oxen powered Desalination
Aboveground Pipes
Overview

The DevelopKit Staged Growth model is a scalable water management system, consisting of a series of core methods that communities can use regardless of their situation accompanied by stage-specific tools to use as they develop greater capabilities.

There are three stages within this model, each consisting of upgraded, stage-specific tools. Stage One is Individual Treatment, a situation in which individual community citizens are responsible for their own water management. Significant time and energy is spent to meet even basic needs. Water treatment unfortunately is not a high priority for this group. Stage One elements introduce basic filtration and treatment options. Core Elements can be leveraged for improved water collection.

Stage Two is Facilitated Collection, where individuals are able to manage their own water resources, but their lives would be improved by efficient localized or group methods taking some of the pressure off the individual. Solutions at this stage seek to provide improved collection and treatment options on a larger community scale.

Stage Three is Community Deliver. Still applicable for communities with very little infrastructure, this set of solutions seeks to be an initial level of water delivery, no longer requiring individuals to collect their own water. The solutions though acknowledge limited community economic resources for creation and maintenance of a complex water delivery system.

Properties

• Staged growth process
• Tools for individuals use

Features

• Core elements are used through out the growth
• Empowers individuals to collect water
• Growth process alongs flexiblity and continued growth
Core Elements

Overview
The Core Elements of the DevelopKit are methods and tools that communities can implement regardless of how developed their water management abilities are. Communities should implement the Core Elements as soon as possible during the Staged Growth model, as they will ease collection, treatment, and storage issues. However, communities can proceed along the Staged Growth model even without these elements, if need be.

**Wind Water Pumps** aid in water collection from either natural or man-made water sources. These pumps are ideal for wells, aquifers, or any below ground water source. Pumps are driven by wind power, needing no connection to an energy source. There are two kinds of pumps, the first works as a direct connection between the tri-blade windmill and the pump. As the blades turn, a series of gears and levers move the pump's mechanism, bringing water to the surface. In the second model the windmill harnesses wind energy and converts it to mechanical energy for powering the electrical pump. In times when wind power is not sufficient to drive the mechanism a human-powered extension is available. This foot and leg pump allows the user to work the pump using one foot.

**Flared Collection Barrels** allow individuals to collect rainwater for treatment and use without installing any infrastructure. Rainwater collection via rain barrels is a common sight in some communities, yet this simple but effective collection means is still overlooked in many areas. Rainwater is an excellent source of water, being practically devoid of minerals, chemicals, or other contaminants. These 50-80 gallon plastic barrels can be placed outside and allowed to collect water when it rains. Use at this level can be amplified by a screw-on flared collection shield. Flaring out circularly at an increasing angle from the barrel's top rim this shield increases the amount of surface area that rainwater can collect on and be diverted into the barrel. Screw-on tops allow for full barrels to be effectively sealed and stored for use when water levels run low.
Where possible, Collection Barrels can placed under runoff spouts or gutters from residences and structures. This increases water collection, by increasing the surface area dedicated to water collection.

**Water Carts and Bags** facilitate an individual’s water collection. Individual collection is limited to the amount that any single citizen can transport. The Water Cart seeks to increase the capabilities of a single citizen, allowing them to not only address their needs but distribute water to additional citizens. The Water Cart is a wheelbarrow-sized wheeled device that easily transports a water barrel to and from a water source. This cart is a frame into which a water barrel is placed and secured. When not in use the cart collapses for easy storage. The cart enables an individual to transport an empty barrel to the water source, return to their residence with far more water than they would be able to carry, unload the barrel from the Water Cart and reload the cart with an empty barrel. The barrels double as a storage means within homes. These barrels can be the same type as the Water Collection Barrels previously mentioned.

Not all landscapes will allow for use of the Water Cart with collection barrels. These communities will benefit from Water Bags, which are collapsible plastic bags with handles that hold up to one gallon of water. Individuals can carry between four and six of these bags at once. Bags can also be loaded into backpacks or other carrying devices if needed. The bags collapse when not in use for easy storage.

**Solar Desalinators** is a renewable water treatment technique for making salt water drinkable. Solar desalinators use solar energy to heat thin layers of water to sufficient temperatures to force the water to evaporate. As it evaporates it is collected on the top of the sealed tray. The top is banked, or arched, so that the evaporated water runs down the side into a catch tray, separate from the main tray of salt water. Water is routed from the catch tray to a water collection barrel or similar collection means. The tray is refilled constantly from a source barrel of salt water.
Overview
Stage One elements introduce basic filtration and treatment options. At this point in a community water is basically accessible, most likely directly from the source, but little, if any, attention is paid to treatment of the water. Drinkable water is not distinguished from less clean types of water. These simple techniques are affordable for communities at this stage. Additional benefits are that they are portable and require little technological understanding.

Water Disinfection Bottles are simple means for individuals to manage their own water treatment. Water is placed in half-blackened polyethylene terephthalate bottles and placed in the sun for six hours for water to be disinfected.

Filtered Water Pump is a pump that has the same form as a bike pump is used to filter water by individuals. At water sources, individuals place one end of the pump in the water source. The other end is placed in the bag or collection barrel. As the individual pumps, water is sucked in the intake and pushed through a ceramic filter to filter and disinfect the water. An output tube then delivers the water to the collection bag or Water Barrel. The pump actually is designed to attach to the WaterCart both for easier transportation and also to stabilize the pump during operation.

Properties
- Bike-pump form
- Ceramic filter

Features
- Individual level water collection and filtering
- Requires little technological understand
Stage Two elements include more advance treatment techniques and larger scale water collection methods. Water is accessible to community members but significant time is spent collecting it. Communities are ready for techniques that operate on a larger scale requiring fewer individuals to participate in the community’s water collection and treatment. Used in concert with an increasing number of the Core Elements communities can start to have an efficient and stable water management process.

**Oxen-powered Desalinators** turn non-potable brackish water into usable, drinkable water through nonelectrical means requiring nominal infrastructure investment. Pressurized brackish water is passed through a membrane removing the salt from the water. Energy needed to pressurize water is captured using pairs of oxen that turn a gear box attached to a high pressure pump. Purified water is then collected in collection barrels or bag for citizens to use. The Oxen-powered Desalinator can also pump water through the above ground infrastructure (that will be introduced in Stage Three). This technique is currently being tested in India by the Central Salt & Marine Chemicals Research Institute.

**Water Trucks and Water Scooters** provide water to citizens who do not have access to water. The trucks and scooters collect water from sources such as rivers, wells and lake from outside the community. Contaminants are removed from the brackish source water during pumping via a series of membrane filters that move from one end of the tank to the other, forcing water through the membrane to filter it. An additional feature can be installed in the trucks is UV disinfection technology. UV light is directed through the collected water during transport, killing bacteria. When the trucks arrive the community center water is distributed through collection barrels or water bags.

**Properties**
- Truck water collection
- UV water treatment reactor

**Features**
- Enables water to be delivered to individuals without expensive infrastructure
- Continues to use the core elements introduced in stage one
- Makes use of water that is not drinkable
Stage Three > Community Delivery

**Discussion**
Stage Three elements upgrade the community’s water transportation ability. Water is now directly conveyed from sources to locations within the community without human involvement. These communities have further reduced the burden on individual citizens, despite still having limited resources to spend on infrastructure. Citizens will see their participation in the water management process reach almost nominal levels when the Stage Three technique is used in concert with advanced water collection and filtration techniques.

**Aboveground Infrastructure** is a system of above-ground pipes that deliver water from sources to locations within the community. This infrastructure requires a fraction of the effort to build and maintain compared to buried infrastructure. Pipes have taps at key distribution points that allow individuals to pour water from the pipe into water bags or collection barrels for transport to their residence.

This infrastructure consists of a series of modular components of straight pipes, joints, routers and taps that are set up above ground. Elevated stands support the pipes and prevent them from being laid on the ground where they are most susceptible to deterioration, bacteria, and damage from weather conditions. The pipes can be covered with a shade screen to prevent warming. Additionally, u-shaped sections can either be buried or raised further above the ground to allow for pedestrian passage and protection against earthquake damage.

This infrastructure can also serve as the background for additional utilities and services. These utilities can run needed piping or cable underneath the water pipes, reducing the need for duplicative infrastructure.

**Properties**
- Interlocking plastic piping
- Standard piping sizes
- Stands for pipe to rest on

**Features**
- Flexible piping system allows for pipes to be moved in development locations
- Allows citizens to get water easily when it is needed, not when it is delivered
Scenario
Jose has been living in a rural slum for several years. When he first moved into his small shack he had no access to running water. He would have to go several hours to find safe drinking water. For several months he would use old milk cartons to carry water back to his home. About two years ago Jose received a Water Cart and Water pump to collect water. This allowed Jose to use a closer water source that is sometimes unsafe to drink because of animals who use the source and industry that contaminate the water.

Jose walked twenty minutes to the natural water source with his Water Cart and pump. He would place one end of the pump in the pond and one end into the Water Cart. The pump is shaped similar to a bike pump, with a ceramic filter inside the pump. In an action similar to using a bike pump, Jose lifted the handle to take in water into the filter chamber. When Jose pushed down water would be forced through the filter and out the output and into the water cart. After several trips Jose would remove the filter to clean it. This involved carefully scrubbing the filter to remove dirt that had collected. The cart held about fifty gallons of water. The large wheels on the cart enabled Jose to push the cart over the rough terrain to the water source. He was able to easily maneuver around obstacles in his way.

For almost a year Jose used his water cart and pump to collect his water. He would have enough water on one trip for two days, approximately fifty gallons. Jose's neighbor Taylor on the other hand used the same water pump but used water bags to carry water from the source to his home. The bags were helpful because his neighbor was able to use the handle on the bag to carry it back. Taylor was also short on space. When he was finished with a bag he would collapse it for easier storage. The water cart simply took up too much room.

Over a year ago Jose and the residents around him began to receive water from the local water truck. The truck would get water from sources outside the community to save water within the community for other purposes. Jose's friend, Mike, was the delivery man for the water truck. Mike would go to outside sources and pump water from the source into the truck. The intake hose pumped water into the truck's reservoir. During pumping, water passed through a filter to remove particles and some bacteria. When the one-thousand gallon reservoir was full Mike would take the truck to local residence and deliver a several-day supply of water. On the way to the residences water in the reservoir was exposed to UV light killing bacteria and viral contaminates. On the way he would deliver water also to the local water scooters, that had one-hundred gallon reservoirs. These vehicles deliver water to areas where the truck is unable to maneuver, like small alley ways and closely packed homes. The Water Scooter also delivers to individuals who do not live in densely populated areas. When Mike arrived at Jose's, Jose rolled out his water cart and Mike filled it full. Again Jose used the system for another year saving him time and energy to do other critical tasks.

The latest update for Jose has been the local above ground water pipe system that Jose helped install. The pipes came in several different sections that could easily be connected together with a insert locking feature. Jose would insert pipes into each other at one end and with a twist the pipes would snap together. When the pipes had to change direction, Jose would use the provided 90 or 45 degree angle corner pieces. Also, at intervals of several meters Jose and the team place stands to raise the pipe off the ground with a three pronged base. The stand would be placed into the ground with the three-pronged base. The pipes then snapped into place on top of the stand. The team realized that the system might have to move if new development occurred or more people moved into the area. The snapping feature would help if this happened.

Jose, on the first day the system was pumping water needed two Water Carts full because he was watering his garden. He walked two minutes to the local tap and filled his tank twice. Jose appreciated that he could now get quickly water when he needed it.
OneChannel Communications

As individuals demand greater access to information, flexibility of communication systems, and interwoven channels of media existing infrastructures will be hard pressed to supply such capabilities. While some communication technology is increasingly compatible, other infrastructures are filling with mutually exclusive systems creating unnecessary redundancy.

Communities need to have a basic communication infrastructure that is reliable, efficient and flexible. Technological advancements have made substantial leaps ahead in capability at reasonable cost and infrastructure investments. OneChannel is wireless communications infrastructure capable of handling all community communication needs; voice, internet, data, and television.
Overview
Consolidation of all communication networks in the community into one all encompassing network based on the current Internet and its protocols. By using one set of protocols, compatibility among all devices is assured and the costs of conversion equipment are reduced. Also, wiring costs are dramatically reduced by allowing all traffic to travel on one network, and the robustness of the network is increased by making it cheaper to add redundancy.

The standard selected for the OneNetwork is WiMax, a fixed wireless broadband connection. WiMax signals have far greater reach than current wireless signals, up to one mile in range from a single tower. This reduces the amount of infrastructure necessary for the community to build. Recent standardization of protocols, encryption standards and operating frequencies makes this a far more viable option than in recent years.

The wireless broadband connection is able to support all communication needs – voice, data, and internet. Analog voice communications are transformed into internet packets carried over internet protocols and then transformed back to analog communication upon reaching the receiver. All data is then able to be transported via the internet, eliminating the need for publicly switched telephone networks.

Properties
- Wireless broadband network
- Routing towers
- Internet protocols

Features
- Streamlines infrastructure
- Permits wireless communication
- Provides wide range of access
- Transmits variety of data needs
OneComputer

Overview
OneComputer provides advanced computing power by networking a large group of individual computers. This method is far less expensive than if communities purchased or built a super-computer. This distributed computing model harnesses the power of any computer within the network, from a handful to a nearly countless numbers. OneComputer makes use of otherwise used resources, unused and idle computing power. Using this array of computational resources programs can do analysis too unwieldy and time-consuming for a single computer.

Many communities without existing centralized computing resources will find the OneComputer program very beneficial. There is no need to purchase extensive amounts of computing hardware or software. They will be able to run advanced systems, such as GAIA and Hazcomm-HF. Non-critical community management systems are excellent candidates to run on the oneComputer.

Properties
- Network of computers
- Protocols
- Integration software

Features
- Harnesses unused computing power
- Gives community ability to run complex programs
- Reduces need for large-scale infrastructure
Overview
SensorMesh is a hardware and software system that manages the communications network, balancing traffic, ensuring security and identifying needed maintenance. The system aggregates information from a variety of telematic and sensor networks installed in the OneNetwork system. SensorMesh is able to control access to the network to appropriate entities, ensuring privacy and allowing for cross-disciplinary systems to be easily created.

Properties
- Telematic and sensor network
- Software components

Features
- Manages traffic loads
- Balances unequal levels
- Secures access to network
Scenario
Amy has been having a lot of difficulty getting in touch with her husband, Mike. It seems that Mike has been spending much of the time where he should have been at home instead at work. It's been ever since his department at the Disaster Knowledge Source acquired that new software system. Amy is well aware though that Mike should be available. As the wife of a communications engineer she's heard many times about how their community's OneNetwork system has greatly increased the community's communications reach and reliability. Still, when she calls Mike he doesn't pick up. Neither does he respond to the emails she sends also via OneNetwork. He no longer has any excuses though, according to what he's told her about this network. The integrated network of voice, data, and internet traffic isn't to blame for him not responding to her calls. He's described in some detail how the MeshMonitor ensures that all communications get through from the sender to the receiver.

Mike's unreliability seems to have only gotten worse with the Disaster Knowledge Source acquiring the Hazcomm-HF disaster modeling and mitigation software. Mike was put in charge of installing the software and making sure it's fully operable. He's been very excited because the community was previously unable to run such advanced and complex modeling simulations. Mike and fellow community employees in other departments have spent significant time lobbying the community to establish a distributed computing system. This system, OneComputer provides computing power of hundreds, if not thousands, of computers that reside within and beyond the community they have the ability to run a variety of advanced softwares. Amy couldn't help hearing about these developments, since it seem to be all Mike talks about, that is when he actually is home.
Distributed Energy Grid

Access to reliable sources of energy are crucial as communities increase their level of development. Additionally, developed communities need to better understand and manage the pressure they are placing on non-renewable sources.

The Distributed Energy Grid disperse electricity generation throughout the community closer to the demand. Placing electricity generation close to its use increases efficiency and creates the ability to harness energy that normally is wasted. The Distributed Energy Grid does not rely on a large power plant outside of the community. This helps protect the community from regional flux in demand which use the same power source.
Distributed Energy Grid

**Discussion**
Distributed Energy Grid is a system of small modular Community Power Centers that work together as a whole to supply and deliver electricity to the entire community. Each of these modular power centers are supplemented with Individual Power centers that allow citizens to produce electricity and give back unused electricity to the community. These distributed generation activities are monitored with a system of hardware based monitoring machines and software that captures production and consumption needs.

**Elements**
- Community Power Centers
- Concentrated Solar Collectors
- Orbiting Solar Reflector
- Underwater Turbines
- Hydrowave Generators
- Savonius Wind Turbine
- Grid Connection Wind Turbines
- Geothermal Electricity
- Biomass Power Plants
- Flow Cells

**Individual Power Centers**
- Urban Wind Turbines
- Solar Panels
- Solar roofing tiles
- MeshMonitor
- CommunityTemp
- Geothermal Heat Pumps
- District Cooling Network
- Cogeneration
Community Power Centers

Overview
Community Power Centers are a system of large-scale power generators for use in the Distributed Energy Grid or as backup against the national grid failure. This system includes a collection of different elements so that communities can select the most appropriate means. Some will be more pertinent in certain geographic and climatic situations. Elements are meant to be used in concert, when possible, to provide fail-safe and redundancy. As the community develops increasing power generation capabilities it becomes less susceptible to regional and even national fluctuations and crises. Almost all of the means described use renewable, non-fossil based sources. This is especially important for developing communities that do not have indigenous fossil fuel resources.

Concentrated Solar Collectors resemble satellite dishes that are lined with mirrors along their concave surface to harness solar energy. The mirrors reflect sunlight back to a single point in front of the dish. At the point there is a stirling engine that converts heat energy to mechanical power. An electrical generator or alternator converts the mechanical power into electrical power that can be used for a variety of applications, such as pumping water or powering a small village. Series of these collectors can be used to increase potential collection. Additionally, these collectors can mechanically rotate to follow the path of the sun allowing more efficient collection.

Properties
- Electricity generators
- Alternative energy source
- Building size power generators

Features
- Creates power used alternative and renewable sources of energy
- Embedded within the community
- Power sources don't release harmful gases or particles
Community Power Centers

Orbiting Solar Reflectors increase the effectiveness of solar collectors by extending the number of hours they can be used. A key limitation to solar power collection is the number of daylight hours in a given day. The reflectors are orbiting satellites that redirect sunlight to the community solar collectors, either Concentrated Solar Collectors mentioned above, solar panels, or solar farms.

Underwater Turbines are anchored on the ocean floor that capture the power of water currents. Harnessing natural sources of energy can also be done by means that capture the potential energy of large bodies of water. Turbines are anchored at angles to maximize the current flow against the turbine’s blades. As the blades are turned by the current the energy is captured and transformed into electricity. The turbines are able to produce a steady stream of electrical energy because ocean currents are constant.

Hydrowave Generators are comprised of concrete capture chambers along the shoreline transform the potential energy within waves into electrical energy. Waves that crash along the shoreline compress air within the capture chambers. This action turns the turbine generator to produce electricity. This renewable energy source can be located along breakwalls and at areas of high current activity, leaving public recreation areas undisturbed.

Savonius Wind Turbine is a low-cost, easy-to-construct, wind harvesting machine. These turbines consist of a series of concave metal scoops that catch the wind, causing the mechanism to rotate. As the mechanism turns the wind’s energy is transformed into electrical energy. There are various designs for the concave scoops which make better use of cross-winds. These turbines can be mounted vertical or horizontally on citizen’s roof, property, or many can be placed together as a wind farm.

Grid Connection Wind Turbines are series or large three-bladed wind turbines can produce large amounts of energy for the energy grid. These wind farms can grow to be quite substantial in size in communities in which climatic patterns produce high amounts of wind flow. These turbines are most effective when facing into the wind. Various mechanisms, such as a small sail, can be used to redirect the turbine into the wind.

Geothermal Electricity taps the hot water under the earths surface to create electricity. Steam from hot water collected is used to turn the turbine. These types of generators are useful both in rural areas serving a limited number of people and larger regional, even national, grids. Geothermal energy also has applications for direct-heat uses (see CommunityTemp section for further discussion).

Biomass Power Plants are designed use alternate fuel sources. Natural by-products from manufacturing and agricultural industries are low-cost inputs. Processing these inputs prevents these waste products from simply being shipped to landfills or otherwise destroyed. The most efficient type of Biomass Power Plants are Biomass Gasifiers. These plants heat, rather than burn the biomass, to a point where it breaks down into a flammable gas. This gas can be captured and treated. Modular biomass-based plants can operate on a smaller scale, such as villages, rural areas where biomass is plentiful but electricity still a scarce resource.
Flow Cells

Overview
Flow Cells are battery like storage on the Distributed Energy Grid. When there is excess electricity on the grid, Flow cells can be used to store the excess electricity. Flow cells are rechargeable and do not degrade over time.

Flow Cells allow Community Power Centers to run closer to capacity because the electricity that is not being used can be stored in the Flow Cells. Power plants that run closer to capacity are also better because higher operating capacities are more efficient. When the grid becomes stressed by demand or natural disasters the stored electricity can be used to help meet demand.

The electricity stored in Flow Cells can be used to protect against local or national grid failure. In the event that either Home or Community Power Centers fail electricity can be routed from the Power Cells to affected homes. Additionally, national grid failure is of increasing concern as the infrastructure ages but is also handling increased capacity. Flow Cells allow communities to have redundancy against national failure as well.

Properties
- Enormous rechargeable batteries
- Connected to electrical grid or the distributed electricity grid

Features
- Manages incoming electricity from grid without distributed generation, protects against surges
- Allows community to store electricity for when the national grid fails
- Stores unused electricity
- Allows distributed plants to work at full speed and store excess
- Provides electricity when renewable sources are not available, wind, solar
- Serves as back up generators if community power centers fail
Overview
Power generation has typically been a community supplied resource. However technological advancements are making it not only feasible, but reasonable, for individual residences and commercial structures to collect and generate their own electrical power. Individuals can protect against community electrical grid failure and reduce overall reliance on the community grid. Individuals can even assist community generation by selling back the power they generate. This reduce the community’s responsibility and while generating income for the individual.

Individual Power Centers include a series of means by which individuals can collect and generate power. Individuals need to select from the options below those that are most appropriate for the geographic and climatic conditions where they live.

Solar Roofing Tiles can be used in new residential and commercial construction. Aesthetically they are less noticeable than large panels. These tiles appear on shinier than typical roofing, but are otherwise indistinguishable. Photovoltaics within the roofing tile collect and transfer solar energy. Installation costs are offset by the fact that this electricity generating method can produce up to ninety percent of a residence’s electrical demand.

Solar Panels allow existing structures to collect solar energy. Panels of variable size can be retrofitted to existing flat or banked rooftops. While aesthetically more noticeable, the effect is similar to Solar Roofing Tiles.

Urban Wind Turbines are for use on buildings in developed, urban, areas these turbines should be placed approximately twenty feet above roof level to take advantage of high winds that result from urban high-rise architecture.
Overview
MeshMonitor is real-time, dynamic, electrical grid management system. It consists of a series of electrical sensors placed throughout the grid and also connected to power generation sources. It also has a series of protocols that route, switch, balance, and transfer electricity throughout the grid. The software interface component allows management personnel to review.

Demand spikes, rolling blackouts, and regional power outages can become a thing of the past. All of those crises are based on unbalanced demand and supply. MeshMonitor smooths out those gaps, dynamically routing power from low demand to high demand areas using high-powered electricity switches. When necessary drawing on excess power stored within the system, described shortly.

By having a means to dynamically route and control electrical capacity communities can direct excess capacity to rechargeable flow cells. Flow cells serve essentially as giant batteries, providing storage for excess electricity and a source of electricity during spikes in demand. Typical electrical grids are not capable of using overflow production, so they run plants at low capacity which is inherently less efficient. MeshMonitor enables communities to operate fewer plants, at full capacity, making the most efficient use of all electrical power generated.

Finally, MeshMonitor has an interface for citizens from which they can interface with the electrical grid. Individuals with power generation capabilities can manage this creation and sell excess electricity the produce back to the local grid, in addition to helping monitor and balance their own power needs.
Overview
Communities can harness readily available energy sources for use in distributing heating and cooling to residential and commercial structures. The methods described below utilize a common infrastructure or insulated pipes. These pipes would run through the Common Utility Ditch whenever possible, benefiting from the additional insulation provided there. Structures would be able to connect to this heating network for a lower-cost source of heat.

Cogeneration is a way to capture steam and heat produced during electrical generation. Electrical generation methods, both traditional methods, and the methods described as part of the Community Power System, produce heat as a by-product of electricity generation. Cogeneration captures the steam produced and uses it to heat the surrounding community. Typically this steam would be released into the atmosphere, not only losing this valuable resource but overtime disrupting the climatic patterns of the area. Power centers pump steam from the turbine to surrounding buildings through pipes located in the Common Utility Ditch.

Geothermal Heat Pumps use shallow ground to balance a structure’s heating and cooling needs. This method takes advantage of constant ground temperature despite wide seasonal variation above ground. Buried heat exchanger pipes are filled with air. The air either absorbs heat from the ground or releases heat within the ground depending on the season. In the summer heat pumps move heated air from indoors into heat exchangers removing the thermal energy and return cooler air. In the winter the heat pump removes heat form the heat exchanger and pumps it into the indoor air delivery system.

District Cooling is a system that collects deep sea water to cool air in heat exchangers. This cooled air is then distributed to structures that need cooling. The system is made up of a series of pumps for bringing cool sea water into the heat exchanger, where the water cools air. This system does require substantially large bodies of water to from which to draw sufficiently cool water. This system cuts down on the use of air conditioners and cooling systems that often emit environmentally harmful by-products and strain the energy grid.

Properties
- Natural energy capture and transfer system

Features
- Relies on natural renewable sources of energy
- Provides a steady source of energy
- Reduces by-product production from typical electrical or hvac generation
- Integrates into other System Element components (e.g., Streetscape)
During the day at work Mike hears over the radio that there is a possibility of strong storms that evening. As Mike leaves for work he see dark clouds and lightning in the distance. The rain begins to fall as Mike is walking home. At lunch Mike had noticed how windy it was from the coming storm. That same afternoon the community’s MeshMonitor has been using the excess electricity produced from the Community Power Center (CPC) Wind Turbine to store electricity in the CPC flow cells. The mesh monitor also increases production at the CPC biomass plant to store electricity in another flow cells. The reason for the meshmonitor to store electricity is so that if the storm knocks out the connection to one community power center the other community power centers and their attached flow cells will be able to share the increased load from the unusable CPC.

As the storm continues to develop Mike arrives at home soaking wet. Reading his MeshMonitor it tells him he has sold much of the excess electricity back to the grid because he was not at home to use the electricity. During the day his Individual Power Center, the Urban Wind Turbine, has been producing excess amounts of electricity from the wind in the storm. Mike is excited he is going to save money but he does not know that the excess electricity was diverted to several of his neighbors who were home during the day. Mike realizes he has actually made more electricity this month than he has used.

At that moment his lights flicker but remain on and he hears several loud claps of thunder. Without Mike knowing it, the connection to the closest community power center has gone down because of a lighting strike. Mike continues to have access to electricity because his Urban Wind Turbine, he’s using power produced by his own source rather than the community power supply. His friend, Jose, down the street is not as luckily. His power has been interrupted because of a difficulty at the closest community power center. Jose does not have any way of generating his own power. At this moment the MeshMonitor routes electricity that has been stored in another CPC Flow Cell and sends it through different series of lines to get to the outage area. The network is setup similar to the internet. If one node goes down, as in this case one of the Community Power Centers, the signal is re-routed through different paths. Other houses in the neighborhood have access to electricity through Mike’s Individual Power Center. Mike remembers several years ago during a nasty storm when his electrical wire in his back yard fell over and he was without electricity for several days. Mike did not worry about that during this storm because the electricity lines are buried in the Streetscape in front of his house. The buried lines can not be knocked over or struck by lightning.

After the storm passes Mike and many of the people of the community continued to have electricity. As a result of the storm the temperature has dropped several degrees. At this moment Mike turns on his heat to warm his home before he goes to bed. As this is happening the meshmonitor senses that there is an increase need for electricity and heat from Mike and others. The MeshMonitor begins to deliver heat through the Cogeneration system. The pipes, buried in the streetscape, provide steam to Mikes house as well as others near the community power center. Heat used in the production of electricity to create steam is transfer to heat houses in the community through the common utility ditch. To meet the immediate increase demand by Mike and others the MeshMonitor first provides electricity through the flow cells. As CPC’s begin to increase production the meshmonitor begins to provide more electricity from the CPC than the Flow Cells.

Mike checks his meshmonitor again before going to bed. The wind had died down and his Urban Wind turbine was not producing as much electricity. The majority of his electricity is now being supplied by the closest CPC.
Community

Shared Responsibility and Interwoven Functionality

Increasing overall population size, coupled with fluctuating local and regional populations, continue to stress community infrastructures. Even in areas where resources are substantial enough and services readily available the distribution is slowed, even crippled, by a lack of fundamental understanding of the nature of our communities’ citizens.

It is crucial to have an understanding of community demographics in order to provide needed services and infrastructure. Gaia attempts to provide community government and related agencies with sufficient localized and community-wide information in order to allocate services and infrastructure in the short and long-term.
Overview

Gaia is a system of technologically enabled means for information collection, tracking, analysis, and dispersal. The community uses information and data from Gaia to assess short and long-term quality and quantity of service provision, resource allocation, and infrastructure demand. Gaia is able to assist in both long-term planning efforts and short-term resource and service balancing. Citizens experience improved community functioning in their day-to-day life without even being aware of it.

Gaia’s information collection means consists of an interconnected wireless network of sensors and tracking devices. These devices can be embedded in community structures and fixtures, such as public recreational facilities, stoplights, or kiosks. Their purpose is to collect localized information about citizen, vehicular, and resource levels by sensing motion of people and objects within its vicinity. Gaia does not attempt to track every individual item or citizen but rather collective sample sets of data that will feed a series of analysis algorithms that can extrapolate larger patterns and overall community functioning.

Information from tracking devices is transmitted to a central collection point that feed its into the Gaia software system. The system analyzes data according to a series of aforementioned algorithms and is able to present population, resource, and a across changing time periods and geographic locations.
Gaia enables a community planning and design program that allocates community services in both the short and long-term. The community can use Gaia to identify needs and patterns of requirements of utility and service delivery modules and to determine where to install or offer services, such as PODs or Hermes.

Gaia tracking devices can also be installed at major traffic nodes and intersections. These will help collect information on traffic flow and possible congestion through those intersections. From these readings messages can be delivered via TransLED signage that could guide vehicles to avoid traffic congestions. The information may also suggest areas that may need additional infrastructure or routing installed.

Gaia also enables the community to be aware of population changes both community-wide and in localized areas. The information generated by Gaia allows the community to estimate the population of a particular area, and additionally the population changes that are occurring in that area. The community is better able to plan residential zoning efforts that include the area’s transportation infrastructure.

The community can also use Gaia during emergency and disaster incidents. Rescue efforts can use Gaia to detect the number and location of people caught in these emergencies and the rescue operators can get to them efficiently and rescue them quickly.

Properties
- Technologically-enabled means
- Series of sensors and tracking devices
- Software interface
- An interconnected wireless network of sensors and tracking devices

Features
- Collects, tracks, analyzes and disperses information
- Assesses long and short-term quality and quantity of service provision, resource allocation and infrastructure demand
- Assists long-term planning and short-term resource and service balancing.
- Identifies needs and patterns of requirements
- Determines locations for service installations
- Collects information on traffic congestion
- Suggests areas that require additional infrastructure
- Estimates population figures and changes
- Assists rescue experts to locate people caught in emergencies
- Detects locations
Scenario
The community has been in flux for the past few years. Economic threats in many communities in the region have caused increases in the number of individuals wishing to live in this community. The addition of significant new populations has started to stress existing infrastructure, utilities and services. The community is generally pleased to be seen as a favorable place to live. The cultures, knowledge, and skills brought by these new populations are exciting.

The community recognizes the community needs to plan for this ever-increasing rate of growth. This pattern is not news to the community though. For at least a couple years they’ve been aware of the general demographic changes occurring. Last year the community decided to implement the Gaia InfoEnabler system. They hoped that the system would allow them to better understand the complex nature of the demographic changes the community was experiencing.

The community spent a number of months installing the Gaia information collection sensors, devices, and nodes. Additionally the software system was integrated into the existing community technology infrastructure. The Gaia InfoEnabler system went live approximately six months ago. At first the system focused on gathering a baseline set of information. Specifically the information collection devices would make records of the number of people and vehicles, amount of movement, and high traffic and activity areas.

As the systems baseline of information accrued it was able to start to identify patterns and make extrapolations from specific records about general trends within specific community areas. A series of integrated algorithms allowed the system to take a series of static readings about community activity and develop accurate information for things such as population size, growth and movement, and roadway demand, congestion levels, and use patterns.

The community is now able to see at a detailed level how its regional popularity has affected workings within the community. Specific observations note that two outlying neighborhood centers are growing rapidly. These centers lie along extensions of current Transways, as the community was expecting growth there. However the community had not planned for this growth for another three to five years. These rapid changes in population were not expected and the existing infrastructure has not yet been developed. With the information analyses Gaia is able to create the community is better able to understand exactly what level of development is required there and they can begin implementing improvements.
Enlightenment

Pockets of information and knowledge must be brought to the forefront to be shared and leveraged by other individuals and institutions. As one of our most valuable, but under-utilized resources, knowledge must be not only increased but increasingly disseminated to all members of the community.

Within a community there exist many sources of knowledge. Enlightenment is the community’s effort to facilitate increased knowledge acquisition and exchange and communication of knowledge gathered. Over time Enlightenment will build a substantial knowledge base that is accessible to anyone in the community. This system encourages individuals into ever-widening thought and action in concert with their fellow citizens.
PeerNet

Overview

PeerNet is a virtual community forum where individuals, each with diverse skill sets and strengths, can connect around shared interests and professional pursuits. Every member in the community is on a relentless pursuit of information. At the same time, every member in the community has something to offer for the well-being of others. This collaborative learning experience enables people to learn from one another and enhance their knowledge levels through interaction and information exchanges. PeerNet creates networks of individuals made up of citizens from a given community and from other communities. The formation of these peer groups is done on the grounds of common vocation or common interests. People within a group are able to enhance/improve their skills through interaction within the group.

PeerNet is a community effort to build sustaining groups to create sustainable social, economic, cultural, research and education organizations and enterprises. It is a cumulative service that encompasses peer information exchanges, offers peer counseling, enables peer-to-peer payment exchanges and organizes peer conferences. The groups within the network are able to share and compare information, experiences and skill sets through electronic systems that might also lead to physical gatherings. PeerNet strives for transparency in any form of transaction or exchange.
Element Discussion

Peer Counsel is an expert and advice service formed through units of experts from different fields. They provide counseling in fields on their own expertise. They manage a database of individuals’ demographics and psycho-graphics in the PeerNET. The information exchange and counseling that takes place on Peer Net is then stored on the Repository of PeerNET. This information is then accessible for any member of this PeerNET.

Peer Info Ex is a distributed set of network devices to which the stored information from the PeerNET repository is transmitted. Peer Info Ex manages information exchange in intra and inter-group interactions. The database at the Repository, that includes project and group account information, is transmitted to the networked devices of Peer Info Ex. It creates and maintains database for reference and a network system for peer-to-peer information exchange.

P2P Payment Ex is an extension of Peer Info Ex that facilities electronic payment transactions. It is a system where, through individual network devices, monetary transactions can take place between individuals registered in PeerNET. It has a P2P micro-payment model which enables transparency in transactions.

Properties

• Virtual network
• Platform for education and research
• Storehouse of extensive and accessible information
• Expert counseling service
• Distributed set of networked devices
• Network of electronic cash transaction devices

Features

• Facilitates a collaborative learning experience
• Enables, intra and inter-exchange of information among peer groups
• Enables peer-to-peer payment exchanges
• Enables access to expert resources
Scenario
An American company has hired ethnographic researchers and human factor engineers to work on a business development project in India. The team selected for the project is made up of individuals residing in scattered cities throughout both the United States and India. Before the commencement of the project the teams agree that they need to start to exchange information, bios, and project plans. Amy and Jennifer, from New York City, and Neha, from Bangalore, form a virtual group of ethnographic researchers on PeerNet. The teams will be able to establish an internet-based working space to facilitate information exchange. The human factor engineers, Phil, from Chicago, and Sumeet and Shashank, from New Delhi, also form a group on PeerNet. They find that exchanging tools and templates helps them to understand the working habits of the individuals from other cultures. They use Peer Info Ex to store, manage and exchange information through a set of networked devices.

While reviewing their PeerNet profiles Amy notices she and Neha both share a common interest in cooking. Neha loves to learn different dishes and is always trying to improve her culinary skills. Amy takes interest in healthy diets and wants to learn more about diet and meal planning. Without PeerNet the topic of conversation might never have come up. Amy invites Neha to join another PeerNet group that Amy belong to, made up of a number of her friends in the United States. She figures that Neha could learn a number of new recipes from them.

The project commences and during the course of the project all these groups are able to interact and exchange information within their own groups and with the other project groups Peer Info Ex. Also, these different groups are able to consult other professionals within their field for advice from time to time. Sumeet is able to let his PeerNet group know about an upcoming conference sponsored by other human factor engineers. The conference happens to be in Japan, a geographic midpoint for the team members. They agree it would be helpful to meet face-to-face and this conference would be a great opportunity. Sumeet says he’ll go ahead and sign-up on behalf of the group, using P2P Payment Ex to pay for their registration. He finds that he and his co-workers receive a discount for being part of their PeerNet group.

As the project continues the entire team is able to submit time sheets and expenses to the P2P Payment Ex system. The company uses the same system to reimburse the project team for their work.
Learning Wider and Deeper

Discussion
A community is composed of individuals with varied intellectual, social and economic capabilities. There are certain members who are not as privileged as others in the community. Because of this disadvantage, these unprivileged members of the community may have limited access to information and learning opportunities. The community should be able to provide all individuals with access to robust educational content at any point in their life. Other citizens in the community desire access to advanced knowledge and specific topical information. They are seeking opportunities and platforms to engage in this intellectual pursuit.

Learning Wider and Deeper is a knowledge dissemination service offered by the community to provide for these unmet educational needs. It provides expanded access to facilities, content, and resources. It provides opportunities for education and research starting from basic education to higher education systems and continuous on-going research opportunities.

With the underlying philosophy of providing education and research opportunities to those who need, require and seek it, Learning Wider and Deeper is capable of customizing the learning experience suited to different requirements and environments. The tangible elements of this learning experience differ with change in environments and the needs of that environment. Learning Wider and Deeper is able to identify the needs of a particular individual, a group or an environment and customize its response according to those needs.
Element Discussion

**Pay It Forward** is an exponential training method used where monetary and human resources are limited. Selected citizens are granted opportunities to study at major schools in exchange for agreement to serve as future training resources. A credit-based system encourages citizens to take classes from these educated individuals and pass along their knowledge as certified Pay It Forward instructors. In this way one initial trained resource may create an entire network of trainers. The tradition of receiving education and then imparting it to newer groups carries on, developing a shared educational experience and distributed knowledge.

**Auditing School** broadcast educational content via radios to rural and underdeveloped areas linked to other Learning Wider and Deeper offerings. Educational broadcasts of pre-recorded lesson content occurs twice a week with time provided between lessons for group discussion. This time between broadcasts allow different members of the community to come together to have active, deeper discussions according to questions and suggestions provided during broadcast. Certain subjects would undoubtedly be more appropriate, such as the social sciences, basic scientific experimentation and language studies. Topics discussed could be linked to the offerings provided by the Pay It Forward program and Mobile Intereactive Classes.

**Mobile Interactive Classes** is a service for both areas without sufficient educational infrastructure and areas trying with need for a temporary, flexible structure. The Mobile Interactive Classes, a sub-service of MobileAccess, equip the vehicle with a variety of infrastructure, computers, internet access, audio/visual materials, collapsible table and chairs, and space for class-specific materials. Vehicles also have communications systems that allow simulcast broadcast of lectures, speakers, or other events. Video is shown via large LCD screens on the sides of vehicles while two-way audio enables the students to speak with instructors. This system allows

**Properties**
- Platform for education and research
- Organization of physical and human resources
- Mobile classroom environment
- Personalized education system
- Virtual-reality educational experience
- Information management system
- Medium for interaction

**Features**
- Provides teaching-learning and research facilities
- Organizes educational programs
- Manages education and research facilities
- Leverages knowledge resources to disseminate exponentially
- Broadcasts educational content
- Provides access to high-end interactive education system
- Provides customized educational content
- Provides realistic experiences for better understanding of educational content
Learning Wider and Deeper

instructors to remain at a central location, but have their lessons broadcast out to multiple groups of students. Communities may find most benefit from using the Mobile Interactive Class at night when citizens, both young and old, will have available time. The vehicle can be set up in public areas and content broadcast on the vehicle’s LCD projection screen.

**Personalized Textbooks** are a service that provides customized content for each student, which can be printed from personal computers. This service provides personalized educational materials for students with different learning speeds and cultural backgrounds. This system is more likely to be accessible to students in developed communities.

**Virtual Classes** is a virtual reality system for educational purposes. It provides realistic experiences for better understanding of educational contents. It is applicable to history, science, music, arts, and foreign language classes. Classes can also be tailored for non-education programs, such as disaster preparedness, resource and waste management, water conservation, and job retraining.
Scenario
Bikila and Salongo are teenagers living in a remote Ethiopian village. They are eager to learn but do not have the facilities and physical infrastructure for schools and classrooms. Their village is part of a larger community but there is no means for them to access the facilities they have there. Despite this issue Bikila and Salongo are quite pleased with the educational opportunities they are afford through the Learning Wider and Deeper network. While they wait for their community to develop more robust educational resources, these mobile distributed services will do. It certainly is better access than their parents ever had.

Bikila especially enjoys the Auditing Classes he listens to over his family’s radio. Although they do not have many technological advancements, most families in the community do have a radio. Every day the Auditing Classes are broadcast over a specific frequency. Bikila listens to these community sponsored educational lessons quite intently. While radio is not an ideal medium, Bikila and his parents were surprised at just how much content can be appropriately conveyed. Bikila is able to find time in the late afternoon every day. Lately he has been listening to lessons about his nation’s complex and rich history. Having not traveled very far he didn’t have much of an understanding of some of the exciting places and events described.

Salongo is anxious to get Bikila to attend the Mobile Interactive Class that is going to be held the following day. Salongo has been listening to Bikila talk about the history lessons he has heard and he thinks the class being held tomorrow would be of interest. Salongo has managed to attend most of the Mobile Interactive Classes that have been held. He’s always very excited when the Mobile Access vehicle is scheduled to pull into his village, even if it is only periodically. The increased attendance at the classes has led to an increase in the frequency of its visits.

Salongo and Bikila arrive early the next morning. The large educational vehicle has already arrived and is stationed to the side of the plaza. Salongo and Bikila join the other individuals, young and old, helping to unload supplies and set up the necessary equipment. Speakers are hung from the vehicle, while a projection screen is mounted to the vehicle’s side. Salongo gives Bikila a hand unloading collapsible tables and chairs for the attendees to sit at. Other individuals are helping unload materials, artifacts, and other teaching aides.

Class begins as the instructor explains that the day-long lesson that day will be dealing with the regions ancient history, longer back than many of the attendees can fathom probably. Bikila is excited to hear this will be the topic, as he has a keen interest in history. He is momentarily distracted, noticing that Fekrou will be one of the day’s instructors.

Fekrou has only made sporadic visits back to his native village. Two years ago Fekrou went to a national university through the Pay it Forward program. He enrolled in this subsidized educational program with the obligation to later spend time distributing the knowledge he received to others in the area he was from. Fekrou has been traveling with the Mobile Interactive Class for months, giving lessons in ancient history. Fekrou sees two youths he remembers, Salongo and Bikila, who seem to be paying rapt attention. He thinks to himself that he’ll have to make a special effort to speak with them later and try to encourage them to keep learning and to share their learnings with others.
Communities are becoming larger, more diverse, incorporating different cultural groups, tourists, and other travelers. Ensuring that all individuals within a community understand their surroundings and can navigate effectively has become a challenge.

While communities cannot ensure that all citizens or visitors speak a common language they can offer ways to make all individuals feel comfortable regardless what section of a community they are in. Hermes Wayfinding provides translation, destination planning and location finding services.
More and more frequently our communities are made up of a collection of individuals with different ethnic and cultural backgrounds. Learning a non-native language can be very challenging and a critical obstacle to becoming an integral part of the community. However as communities grow with an increased number of ethnic groups another interesting phenomenon has occurred. These groups have formed enclaves or communities of their own in which their native language is spoken primarily and signage and communications are given in that their preferred language. Native speakers can find entering these communities just as daunting as non-native speakers entering the mainstream community.

Hermes Wayfinding system helps citizens navigate within their own community. It provides translation, path finding, and goods/package delivery services. It provides a comprehensive service, which enables path finding, information exchange through Electro Signs and also a door-to-door delivery service for shopped consignment of goods. All this is done through a network or association of government, businesses (stores, restaurants etc.) and other attractions to create an advanced information service for travelers.
Overview
PathFinder helps travelers find locations and directions. PathFinder is stationed in public kiosks, located sporadically throughout communities and in more concentrated locations in high-traffic, central locations. It has an LCD display screen that can display location information, but more importantly 3D maps of the city, orientated to the view of the user. Through this system, travelers can see the landscape behind buildings and other built spaces; better understanding the path they must take and their orientation to their destination. This “see-thru” ability is made possible through GIS mappings of the city.

The booths can also provide information, history and area guides that may benefit tourists or business travelers, anyone visiting the city that wishes to learn more. In the event of emergency, the PathFinder also has the ability to summon help and open a communications channel with an emergency response operator.

Properties
- Information system for travelers
- Path-finding tool

Features
- Helps locate destinations and receive directions
- Enables city information browsing
- Provides emergency contact facilitation for pedestrians
- Provides electronic map information
- Enables path finding
Overview

Hermes ElectroSigns are an information and translation service that uses the Hermes software installed on any PDA or rented separately as a device just with the Hermes software. Businesses, municipal centers, even public transportation vehicles have embedded chips that the PDA will recognize. The PDA presents the user with information in the preferred language about what that sign says and further context, if any has been provided.

Properties

• Language translation tool
• Electronic advertisement

Features

• Provides translation services
• Provides contextual information about business, community services
• Increases non-native speak traffic at community businesses

Travelers can rent the mobile device from the service providers or from the hotel where they are staying. Since the stores and restaurants are networked with the service providers, travel centers or hotels, the traveler can get well organized information while they are walking on the streets.
Overview
Hermes Delivery Service enables citizens and travelers to have a hassle free shopping experience. The Hermes delivery service picks up the goods from every point of purchase and delivers the complete consignment of shopped goods at their doorstep. Often shopping can become a cumbersome activity, especially when citizens are making better use of the public transportation system that often has limited room for personal packages. When making a purchase, be it groceries or luxury department store items, the buyer can request Delivery Service, leaving the goods there at the store to be delivered later with the other purchases made that day.

Properties
• Network of delivery vehicles
• Fleet routing and management

Features
• Provides door-to-door delivery of packages and goods
• Enables unencumbered transit
**Hermes Wayfinding**

**Scenario**

Kensia and her family have lived in a London suburb for years now, though her family is originally from Minsk and they immigrated to Britain only eight years ago. Kensia is fluent in English because she came here when she was early in her schooling, but Kensia’s mom, grandmother and grandfather are not. Her mom has learned some basic language skills but is still more comfortable when she can find people who have emigrated from the old country, as they like to call it. Kensia’s grandmother and grandfather have had a difficult time though. They have all but given up on trying to understand this foreign language, preferring to use Kensia as a translator. When Kensia goes to school her mom and grandparents can have a very difficult time navigating public transportation, shopping, or locating health services.

One day as Kensia arrives home from school her mother is very anxious to show her something. Her mother, Nadia, has received a new device called Hermes Wayfinding. One of Nadia’s friends, a fellow-Russian emigrant, introduced her to the service. She describes it to her daughter as a service that will help them better understand their surroundings and help move from place to place and find services. Nadia tells Kensia that she has already registered her family and received the Hermes device, approximately the size of a standard PDA.

Just weeks later Kensia has noticed a substantial change in her family’s attitude to going out into the community. Their English has not improved really but they are much more comfortable. It’s actually been quite enjoyable to see her family out with the Hermes device. When her mom and grandparents go out they take Hermes with them everywhere. As Kensia’s family moves about the city they are able to receive translated information of areas signs. Many of the public transportation services, commercial businesses, and municipal buildings have recently had electronic chips installed in them that contain translated names and information about the building or service in question. The information on the electro signs all around the city gets displayed on the screen of their handheld mobile device. These Electro Signs are becoming more popular as businesses with them see an increase in the customer base of non-English speaking citizens.

Nadia explains to Kensia that she finally figured out what those strange booths some of the street corners do. Her Hermes device informed her that they are the Hermes PathFinder, a transportation and route finder. Nadia has even used it a couple times now to find new destinations to take her aging grandparents. It helps her not just to find the destination but the LCD screen displays a 3-D picture of where that building is in relation to her present position, as if she could see through the existing buildings that lay between her and her destination.

Nadia has also found another new community service especially helpful. She and her parents have to take public transportation to go shopping for various items and it can be extremely difficult for her to carry home all that they have bought sometimes. Admittedly her parents, Kensia’s grandparents, just aren’t that much help carrying packages and bags. Nadia has started using the Hermes Delivery Service that picks up the goods from every point of purchase and delivers the complete consignment of shopped goods to their doorstep.
Apollon Health Services

At one end of the spectrum we see communities with complex public and private services for managing an individual’s health. While at the other there only access to basic health services. Yet a common theme is that both could be improved vastly by better management of the health data.

Apollon Health Services ensure that our communities treat all health and medical information as a valuable resource. All citizens deserve access to the advanced diagnostic and preventative medical services that can be derived from this data. Apollon also seeks to provide increased access to health services by making information collection a routine part of citizen’s life.
Apollon Health Services

**Discussion**
Apollon Health Services makes health and medical information collection and analysis a more integrated part of citizen's daily lives. Additionally, it encourages the community to view an individual's health and medical knowledge as a valuable resource that should be leveraged in many parts of an individual's life. Apollon also seeks to marry many different types of health-related information, including, but not limited to: personal medical history, family medical history, nutrition, and fitness. Individuals involved in a citizen's health management can provide better instruction when they have up-to-date, comprehensive information.

**Elements**
- Apollon Repository
- Health Check Centers
- Distributed Health Check
- Mobile Health Check
Overview
Citizen’s control the access to this information, making available to community personnel, such as doctors or nutritionists, the quantity of information they so choose. Over time citizens hopefully develop trust in the Apollon system and more willingly share their comprehensive information with more of the personnel helping them with their health management.

Apollon facilitates the submission, collection, aggregation, and dissemination of health information. It is a central computer-based repository that is linked to the different systems run by health and medical providers throughout the community. Information can be updated many community sources and by the citizen. Collection of relevant health information can now occur with regularity, as information is collected and submitted via a variety of community sources that have Distributed Health Check installed. Citizens now have the ability to manage their health on a regular basis rather than when conditions strike.

Comprehensive health and medical records are invaluable to doctors. With the comprehensive record available doctors can more easily diagnose conditions and prescribe necessary treatments considering the overall situation with information from the past as well as the present. Other community health professionals, such as a nutritionist, will benefit similarly. By understanding a citizen’s unique conditions and past history they can identify possible issues that the citizen might not find relevant to mention. Remembering complex medical histories and the history of family members can be difficult and citizens often do not have information readily available when meeting with health personnel.

Properties
- A comprehensive medical history database
- A networking of electronic devices

Features
- Makes medical history available and accessible whenever required
- Collects and monitors a person’s health status data on a day-to-day basis.
- Enables recording of comprehensive medical history by creating many recording points
Overview
The Apollon Health Check Center is one of the ways that the system integrates health services into the daily fabric of citizen's lives. These centers distribute medical testing and information collection services throughout the community. They are co-located at centers of activity, such as Transway Stations or ServiceHubs. These centers seek to separate routine health testing and monitoring from more intensive diagnostic and treatment activities. Many non-emergency trips to the doctor or the hospital are merely to gather information that can be used for diagnosis. Services and tests such as phlebotomy, x-rays, blood pressure do not require the presence of a doctor nor a trip to a complex medical facility such as a hospital.

The centers, though limited in size, can handle a large number of clients, since they are only conducting testing procedures that often are short. There are no doctor patient conversations that often can disrupt schedules at a medical facility. Citizens are able to stop in for brief testing, as requested by their health professionals, as part of their commute, lunch break, or when they can fit it into their schedule.

Information collected at the Health Check Center is entered into the citizen's Apollon Profile. The health professional that ordered the testing can pull up the results, order diagnostic testing, or consult with other professionals. When sufficient diagnosis has been done the health professional contacts the citizen, notifying them if a consultation or further testing is necessary, or if there is no need for concern.

Properties
- Localized testing facility
- Communications protocols

Features
- Provides health and medical testing services
- Creates easier access to testing facilities
- Speeds testing activities by separating diagnostic activities
- Updates Repository citizen record
Overview

Distributed Health Check is a health condition information collection means that is integrated into the health related destinations citizens use on a regular basis. Locations such as rehabilitation centers, fitness centers, nutritionists, blood donation service, Health Club serve as information collection nodes, as well as service delivery points. Citizens currently undertake many activities that contribute to their overall health condition. Frequent exercise, dieting, emotional counseling and other activities together form a comprehensive picture of an individual's health. Only the individual in question knows all of this information though. And even that is somewhat of a stretch – individuals do not actively think about these seemingly disparate parts of their health condition to be related. Information they may share with a nutritionist they don't think relevant for their doctor's use.

Distributed Health Check maximizes the amount of health related information that is collected by integrating this collection into all nodes of health management. When individuals visit any of a variety of health centers they are assured that the information recorded there is entered into their Apollon Health Services profile. Certain activities, such as visits to a nutritionist or rehabilitation center would be entered by the health professional. Other information can be collected directly, such as at fitness centers. Machines can automatically track results, updating the citizen's health record.

Distributed Health Check involves collection and monitoring of a person's health status on a day-to-day basis. Citizens develop a greater appreciation for their overall health picture and how the diverse activities they participate in all affect this picture. This information and history gets recorded and stored over time and is made accessible to health professionals, who benefit from seeing an increased volume of information that can often provide better context for the citizen's health conditions.

Properties

- Integrated collection service
- Communication protocols

Features

- Collects health and medical information from daily activities
- Integrates data collection into everyday activities
- Enables additional health related personnel access to citizen's health background
- Updates Repository citizen record
Community

Health Check Center/Distributed Health Check

Scenario
In the past, when SungHan would visit his doctor, he was rarely able to provide his doctor with his own comprehensive medical history. He was always trying to remember the information he'd given to his previous doctor. It is not easy for him to keep track of the various diseases, disorders, prescriptions, and allergies he suffers, much less the ones in his family's history. His doctors have told him in the past that this information is beneficial to get a complete health picture so the doctor can prescribe the most precise treatment.

SungHan hopes that's all changed now. He used to dread those visits but he thinks now he's got a better handle on things. SungHan's wife recently registered them in the Apollon Health Services. They will be able to enjoy the benefits of having their medical conditions recorded and monitored from community locations, such as Fitness Centers, Health Clubs, Rehabilitation Centers, and the Blood Donation Center. SungHan thinks this will make his next doctor's visit much easier, now that they'll have so much more information. In fact, he was excited to hear that since he and his wife will be transmitting data at regular intervals from these places within the community the doctor may be able to diagnose conditions without ever having to go to the hospital.

SungHan happened to visit the Blood Donation Center and saw the process firsthand. As he waited in line in the office he read material about the Apollon Health Services. The material helped him understand better the benefits of the system. He was surprised when the nurse handed him forms to fill out that had already been partially pre-filled with his personal information and medical history. The forms only had limited information though. SungHan only had limited time to log on from home to the secure Apollon Repository database and enter personal information. It was a lot easier for them to do from home, where they had access to past records, their medications, and the ability to contact their family members by phone or email for more information. They did have an opportunity to enter basic personal and contact information plus information about their current medications and recent health history, like the fact that SungHan suffers from asthma and has allergies to peanuts and penicillin.

Back in the doctor's office, SungHan completes the necessary forms, and signs a waiver at the bottom of the form to have his information added to his Apollon Repository profile so that it can be shared with his doctor at SungHan's discretion. The fact that the Blood Donation Center is networked to the Apollon Repository makes it a Distributed Health Check. SungHan has his blood drawn and heads home. The following week SungHan receives a phone call from his doctor's office. SungHan is a bit surprised, he hasn't been to the doctor in a couple months so he's not sure why they are calling. A nurse informs him that the recent blood sample showed a lower red blood cell count than previous tests. They'd like to follow this possible issue and hoped SungHan could stop by the Health Check diagnostic facility some time in the next week to give another blood sample.

Happy not to have to visit his doctor's office or the hospital, both of which are located on the other side of the community, SungHan decides on Tuesday he'll visit the Health Check facility located near the Transway Station on his way to work. Unfortunately, SungHan is running late that morning, having overslept. He decides that he'll have to forgo visiting the Health Check facility on his way to work, he'll have time during his lunch break. There's another Health Check facility located in the neighborhood where he works. With only a limited time over lunch to visit the Health Check facility SungHan hopes it doesn't take long. He notices only a few people in the waiting room and they're moving pretty quickly in and out of the office. Since Health Check only does patient testing, not diagnostics, patients are helped quickly, receiving shots, giving blood, having other vital signs tested. SungHan is called and gives another blood sample. The sample will be sent for further testing and the results recorded in the Apollon Health Services, available to his doctor for diagnosis. SungHan is happy that he's only had a brief interruption to his day.
Overview
Rural and undeveloped parts of a community often lack access to quality health services. What is provided is done on an as-needed basis. These citizens have no less need or right to such community services, though it has been difficult to find ways to provide services in these areas that often lack means of access or pre-existing infrastructure. Mobile Health Check, part of the Apollon Health Services system, provides regular access to health services, diagnostic capabilities, and treatment options. Part of the MobileAccess vehicle pool, Mobile Health Check has a series of testing and treatment facilities built into a large vehicle.

The key to Mobile Health Check services is the staged operation model. Initial visits are aimed at stabilizing immediate medical and health needs while also building an information base about citizens. This information is recorded in the Apollon Repository, just as citizens in more developed areas. Health information for citizens in these un- or underdeveloped communities is likely to be less robust. Citizens may have less information about past conditions or family history. It is still equally important to start to develop a comprehensive documented history for these citizens. Once immediate needs are stabilized, the Mobile Health Check starts to operate in a cyclical model that includes Testing, Diagnosis, and Treatment.

The first stage, Testing, focuses on collecting specific health information from citizens. Technicians collect and document samples of blood, bodily fluids, and other cultures. Basic medical measurements are taken, such as blood pressure, height/weight, and when necessary, x-rays. This collection of information is entered into citizen profiles within the Apollon Repository and also contributes to the second stage of the Mobile Health Check model.

The second stage, Diagnosis, occurs when the Mobile Health Check returns to the community center. At a larger scale diagnostic facility all samples and information collected can be analyzed, categorized, and

<table>
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<th>Properties</th>
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<tr>
<td>Mobile vehicle</td>
</tr>
<tr>
<td>Medical equipment, testing appliances</td>
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<td>Treatment supplies, educational material</td>
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<table>
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<th>Features</th>
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<tr>
<td>Collects information about citizen’s health conditions and history</td>
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<tr>
<td>Uses the Apollon Repository to store data</td>
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<tr>
<td>Enables access to basic medical services</td>
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<td>Collects health samples</td>
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<td>Communicates diagnosis and prescriptions</td>
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<td>Records medical history for extrapolating health patterns</td>
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<td>Conducts health awareness programs</td>
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studied. The benefit here is that at this stage the Mobile Health Check
vehicle can be visiting other communities and performing Testing
and Treatment activities. The vehicle should not go unused while
diagnostic activities occur, activities best completed at facilities that
have sufficient scale to be efficient and effective. Once diagnostics
are complete health professional create individualized treatment
plans but also seek to find community patterns, such as nutrition
needs or dental practices. Additional community-wide education and
awareness campaigns are developed to address wide-spread issues.

In the third stage, Treatment, the Mobile Health Check first stocks
the vehicle with pertinent supplies, medications, and educational
materials specific to the community they are about to visit. The
diagnostic results of stage two, and aggregated information from
Apollon Repository, create a checklist of materials that should be
stocked. Mobile Health Check vehicles do not need to worry about
having each and every possible supply or material on hand, freeing
up space for other useful equipment. Mobile Health Check arrives at
the community and commences the treatment activities. These may
include direct medical treatment for existing, documented conditions,
distributing prescriptions, and distributing educational information
about existing or predisposed conditions.

Overall, Mobile Health Check seeks to bring a more comprehensive,
long-term approach to health services in these under-served areas.
Citizens now receive tailored services aimed at stabilizing current
conditions, identifying predisposed conditions, and providing
preventative care.
Community

Mobile Health Check

Scenario
You Ae lives in a village in North Korea. Earlier whenever someone would fall ill in the village, they would have to go to the nearest town to consult a doctor. This often took time and was inconvenient. Moreover as far as general health education was concerned, there was not much awareness among the people in You Ae’s village. Since the last week, Apollon: Health Matrix system, a Community Service, identified the needs of this village and the Mobile Health Check-Mobile Apollon service has started making trips to Young Ae’s village. This mobile service conducts health related educational classes and fitness consulting. It also offers basic medical services along with nutrition related programs. At the blood donation camps organized by this service people are able to donate blood to this mobile service. Now Young Ae’s is gradually turning into a self sufficient place as far as basic medical services and health knowledge is concerned. The villagers are much more aware about health conditions and services available.
We live in a world where we “dispose” of waste. Realistically there is no disposal, but rather storage that focuses on a short-term patchwork solution and ignores the medium and long-term effects by burning, burying, and hiding this waste from the community’s view. This model is inherent to a system that considers our unwanted goods to be waste.

Revitalizer is waste management philosophy and set of tools that encourages the community’s treatment of waste as that of a resource. This illuminates the fact that citizens, businesses, and the community as a whole, all have a role to play in reducing waste levels, finding alternative uses for landfill-bound waste, and improving the natural environment in and around the community.
Overview
ManageWaste is a system of regulations, procedures, and organizations that support the efficient handling of disposables, reusables, and recyclables within the community. This system seeks broadly to control the amount of waste produced in the community by shifting the paradigm from waste as an end unto itself to waste as a resource that has value. The cycle of resources becoming materials and products becoming waste is not a responsible one. This cycle is one that will continuously deplete resource reserves, and quickly. Understanding our finite resources, along with the potential of waste as a resource will create a new paradigm. This responsibility is one that has to be born by all members of the community, distributed amongst the citizens, commercial enterprises, and the community government. Specifically, ManageWaste will achieve its broader goals by encouraging the reuse of products and materials that still have value, maximizing the amount of recyclable materials that actually get recycled, and maximizing the amount of household hazardous materials that are processed correctly.

The sub-elements of the ManageWaste system form a comprehensive approach to controlling and reducing the amount and types of waste produced, all along educating the public about more responsible waste and resource utilization. It is important to recognize that reusables are goods or materials that in their current form do not have value to their present owner but would to another owner, while recyclables are goods or materials that can be reconstituted to form the raw materials for new goods or materials. Finally, household hazardous materials are products such as batteries, electronics and petroleum products that require special handling to dispose of because of either their reluctance to breakdown over time or the damage the materials cause to the natural ecosystem.

MarketWaste is an online market for selling recyclables that are collected and processed by the community. Recycled raw materials are auctioned off to the highest bidder in the web auction section, or

Properties
• Waste handling system
• Set of regulations, procedures, and organizations

Features
• Supports the efficient handling of disposables, reusables, and recyclables within the community
• Encourages the reuse of products and materials that still have value
• Maximizes the amount of recyclable materials that actually get recycled
• Maximizes the amount of household hazardous materials that are processed correctly
lots are bought and traded with established customers in the sales section. The two immediate benefits are that recyclable materials are not being sent off to landfills and that manufacturers need not use up new resources to make their products. From the community’s perspective there is benefit as well. This marketplace creates a substantial source of income for the community to offset its waste management operations. Also, the recycling processing program offers employment to low, or unskilled, citizens.

While use of recycled materials is growing in favor, a certain stigma still exists that these resources are of lesser quality. While not the case, the public and commercial entities need encouragement and education. DiscountWaste is a set of governmental policies to encourage the use of reusables and goods made of recycled materials. There are two major components: (1) reduced or no sales tax for goods that are composed of at least 95% recycled materials by volume and (2) a “disposal tax” on all goods that are not recyclable. This places the end-of-life costs on the consumer rather than the community responsible for disposal of the item. This tax is similar to the “luxury tax” placed on automobiles sales for vehicles that do not meet minimum fuel economy standards in the United States. These policies will stimulate both citizens and businesses to look more closely at using recyclable materials.

DepositWaste is a monetary deposit program designed to encourage responsible disposal by citizens of electronics, household hazardous materials, and recyclables. The goal is to eliminate recyclable and hazardous material entering landfills. When a consumer purchases a product that qualifies for the program, a small monetary deposit is added onto the price. Consumers get the full deposit amount back when they return the electronic good to a community collection site for proper recycling or disposal. Modeled after the bottle return policies present in several US states, the idea is extended to cover batteries, electronics, and recyclables.
Overview
From a citizen’s perspective, either residential or commercial, waste is waste; a useless, unavoidable outcome of purchasing, using, and owning material things. WasteKits attempt to shift this opinion about waste by empowering citizens to better understand waste collection and to make an impact on this process. Waste can break down into multiple categories, organic, inorganic, recyclable, and reusable. All of these categories except inorganic can, and should, be treated as resources. However our current waste collection models still typically treat these all the same, which more quickly fills our landfills and dumps or even less formal collection places communities may use (e.g., open space, waterways).

HomeWaste and WorkWaste kits are collections of tools and products that fulfill three main functions. First to reduce the amount of waste being collected. Certain elements enable citizens to process waste at their residence that reduces the amount of waste the community must collect. The second function is to pre-sort waste. Other elements help citizens sort the waste prior to collection. Waste is exponentially more difficult to sort though once it has been aggregated at the community level rather than at the individual level. Sorting waste prior to collection this speeds the sorting that must happen at the centralized collection point. Finally, WasteKits educate citizens about the importance of respecting our resource supplies. By giving citizens the tools to control their own waste they not only assist the community’s waste management collection but enlighten themselves as to the importance of such practices, developing a further appreciation for the limited nature of resources and individual responsibility.

Properties
- Pre-assembled sets of collection and sorting tools

Features
- Empowers citizens to better understand waste collection and to make an impact on this process.
- Reduces the amount of waste being collected
- Pre-sorts waste
- Educates the citizens
Element Discussion

HomeWaste Kit empowers citizens to become an active participant in the waste and resource management process and are appropriate for single-family, multi-family, and large-scale residential structures. HomeWaste kits are distributed to residences in the community via the Community Resource Management Center. The kits include a series of tools: multi-colored waste bins for sorting waste for collection into recyclables, organic and non-organic waste, composting kits for processing organic matter at one's residence, and educational materials about the community's waste and resource management practices and the impact such programs can have.

WorkWaste Kits operate similarly to HomeWaste kits but for use by local commercial enterprises and businesses. These kits are customized to the needs of small businesses, taking into consideration the size and type of business. Some of the efforts are concentrated on the proper handling and recycling of paper waste, proper handling of office machinery service, resupply, and disposal, and finally managing office equipment to produce less waste and use less power (e.g., double-sided printing, energy efficiency settings). Businesses are encouraged to work with the community to develop practices tailored to their needs.
Overview
The CollectWaste is a networked waste collection system that operates with two core elements: **LittleTrucks** and **Mothership**. These vehicles work in concert in a local area with smaller LittleTrucks responsible for source pick up and delivery back to the more centrally-located, large-scale, Mothership. This process continues until all waste in the area has been collected. The range of scale of this system allows it to be useful in a variety of scenarios and communities.

Specifically, LittleTrucks, similar size to a golf cart, collect waste from curbside containers, public trash cans, alley-based waste containers. The LittleTrucks, and also the Mothership, support sorted waste collection, including recyclables, organic, and inorganic waste. This is enabled through use of the HomeWaste and WorkWaste kits, where citizens sort the waste themselves. LittleTrucks also can operate without Motherships where volume does not demand such a large-scale vehicle.

This system provides a number of benefits to the community, increased flexibility, limited disruption, and aesthetic improvement. LittleTrucks, because of their size, can go more places within a community, including back alleys, parks, and narrow pathways while not blocking roadways or intersections as large vehicles often do. Finally smaller, less obtrusive vehicles are visually more pleasant than large traditional garbage trucks, often seen to the point of overflow. As the waste management paradigm shifts even visual cues such as these will help reinforce the model that waste has value.

In addition to developed communities, CollectWaste is applicable in developing areas that do not have the physical infrastructure to support larger vehicles. LittleTrucks have a flexibility that allows them to navigate small pathways and tight turns. While the LittleTrucks can navigate within that type of area, such as a slum, Motherships can be waiting on the exterior. LittleTrucks also can be used for rural, less-dense areas, where operation of a Mothership to collect from a small number of sources across a large geographic range is not efficient. The LittleTrucks, in this example, may be the sole means of collection necessary.

Properties
- Networked, scalable, waste collection system

Features
- Provides flexible infrastructure, applicable in a variety of community scenarios
- Provides limited disruption to traffic patterns
- Allows for collection of pre-sorted residential and commercial waste
- Reduces visibility of waste collection functions
Community Resource Management Center (CRMC)

Overview
At the core the Community Resource Management Center is a centralized location that coordinates and processing of community waste (organic and inorganic), reusables, and recyclables. However the CRMC represents so much more, serving as a highly visible, progressive effort to efficiently handle and process waste while serving also as an education vehicle for improved community practices. The CRMC strives to maintain a clean, positive, citizen-friendly aura in high contrast to most communities’ view of their landfills, waste dumps and recycling centers, if even those exist in a community. By placing the focus on the “resource” rather than the “waste” the CRMC is fundamentally altering community’s outlook on these topics. The CRMC can be viewed as an economic and social service effort, providing employment for low-skilled and under-skilled citizens, paying special attention to individuals with long-term unemployment histories, homelessness, and citizens with physical and mental disabilities. The CRMC is made up of four core areas of responsibility.

MassCollect is department within the CRMC that receives waste, be it from the wastePODs, littleTrucks collection system, or from the community in general. MassCollect sorts materials into categories to allow for recycling, reuse, and energy production. It also serves as a collection point for the depositWaste program, and prepares what comes in for proper processing. While a seemingly basic functionality, without segmented collection and sorting processes and tools waste cannot be categorized for later reuse. Current waste management operations often fail at this step to identify and sort out potential resources, placing further burden on overloaded landfills.

ReuseHub is the department that collects reusables from the community, reconditions reusables for their new purpose, and coordinates reuse of construction waste. This department also manages the sale of reusable materials back to community members through the MarketWaste program.

Properties
• Visible, accessible community facility
• Single point of contact for multiple waste processing functions
• Educational facility

Features
• Coordinates waste management functions
• Strives to maintain a clean, positive, citizen-friendly image of waste management
• Broadens the definition of waste management to include resource awareness, education, and awareness responsibilities
Community Resource Management Center (CRMC)

**AllCompost** enables the CRMC to serve as a compost facility responsible for collection of compostable materials and preparation for reuse. These compostable materials come from the garbage collection and the sewage treatment plants. They are processed together in an efficient manner. It does this by ensuring aeration and mixing of the compostable material and the addition of microbes to speed up the decomposition process. Additionally, installed gas collection facilities collect the methane and other gases that are released during composting for electricity generation.

**Educator** is responsible for education and outreach efforts. This includes a variety of programs that target all segments of the community. This type of effort works across socioeconomic, geographic, and other demographic strata. Efforts are fine-tuned, whether it is efforts in developing countries to educate citizens how improper waste disposal can contaminate water resources or efforts in developed urban centers about electronics disposal. These efforts have been given the programmatic title of “Your Role, Our Community, Everyone’s Resources”, in an effort to highlight that resource management is both an individual, local and global issue. The CRMC creates both in-house exhibition and display spaces for visitors and school groups and conducts outreach at community locations such as Transway Stations, ServiceHubs, or using Mobile-On-the-Go vehicles for remote efforts.
Overview
Resource management entails not only proper use of the limited supply of resources that communities have available but also proper care for the environment from which those resources came and all too often the pollution associated with the processing of those resources. Greener seeks to balance out the harmful effects that mishandling of resource has caused, paying special attention to air and water ecosystems.

Tree Planting Programs seek to reduce the heat-island effect associated with urban areas, both developed and developing by planting trees in public spaces. Urban areas may have temperatures up to ten degrees higher than outlying areas due to natural surfaces being replaced with asphalt and concrete streets and sidewalks, residential and commercial buildings, and other structures. These issues negatively impact citizens, amplifying the risk of heat-related health conditions, increasing utility bills, and contributing to creation of smog. The fact that this program is labor-intensive is a strong economic development model, creating low-skill and unskilled jobs and training opportunities.

Community Rooftop Gardens can be placed on public, private or municipal buildings in order to control both temperature (heat-island effect) and air quality. These gardens seek to replace the common black tar roof with a garden of green plants. These plants help to improve air quality and CO₂-O₂ balance. They also reduce temperatures by reflecting heat and creating shade, and also cooling the air through evapotranspiration. Buildings are able to better regulate energy use because the gardens absorb less heat in the summer, keeping the building cooler, and insulating buildings in the winter. Finally the garden serves as a rainwater collection device, preventing water from entering the sewer system.
Algae Based Air Cleaners are a biological-based smog-reduction system used at commercial manufacturing facilities, or any structure, that emits nitrogen oxides and carbon dioxide. Harmful gases are passed through tubes filled with the algae that process the gases, effectively eating them. The variety of algae species available allows the system to tailor the algae chosen to the type of gas emitted. This technology, being tested by Massachusetts-based GreenFuel, is far less expensive than presently available technologies.
Scenario
Gitte and her children recently made a trip to the Community Resource Management Center (CRMC) to drop off a couple pieces of small furniture they no longer are using and do not have space for. They know that the CRMC’s ReuseHub will be able to find a better home for these items with someone who will be able to put them to use. Gitte does not think the items will need reconditioning, but she will leave that up to the CRMC workers who do an excellent job of repairing items before resale. Hans, her oldest child, has seemed to have wandered off and Gitte finds him in the CRMC’s Educator center. The current exhibition highlights all of the ways that individuals can make a difference within the community. Lately Hans has been learning about the environment at school and taken up the cause to be a more proactive young citizen. Upon seeing his mom, Hans immediately asks her why they do not have a HomeKit, to help them manage their waste creation and collection. Gitte isn’t quite sure what a HomeKit is, but after reviewing the information and sample items, she does not see any reason why their family should not request a kit that includes the Multi-Colored Bins, Composting Kit, and Educational Materials. It will certainly give Hans a more productive way of spending his time.

After only a couple weeks of use Gitte is glad that Hans prompted their family to receive a HomeKit. Her husband, Erik, along with Hans have taken an active interest in setting up the Composting Kit that helps the family dispose of organic waste and will provide a source of fertilizer during the spring planting season. The Multi-Colored Bins have also allowed the family to sort their waste into recyclables, inorganic, and organic waste. In fact, just yesterday a community waste collector complimented her on her family’s use of the HomeKit. He explained that the more families that use the bins the better the community’s waste management efforts operate, and making his job easier.

Since families are now more cognizant of their waste and also using their composters, his job as a waste collector has gotten easier. It also supports the new CollectWaste operating model that the community has moved to. As a waste collector he drives a LittleTruck, a new golf-cart sized vehicle that collects waste from a limited geographic area and then returns it to the Mothership vehicle, making the necessary amount of trips to complete waste collection for a neighborhood.

The Mothership, along with the LittleTrucks, then return to the CRMC MassCollect facility. Most waste is presorted, thanks to the HomeKits and WorkKits. It is quickly allocated for different ends. Unsorted waste is sorted at the CRMC and added to the presorted waste. Recyclable materials are sent to be processed at the recycling facility. The raw materials produced from this process will be sold online via the MarketWaste system, that sells lots of raw materials to the highest bidder. Reusable materials are sent to the ReuseHub where they can be cleaned, reconditioned, and/or repaired if need be. These goods will be either put up for sale, at a minimal price, or marked for pickup by citizens without economic means to purchase such goods. Organic materials are sent to the AllCompost facility. Here a large-scale composting effort produces fertilizer sold to consumers such as landscaping companies and gardeners. One regular customer is the community’s Tree Planting Program.

The Tree Planting Program uses the fertilizer at the sites where it is planting trees, shrubbery and greenery. The Tree Planting Program plants at sites such as community parks and Transway Planters. Recently the Tree Planting Program has been coordinating with the Community Rooftop Garden effort. As the community continues to develop it’s population grows and the amount of greenspace has been quickly eroded away, replaced with asphalt, concrete and any number of structures. The Community Rooftop Garden program has been encouraging citizens, businesses, and municipal agencies to install a gardens on top of their buildings to reduce the heat island effect and help balance CO₂ levels.
Citizen Planner

Citizens are seeing advances in technology and communication infrastructures providing more information but no more control over their lives. Regardless of a community’s place along the development spectrum we want our ideas and wishes to be heard and taken seriously. Communities need to empower citizens to take an active role in their development.

A community is essentially an interconnected group of citizens. Citizen Planner is responsible for fostering strong, active, healthy communities in which citizens are encouraged to participate in civic matters. In order to do this citizens must be given means to express themselves, access to information, and be encouraged to be part of the process.
Communicator

Overview
Communicator is a program that seeks to inform, engage, and encourage participation by citizens in civic matters. Citizens will feel empowered to shape the nature and direction of their community if given the means by which to do so. An engaged and empowered community will be able to better identify community and individual needs and develop services to meet those needs.

The elements of Communicator can be used across a range of communities, almost all being appropriate in any location or socioeconomic standing.

StreetStalls are interactive, public, outdoor displays that allow comment on planning proposals. Similar to Roadshows they are a means to encourage citizen participation and comment. These would be erected in central public locations, or at the location of a proposed initiative. They seek to informally engage passer-bys who otherwise might not have known, or sought additional information, about the issue. The public can comment, either via a computer terminal or handwritten means, on the proposed issues.

Video Soap Boxes are publicly erected video project screens that broadcast recorded comments from citizens. These screens are typically located at centers of public activity; markets, transportation centers, government offices. They create an informal means for citizens to have a voice, a voice that can be heard by many people. Citizens have the opportunity to record their comments at the base of the structure. Comment may be on public life in general, a specific issue, or timely topic. The recorded comment is then broadcast, along with other citizen’s comments throughout the day. In addition to providing a forum for citizens it brings such issues to the forefront of public life, stimulating engagement and discussion.

MayorTalk offers citizens a periodic “open-door” meeting with community and government leaders. It encourages each and every

Properties
• Programs, policies, and physical infrastructure

Features
• Encourages citizens to express their opinion
• Reassures citizens that their voice in being heard
• Stimulates community discussion and awareness
• Solicits and collects feedback on proposed community initiative
• Aligns community opinion and need with government planning efforts
member of the community to voice their concerns directly with the community leadership. Too often citizens believe that their community leadership is not representative and not listening to their needs. This forum should allow for a more open, transparent relationship between those creating and enacting policy and those citizens they are doing it for.

Roadshows, based on an idea from the New Economic Foundation, are travelling exhibitions that showcase community development plans and initiatives in order to solicit public feedback. Roadshow relies upon the MobileAccess vehicles, creating arenas in which citizens are able to view plans, make public comment, and participate in forums designed to solicit feedback and generate alternative ideas. The travelling nature of the exhibition ensures that all members of the community, regardless of location, have an opportunity to comment.

Communicator Vote is a non-binding voting mechanism that allows citizens to vote on planning proposals. Through the variety of communication vehicles within Citizen Planner, planning proposals are introduced to citizens with opposing arguments. After reading the issues involved citizens can vote on the proposal. The votes are tabulated and delivered to the appropriate parties as feedback. In certain mediums comments will be able to be attached to the vote to gather richer information. Communicator votes can also be used by government officials to receive feedback from their citizens on matters affecting the community.
Overview
In addition to making sure that citizens can have their voice heard and listened to it is important to enable citizens to be active in creating and developing ideas that will shape community social, development, and economic policy. Citizens, in groups or as individuals an excellent resource of ideas, as government and leadership.

Citizen’s Planning Guide is a print and online resource allows citizens to understand the community planning process and how they can participate in it. The Guide is a detailed, step-by-step resource that offers instruction, tools, and templates so that citizens can develop their ideas, solicit public opinion, submit ideas to the community government. The Guide includes copies of the community’s guiding principles, long term goals, and master plan, if so developed.

The Community Planning Council is a designated public body tasked with producing plans and policies for a community. It draws its membership from the from four key groups within the community: the local government planning authority, community groups, key agencies, and citizens. Its responsibilities are to guide the evolution of the community through the development of policies and projects, foster sustainable development, oversee the suggestion, creation and evaluation of initiatives, It however is not responsible for overseeing implementation.

Properties
- Companion for citizens to the community development process
- Print and online resource
- Advisory body

Features
- Encourages citizen participation
- Ensures citizens have an easy and understandable experience in community planning
- Represents communities broad variety of opinions
- Provides advice and counsel during the process
Overview
Citizens need to have access to information about their community in order to feel a part of it. This information though needs to be presented in a variety of compelling mediums to ensure that all citizens not only have access to it, but are engaged by it. While the Involvement system allows citizens to share information with other citizens and the government, the Notifier system of elements is a way in which the community government can inform, educate, and encourage citizens through compelling, accessible mediums.

Notifier is a series of communication mediums and information forums that allow the community government, agencies, and groups of citizens to communicate important, non-emergency, information with the citizenry. Some elements of Notifier do require a more developed technology and communication infrastructure, but there are also elements that accomplish a similar function for less-developed communities. Information access and distribution is important in any type of community.

eCommunity is an online community forum structured around government operations and community forums. Individuals are able to access information about municipal, civic, and government services. Where applicable, citizens can make transactions and get in touch with government personnel. Additionally eCommunity serves as a location to publish information about community events, developments, issues, and warnings. By providing updated, relevant, authoritative content eCommunity ideally becomes a key node in a citizen’s information collection, along with other internet sites, email, and the news media. Citizens also will have the opportunity here to interact in topical forums. For individuals who do not have access to a computer within their home, eCommunity kiosks will be placed around the communities in PODs, ServiceHubs, Transway Stations, libraries, and other locations. This provides access to eCommunity to all citizens, even in communities with a varied, or under-developed infrastructure.
**Reverse311**, similar to Reverse911, Reverse311 is a mass telecommunications broadcast method but for non-emergency information. Reverse311 could be used in instances such as school closings, public transportation breakdowns, or local community planning meeting announcements. Reverse311 allows the government and other groups to ensure that citizens have access to important information they otherwise would have missed. Reverse311 can operate through email, phone (cellular or analog), fax, pager, PDA or other technology in developed communities. While in less-developed communities information can be broadcast via the commPOD’s LED screens and audio speaker system. Also designated radio frequencies, Transway Stations, and even OffGrid Warning Sirens could be used if information was critical enough.

**Video Soap Boxes** were previously described as a means to broadcast citizen opinion. They can also be used to broadcast government, civic or municipal information.
Scenario
Claude, a longtime community resident, has watched the vacant lot at the end of his block go unused for about two years now. A residential development plan stalled and no other progress has been made at developing it. It now lies vacant for sale, as it has for months and months. Claude recently got an idea while commuting to work. He was at the Transway Station listening to the broadcast over the Video Soap Box. This one really caught his attention. The speaker, a woman who appeared to be in her mid-30’s was talking about the need to retain the natural, environmental health of the city. On the bus headed to work Claude got an idea; the vacant lot at the end of his block should be turned into a community garden with a park. That would provide residents a place to play, interact, and harvest vegetables.

On his way home Claude stopped at the Transway Station for a couple minutes to record a message on the Video Soap Box. He just wanted to get people thinking about the idea and maybe that other, better alternatives existed. Upon arriving home, still feeling inspired, Claude logged on to the eCommunity website. He posted a new forum topic, where other residents could read his idea and post a response. Claude included his name and contact information in case anyone else was interested in his idea.

Within a few days Claude’s post had been read by dozens of fellow citizens. While not all agreed that a park was the best idea, there was a very supportive majority. A couple days later Claude even received an email from Celeste, a recent college graduate who studied urban planning and environmental policy, who was very excited to talk further with Claude about the plan. Claude and Celeste agreed to meet and became even more excited about the idea. They agreed to consult the Citizen’s Planning Guide to determine how best to go about making their idea a reality. The Citizen’s Planning Guide instructed them on the inner workings of the community government, what it took to submit an idea for consideration, how best to promote the idea, and what they could expect of the process if the idea is accepted. It all seemed simple enough to Claude and Celeste, who drew up an initial proposal according to the template provided at eCommunity.

Celeste suggests the two seek a bit of professional advice and visit the community Parks Commissioner next week during the MayorTalk session. Claude has never had any reason before to visit the community government and administrative offices on this day when the officials meet publicly with anyone who is interested. However he thinks it is a great idea and Claude and Celeste find themselves in line to speak with the Parks Commissioner less than a week later. There certainly are a number of people at the government offices today. Claude had no idea how popular MayorTalk was with the citizens. Their line is moving fairly quickly, as conversations are limited to a short period of time, and honestly the Parks Commissioner is not that popular a figure to speak with. Claude and Celeste are granted a chance to speak with him and show him the proposal they have drafted. The Parks Commissioner compliments them on first their appropriate use of the Citizen’s Planning Guide and its supplied templates. He is very quickly able to assess their idea and give them some feedback. The biggest challenge for their idea is raising funds to purchase the land, but if Claude and Celeste can form a non-profit organization to manage the site, raising income through sales from the community garden, then the community might purchase the land and lease it to their organization at a very nominal cost.

Claude and Celeste are pleased with their time at MayorTalk and go about revising their plan. OurPark, a slightly corny but accurate name is the name for the fledgling effort. Their next step is to go before the Citizen’s Planning Council, a group of government employees, community group members, individual citizens, and other significant figures. Claude and Celeste are seeking approval from the Council to move forward with their idea. They have already gotten an adequate number of signatures on their petition, as instructed in the Citizen’s
Scenario Continued...

Planning Guide and have scheduled time at the next Council meeting. Their short presentation goes well, the Council, an informal body, quickly surmises that the two have made a strong case for moving forward. Claude and Celeste are aware that the Council's approval does not mean that the idea is going to happen for sure. But they now receive resources to create a StreetStall and collect feedback from the public. They are provided with the StreetStall kit, a kiosk-like display system that they will erect at the site of their proposed idea. The StreetStall has room to post written information, drawings, diagrams, budget, and timeline information. Also included is a very basic computer terminal that allows citizens to make comments after they review the proposal.

Claude and Celeste were also granted permission to create a message to be distributed via Reverse311 to their neighborhood residents about the proposed plan, asking for comment. They submit the short message and within a couple days the Reverse311 system sends out a recorded communication, via both email and phone, to the targeted residents alerting them to the proposal and the erected StreetStall located at the vacant lot. Over the course of the next week Claude and Celeste notice citizens stopping by the StreetStall, they have even heard discussions about it while shopping in the community and taking the bus to work.

The Community Planning Council, along with Claude and Celeste are privy to the comments made at the StreetStall. A month later at the next Council meeting the Council presents a summary of the findings, that Claude and Celeste can contest or accept. The Council though presents an opinion, siding with the feedback received, that the idea is a very good one. The Council votes to approve the agreement by which the community will purchase the land, granting Our Park the land in exchange for a long-term lease.

Our Park, and Claude and Celeste, still have a lot of work to do. They will have to motivate fellow citizens to help restore the vacant lot, building necessary plant beds, set up a means to allocate the space and more. But they are hopeful and want to see the effort through. While it has taken some work it has been exciting for them to take an active interest in their community and to see how that has infected their fellow citizens with hope for this once-vacant lot. Based on the feedback they have received they are sure they will find even more citizens who want to take an active role in improving their community.
Conclusion

Solutions must be woven into the fabric of our communities, not merely placed on top of existing infrastructure and services. These solutions strive to integrate different facets of community life creating cohesiveness instead of increased complexity.

(mesh) Community enables community functions to be a more integral part of a citizen's daily life - increasing the access and availability of services, and distributing functionalities throughout the community.

Communities need to instill awareness, a sense of pride, and a renewed sense of faith in the capabilities that individuals citizens have. The greatest changes will not be given to or implemented in a community, but rather built by empowered, educated, and inspired citizens.

(mesh) Community empowers individuals to have a greater sense of community. It recognizes that individuals can make a valuable contribution to the community and enables them to participate with an increased sense of personal responsibility.
Communities should strive to be proactive and forward-thinking, focusing on sustainable, adaptable and systemic solutions. Resource paradigms need to shift to broader definitions - where all resources, natural, man-made, or intangible, are too valuable to be misused.

(mesh)Community encourages the responsible, sustainable use of resources and the appreciation of those resources. Meshed networks of infrastructure and utilities allow communities to make more efficient use of limited resources by promoting distributed utility generation and distribution, increasing resource recovery, reuse, and recycling.

The pursuit of knowledge is a laudable one, but it only when knowledge is shared does it reach its greatest potential. Individuals within a community should strive to be educated, but communities must also strive to use that knowledge for communal good.

(mesh)Community values the implicit and explicit knowledge of individuals, groups, businesses, government, and other communities. Collecting, analyzing, and making information available are crucial community responsibilities. Finally, communities must ensure access to this information regardless of status, location, situation.
Solutions should be proactive not reactive, allowing for growth and development, not merely survival. We should overcome not just what plagues us now but build for the future.

(mesh)Community empowers communities to increase stability, increase development, and manage growth through solutions that acknowledge individual communities have a unique socioeconomic status, geographic location, and culture. Solution modules are designed to allow selection of elements appropriate to a given community, that meets the needs that community has.

Aging infrastructures and an increased reliance on non-redundant technology have made us vulnerable. Combined with the identified threats there is reason for concern. Communities need to have systems that allow for stability even in the face of daunting circumstances.

Meshed networks provide communities with delivery systems that have the redundancy needed to provide fail safe operation in the face of errors, damage, or disasters.

...for almost a year Jose used his water cart and pump to collect his water. He would have enough water on one trip for two days, approximately 50 gallons. Jose’s neighbor Taylor on the other hand used the same water pump but used water bags to carry water from the source to his home. The bags were helpful because his neighbor was able to use the handle on the bag to carry back. Taylor was also short on space. When he was finished with a bag it could be collapsed for storage for use later. The water cart took up too much room...

...this program creates a series of response protocols that leverage the infrastructure of the commercial businesses in the area. SupplyNet will allow Jacob’s community to have predetermined suppliers of resources at times of emergency need. These suppliers will be paid for their goods, but what helps so much is having this relationship predetermined. Every year it’s very hard scrambling to get water, food, and other basic supplies delivered in a timely manner...
Our communities are in danger - urban or rural, developed, developing or under-developed, rich or poor. Some of the threats are explicit – natural disasters, economic upheaval. Some are less obvious – growing populations, increasing expectations. Finally some we simply refuse to admit – resource mismanagement, global warming.

The situation is not without hope. On a daily basis we are developing technological advancements, developing global partnerships, and sharing information. However, we still view the threats we face as singular issues that we can isolate and solve - if we think long enough and hard enough on any one issue the solution will present itself. That paradigm must change.

The threats we are faced with are not isolated, they do not develop alone, but rather in concert, exponentially. It is the appropriate time to recognize that solutions must be of sufficient scope to address this combined threat. We must unite our capabilities. We must come together as collections of individuals.

The strongest existing bond we have is the community belong to. This is not only a manageable level at which to effect change, but it is on at which individuals can see their actions making a difference. Community has an inherent definition we all are familiar with – despite different backgrounds, vocations, cultures, we have a common bond, a united sense of purpose.

Community believes that at the community level we can face these combined threats. We must recognize though that the responsibility for this belongs to us all though. And that only by understanding and leveraging the inherent commonalities that weave between our communities’ issues and solutions.

Community is a series of interrelated and interdependent systemic solutions that enhance communities, first by sharing responsibility; empowering all community citizens to participate actively in the operation and development of their community - and second, by interweaving functionalities. Ensuring creation, storage and delivery of community services and the certitude that utilities are efficient and sustainable.