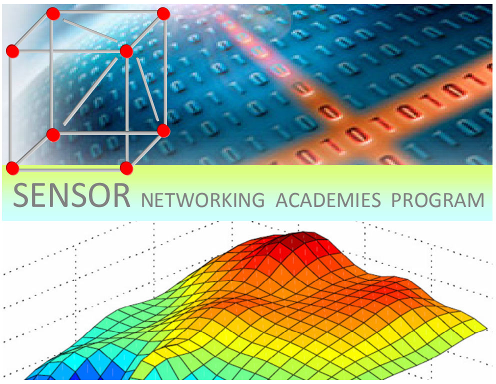


ENERGY, HEALTHCARE & RETAIL convergence: LIFESTYLE SYSTEMS

SNAP — SENSOR NETWORKING ACADEMIES PROGRAM

	Description	Comment
Goal	Accelerate the diffusion of the concepts of [1] energy conservation and energy efficiency [2] healthcare monitoring and preventative medicine using ubiquitous computing achieved from deployment of sensors.	[1] Advances in micro-metering may be catalytic to drive the return on investment for the smart grid. [2] Without remote monitoring and preventive healthcare, the cost of healthcare may be a problem.
Outcome	Hands-on experience and education about sensors and dynamics of energy [sensors for monitoring usage, optimize energy efficiency] and preventative medicine (remote monitoring).	Grass roots approach and an academic-industry channel to share science and data for issues on energy and climate change. Applicable for healthcare issues.
Aim	[1] Improve teaching of physics, mathematics [2] Demonstrate use in energy and healthcare [2] Build consumer awareness and market demand for sensor networks, tools and services. [3] Workforce creation and job re-training	SNAP is aimed for school and college students as well as job re-training programs, in much the same way that John Morgridge of Cisco Systems started the Cisco Networking Academy[1] in 1996.
Target	[1] High schools [2] Tertiary institutions [3] Workforce re-training	Potential to engage with local and state authorities that may access stimulus funds for job growth and entrepreneurial innovation.
Investment	[1] Seed to implement the first Academy [2] Support academic-industry partnership	Foundations and corporations as sponsors.
Commercial	**LIFESTYLE Applications: See Convergence of SINS**	**http://esd.mit.edu/WPS/2007/esd-wp-2007-17.pdf**

[1] Cisco Systems initiated Cisco Networking Academy (1996) in liaison with Thurgood Marshall High School (TMAHS) in the San Francisco Unified School District, with help from a talented teacher (Dennis Frezzo) and the then visionary Chairman of Cisco Systems (John Morgridge). It gained worldwide acclaim and cited by the White House as a key instrument of IT workforce creation. It was widely disseminated (www.catholiceducation.org/articles/education/ed0026.html) and the cover story of US News & World Report (2 December 1996). A decade later, we have moved ahead from 'computers' as boxes and 'network' as the transmission backbone to pervasive or 'ubiquitous' computing as a function for providing business services. Hence, SNAP.

Problem based Innovation a Catalyst for Demand Creation & Market Growth

Dr Shoumen Datta, School of Engineering, Massachusetts Institute of Technology, Cambridge, Massachusetts 02139, USA

Is there a problem?

US debt may reach $20 trillion by 2020. It may seem ominous because numbers are relative to the size of the economy and $20 trillion in debt is about 90% of the projected US gross domestic product [2] in 2020. In 2000, there were 4,058,814 new babies born [3] in the US. By 2020 they may be on the verge of joining the workforce in a year where US debt-to-GDP ratio is predicted to approach 90%, if conditions remain unchanged. Last year the debt-to-GDP ratio for Greece was 115%. Are the riots in Athens is the writing on the wall for the US in 2020?

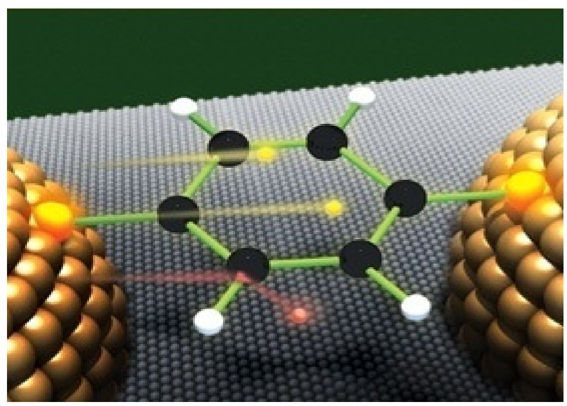
Should we extrapolate?

Are the horrific events in Greece a predictor for what may be in store for the US in 2020 or sooner or later? Predictions about the future are difficult but this one is easy. No. US history offers a different perspective. US debt-to-GDP ratio was 109% in 1945 at the end of WWII yet the country escaped the public wrath that spilled on the streets of Athens in 2010 due to a ratio close to the US figures in 1945. Ask why. Innovation is one answer.

Why Innovation?

The illustration below may offer clues why the fate of Greece may not be an indicator for the US.

Riot police outside the burned branch of Marfin Egnatia Bank, Athens, where 3 people died on May 5, 2010 [4]



New molecular transistor made up of a benzene molecule linked across gold electrodes.[5]
Hyunwook Song, Takhee Lee and Mark Reed, Yale University (2010)

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[2] www.washingtontimes.com/news/2010/mar/26/cbos-2020-vision-debt-will-rise-to-90-of-gdp/

[3] www.cdc.gov/nchs/data/nvsr/nvsr50/nvsr50_05.pdf and www.cdc.gov/nchs/pressroom/02news/womenbirths.htm

[4] www.time.com/time/world/article/0,8599,1987368,00.html

[5] http://news.discovery.com/tech/molecular-transistor-benzene.html

What is the solution?

Innovation. Soon after the end of World War II in 1945, the US and the world witnessed the birth of the transistor in 1947 in New Jersey. In 1953, scientists from US and UK proposed the structure of DNA. In 1954, at the Bell Labs in New Jersey, Charles Townes [6] discovered first the maser and then the laser. These innovations ushered in the new world economy that is currently valued in excess of $50 trillion. The market capitalization of the top 10 US companies alone approaches $1.5 trillion in the information technology industry [7] which was made possible by the transistor. The top 10 bio-medical companies [8] reported revenues in excess of $500 billion in 2006, empowered by bio-technology [9] which rapidly evolved in the US following the discovery of the structure of DNA in 1953.

How can innovation catalyze change?

The lessons from innovation form the foundation of the US economy to recover and grow. However, the nation continues to struggle to implement practices that may stir imagination and empower innovation. Part of the reason is the chasm that separates public education from the national challenges, e.g. health and energy. Any responsible citizen will concur that innovation, invention and imagination are necessary to address the future of energy and healthcare. Yet, it may be difficult to find any significant initiative in the 100,000 public schools in the US or any exposure of the 50 million students [10] to the issues that will shape their future and our destiny. This is the change that must be sought. Infectious innovation must be seeded in a manner that percolates the science, technology, engineering and mathematical (STEM) issues related to the national challenges through the public education system. The creativity latent in the 20 million or more high school students in the US is a resource which remains largely untapped. On 12.21.2010, US House of Representatives approved HR 5116, the America Competes Reauthorization Act [11] which provides $40 billion in support for research, STEM related education and innovation.

How to accelerate change?

We suggest modest beginnings which mimics, in principle, the success of the Cisco Networking Academy which, in 1996, introduced to US high schools the elements of networking as a tool for the information age. Using project based hands-on learning, we propose [1] the introduction of remote health [12] monitoring to improve personal health and [2] energy monitoring to reduce energy [13] use as well as a reduction in greenhouse gases.

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6 www.physics.ucla.edu/~ianb/history/

7 http://en.wikipedia.org/wiki/List_of_information_technology_companies_by_market_capitalization

8 http://en.wikipedia.org/wiki/List_of_pharmaceutical_companies

9 www.genengnews.com/gen-articles/twenty-five-years-of-biotech-trends/1005/

10 http://nces.ed.gov

11 http://thomas.loc.gov/cgi-bin/bdquery/z?d111:H.R.5116:

12 http://esd.mit.edu/WPS/2008/esd-wp-2008-17.pdf

13 http://dspace.mit.edu/handle/1721.1/53329

Justification and Assumptions

[1] The focus on energy and health need little justification in view of the global and national challenges. Those who seek justification why pre- and post-collegiate students may engage in these endeavors (and the obvious challenges it will present) may also wish to consider the following:

[a] knowledge percolates downward with time or in other words, material once believed to be a 'frontier' in research or for the elite, will, over time, finds its way into secondary and elementary text books in public schools

[b] K-16 is the tier 1 of the supply chain of 'adults' who will face the consequences of energy and healthcare

[c] resistance to adopting benefits of technology is proportional to age if one lacks prior educational exposure

[d] the existing knowledge economy is sluggish in its attempt to foster the mythical 'innovation society' partly because partitioning of knowledge and selective dissemination (in K-16 education) continues to breed social injustice by cementing the gulf between knowledge 'have' and 'have-nots' in a manner resembling the elusive quest for the 'bridge' which technology was supposed to build.

[2] The emphasis on health rather than healthcare is rooted in the observation that K-16 education serves the population which may be disinterested in the national health*care* debate. The prevalent opinion is that the latter is for politicians, bureaucrats, hospitals and seniors seeking treatment. At the heart of K-16 effort, therefore, is a nuclear interest in personal health rather than health*care*. Hence, education catalyzes the paradigm shift from health*care* to health. This shift will guide how to develop health related initiatives which will, ultimately, provide health*care* related benefits, without which the K-16 initiative may be yet another purposefully diluted feel-good exercise. Hence, in principle, the K-16 health initiative must adhere to a vision, which, at least in part, must be reproducible, scalable and sustainable in order to be deemed successful. The degree to which the vision may be executed is understandably limited by the type of health models which can be implemented with available resources and contribution from academic partnerships as well as inclination of corporations to form alliances.

[3] Energy requires the least justification due to its pervasive impact on daily lives commencing with the electric tooth brush in the morning to the water-jet floss before bed-time. The sources and the network that drive the energy to these devices are largely unknown to most secondary school students. The expectation is to trigger imagination about sustainability and accomplish defined tasks where the fruits of technology may be used to improve energy conservation and GHG reduction. If other forms of creativity arise in the process, even better.

[4] Risk pooling of both efforts on a shared platform provides a common use case (remote monitoring) through the deployment of wireless sensor networks (WSN). Convergence of data acquisition and transmission using the principles of WSN is applicable across a broad spectrum of verticals including healthcare and energy. WSN is a widely supported engineering system with a deep knowledge base and curricular support for rapid integration.

[5]Embedding innovation as a project in a secondary system is expected to spur entrepreneurial activities which will add to the portfolio of anticipated outcomes. The vision (see Appendix 1) of health and energy are service-centric. It requires human-computer interactions, virtualization and visualization software for devices (iPhone). The application must also offer robust transactional security in order to be commercially viable and profitable.

Description of Work Package [1] Health

The simple yet powerful demonstration of bi-directional data flow is central to future healthcare to reduce cost of operation. Inextricably linked to flow of data is the question of analysis or ***sense and response***. The question of analysis may never be 'solved' because analysis will continue to grow as more and more relationships, links and cross-references are uncovered. It is possible, however, to provide a subset of analysis for the proposed project by focusing on a few select parameters. This is the suggestion for this project in order to demonstrate the sense and response scheme due to bi-directional data flow. The proposed project scenario is as follows:

[1] student running on a treadmill serves as the data source for key parameters eg heart rate and blood pressure

[2] real-time readings of the individual are transmitted using wireless or wired sensors (heart rate, BP)

[3] data transmission uses a dedicated gateway for the specific data type (heart rate, blood pressure)

[4] uploads to existing common WLAN infrastructure (no new investment in infrastructure)

[5] via the internet the data arrives at a clinic or hospital site which is monitored by a human or a software agent

[6] data analysis limited to select parameters and narrow definitions of 'normal' heart rate or blood pressure

[7] upon completion of training, individual receives a work out summary and physiological report on her iPhone

[8] in a simulated scenario the heart rate is increased which creates an 'alert' for the medical practitioner

[9] alert response is also transmitted to individual in school (iPhone) and designated administrator or guardian.

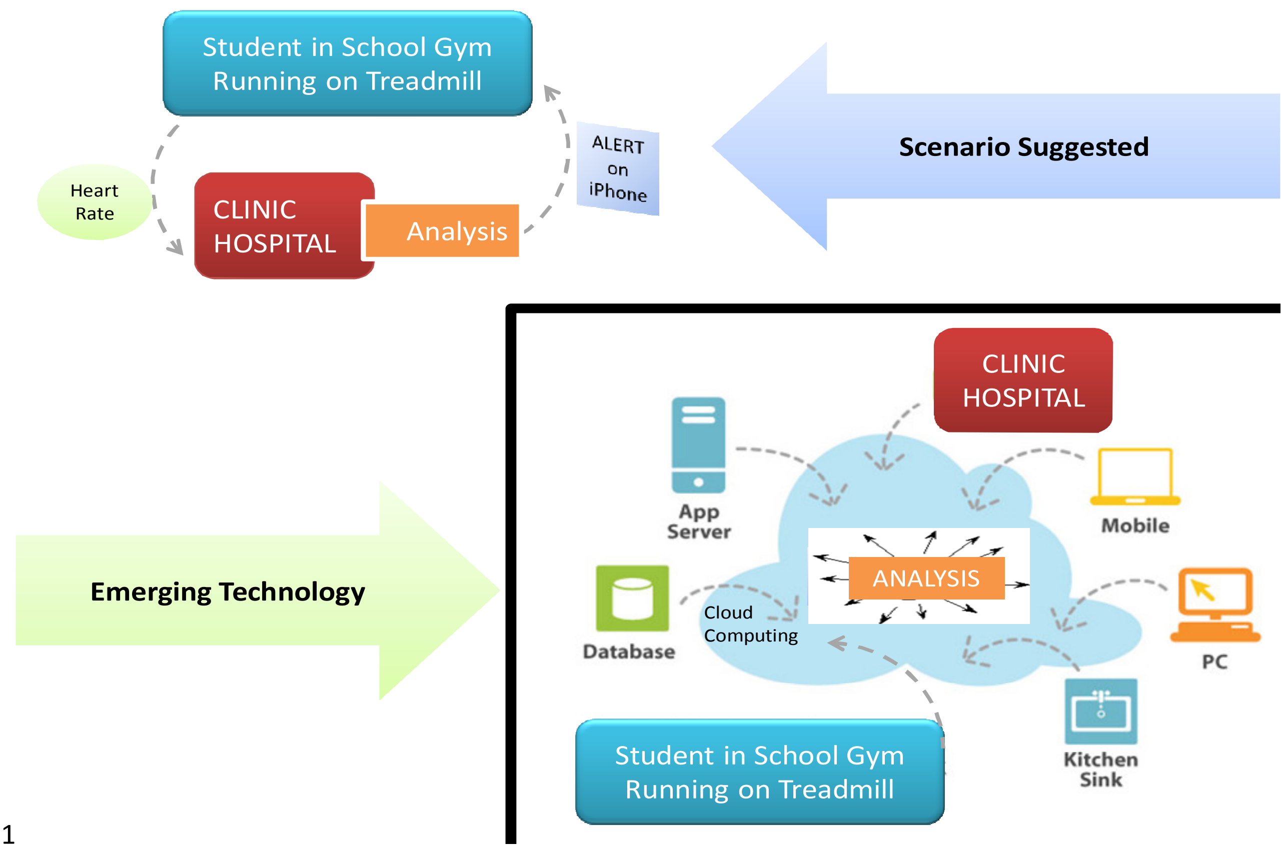


Fig 1

Illustration in Figure 2 (below, right) from commercial sources support the suggested scenario to monitor heart rate and blood pressure using wireless sensors as data acquisition tools (heart rate, blood pressure)and wireless sensor networks (WSN) as data transmission medium connecting through a gateway and internet to the clinic. In an academic version (see Appendix 2) a similar *modus operandi* is presented to address the future of healthcare.

The caveat in this scenario is unauthorized visibility of the data which poses a privacy issue unless the individual is indifferent. The assumption in this scenario is that the data from an individual during an exercise session will remain anonymous and that the data *per se* is of no value because the data is not archived or linked with an id.

However, the ability to create secure data transmission is the eye of the storm in public debates on privacy in healthcare. Various attempts are underway to secure electronic medical records (EMR). The problem presents an opportunity for uncluttered minds in secondary education to take a fresh look at data security with new eyes. With experts as mentors, this is an area where innovation may generate a disruptive technology or tool which may change the way EMR security is handled in future. This is not within the scope of the proposed project but certainly could be a defining moment of this project if students may take an interest to explore this quagmire.

Suggested K-12 scheme for Work Package [1] Health is congruent with commercial as well as academic vision.

Operational scheme for **Work Package [1] Health**: Mobile bidirectional data flow from school to clinic. Alerts and notifications.

Fig 2

Ecosystem of Work Package [1] Health

Implementing the health scenario schematically illustrated in Figure 1 (top left hand corner) is simple if one knows the various elements that must converge. The outcome is a tangible process with explicit data trace. However, the benefit to students and secondary education is not only a project with real-world impact but a plethora of outreach as a result of this endeavor, if appropriately orchestrated. Table below offers a partial list.

Academics	Vocational - Careers	Partnerships	Infra-structure	Technology
Physiology	Student Internships	Hospitals	Sensors	Gateway Node
Nutrition	Respiratory Therapist	University	Wireless LAN	Communication
Genetics	Sports Medicine	Medical Schools	Monitors	Device to Device
S T E M	Paramedic Aide	Phillips - Orion		Mobile to Mobile
C S / A I	Bio-engineering	Google		Secure WSN
	EE / Mechanical Eng	Apple		Data Security
	Network Specialist	CISCO		Virtualization
	Software Applications	AT&T		Visualization
	Programming	GE Healthcare		SOA / Mobile Apps
	RDBMS	UN/UNDP/WHO		Cloud Computing

Work Package [2] Energy

Simpler to implement than health scenario yet robust return on investment due to monetary savings from reducing energy consumption by improving energy efficiency (Appendix 3) based on the principle of energy conservation. The tools are sensors and wireless sensor networks. Hence, shared grounds with health initiative.

To conserve energy the lowest common denominator is preventing waste. Unfortunately, public schools in the US waste about 60% of energy due to failure to turn off appliances and HVAC when unused or unnecessary. Dependence on personal responsibility to prevent waste in public buildings has proved to be somewhat of an oxymoron. The solution at hand is to 'sense' the need (too hot, too cold, occupied or unoccupied) and trigger automated action (on/off) based on data analysis (wireless sensor data for temperature, humidity, occupancy).

This project is a matter of execution but the challenge is to first educate and then train students to implement. The commercial viability of energy conservation is well documented. Hence, the resistance from corporate partners to 'teach' implementation of energy conservation using WSN may be an issue. The latter may call for academic partnerships rather than corporate alliances. Illustrations in Figure 3 represents a typical function, generic user interface and wireless sensor technology expected to be installed as a part of this implementation.

Sensor networking using bio-medical (heart rate, blood sugar) or energy related (temperature, light) sensors use the same principles of physics and engineering. The interpretation of data and response creates the difference. Communications network are identical in both cases because its sole purpose is to transmit data packets. Hence, a certification scheme for secondary students trained in sensor networking (see Appendix 4) is likely to help in skilled workforce development as well as job readiness. It also represents, in theory, the potential to embed principles of ubiquitous computing in public education and lead to market growth for energy business services.

Work Package [2] Energy: Conservation, Waste Reduction & Decreasing Consumption using Wireless Sensors

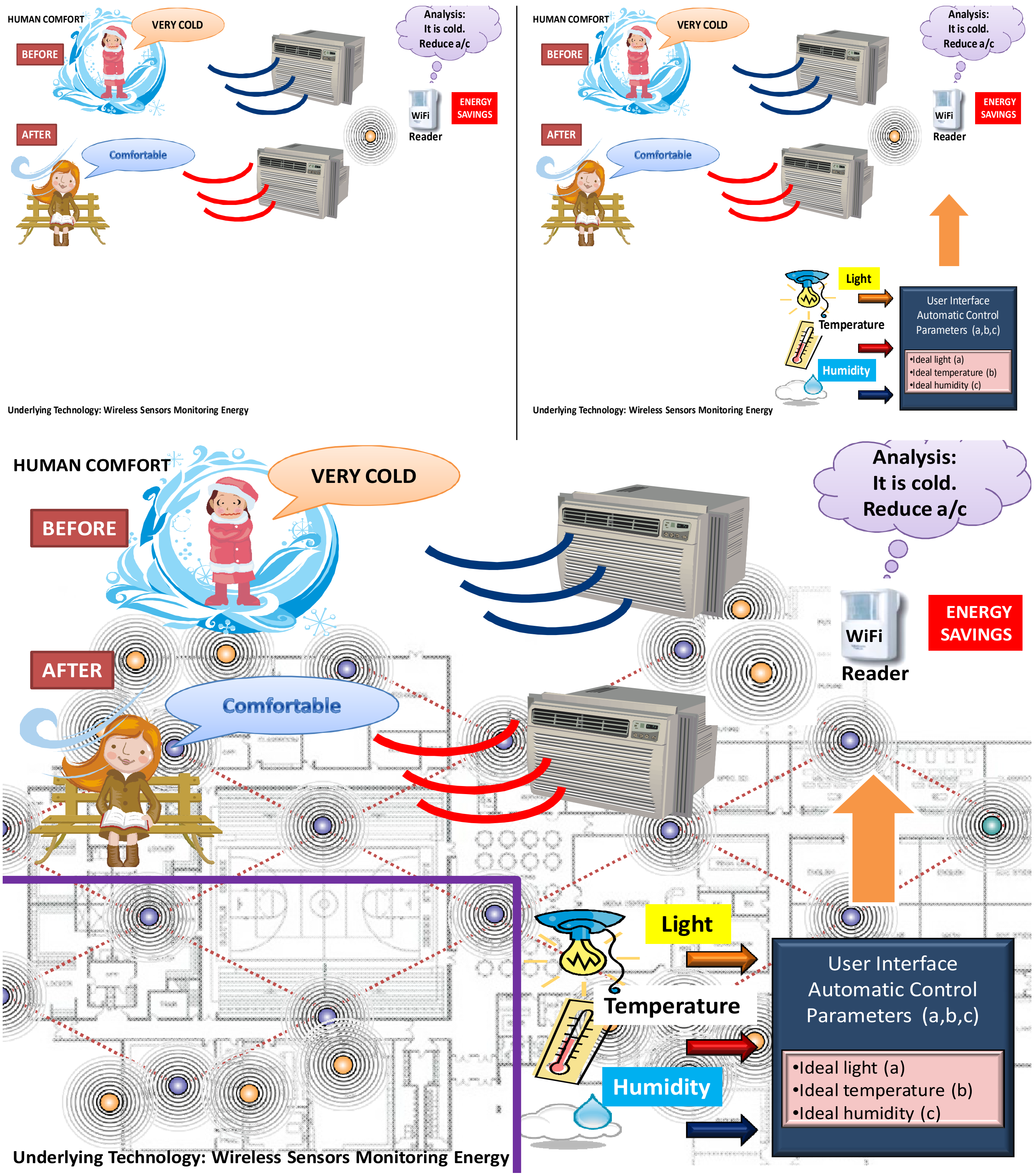


Fig 3: Implementation of energy conservation serves the function of human comfort. The interface to control basic parameters may be on a PC or mobile device (iPhone). The underlying technology uses wireless sensors.

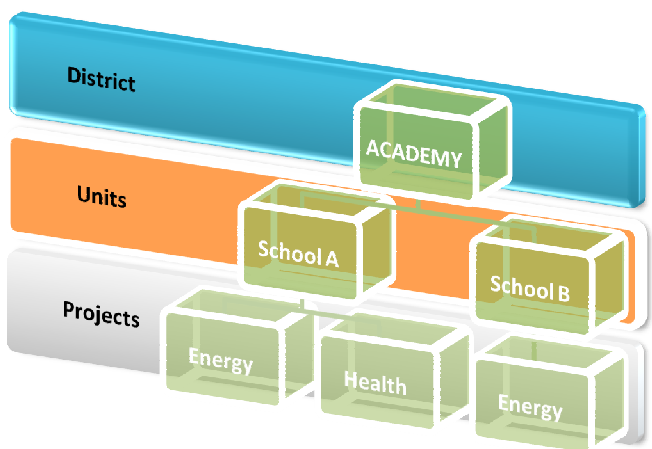
Ecosystem of Work Package [2] Energy

Complex inter-relationships between energy forms and its economics are difficult to comprehend but that should not preclude the topic from secondary education, particularly since innovation is key to energy and sustainability. This project aims to stir the academic discussion but focus on the topic of conservation and implementation of energy efficiency schematically outlined in Figure 3. The energy ecosystem includes:

Academics	Vocational - Careers	Partnerships	Infra-structure	Technology
Physics	Student Internships	University	Sensors	Gateway Node
Chemistry	EE / Mechanical Eng	ArchRock	Wireless LAN	Communication
S T E M	Network Specialist	Millennial Net	Monitors	Device to Device
C S / A I	Software Applications	Rockwell		Automation
Bio-tech	Programming	Siemens		Virtualization
Agri-waste	RDBMS	CISCO		Visualization
		GE Energy		SOA / Mobile Apps
		UNFCCC/IPCC		Cloud Computing

Organization

To start small, it may be prudent to incubate the projects within an 'academy' with select schools initiating one or more projects. Day to day operation must be designed and supervised without additional work on existing teachers. The ecosystem of partners and alliances must be developed to provide support for implementation.

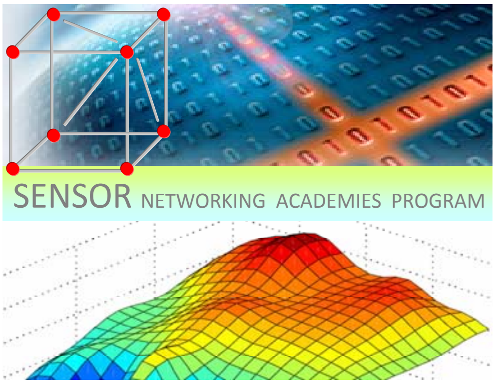


Appendix [1] http://dspace.mit.edu/handle/1721.1/53329 and http://esd.mit.edu/WPS/2008/esd-wp-2008-17.pdf

[2] http://dspace.mit.edu/handle/1721.1/54801

[3] http://dspace.mit.edu/handle/1721.1/54800

[4] http://dspace.mit.edu/handle/1721.1/54802



ENERGY & HEALTHCARE

SNAP	**SENSOR NETWORKING ACADEMIES PROGRAM** : *Energy and Healthcare*

	Description	Comment
Goal	Accelerate the diffusion of the concepts of [1] energy conservation & energy efficiency [2] healthcare monitoring & preventive medicine using principles of ubiquitous computing achieved from granular deployment of sensors.	[1] Advances in micro-metering may be catalytic to drive the return on investment for the smart grid. [2] Without remote monitoring and preventive healthcare, the cost of attentive medical care will bankrupt the USA.
Outcome	Hands-on experience and education about sensors and dynamics of energy [sensors to monitor usage, optimize energy efficiency] and how to improve preventive medicine through remote monitoring.	Grass roots approach and an academic-industry channel to share science and data for issues on energy and climate change. Applicable for healthcare issues.
Aim	[1] Improve teaching of physics and mathematics [2] Demonstrate use in energy and healthcare [2] Build consumer awareness and market demand for wireless sensor networks and related tools / services. [3] Workforce creation and job re-training	SNAP is aimed for school and college students as well as job re-training programs, in much the same way that John Morgridge of Cisco Systems started the Cisco Networking Academy[1] in 1996.
Target	[1] High schools [2] Tertiary institutions [3] Workforce re-training	Potential to engage with local and state authorities that may access stimulus funds for job growth and entrepreneurial innovation.
Investment	[1] Seed funds to implement the first Academy [2] Support academic-industry partnership	Foundations and corporations as sponsors.

[1] Cisco Systems initiated the Cisco Networking Academy in 1996 that started with a liaison that I created with the Thurgood Marshall High School (TMAHS) in the San Francisco Unified School District (SFUSD). Please see enclosed PDF and note that all the photographs are from TMAHS classrooms. Background: during 1995-1997, I was a Special Assistant to the Superintendent of SFUSD to develop academic operations to advance mathematics and science. Hence, I created the collaboration with Cisco Systems through a talented teacher, Mr Dennis Frezzo, who helped start the first Cisco Networking Academy (in SFUSD). It gained worldwide acclaim and cited by The White House as a key instrument for IT workforce creation. It was the cover story of the US News & World Report (2 Dec 1996) and widely cited (www.catholiceducation.org/articles/education/ed0026.html). A decade later, we have moved ahead from 'computers' as boxes and equipment to 'ubiquitous computing' as a function and service. Therefore, an inclination to re-create the former model but with new concepts for the 21st Century – hence – SNAP.

Cisco Networking Academies Program

Through an innovative partnership with school districts across the U.S., Cisco Systems is preparing students for the demands and enormous opportunities of the information economy while creating a qualified talent pool for building and maintaining education networks.

Network switches. Routers. Patch cables and punch-down blocks. RJ-45 jacks. Not your ordinary list of back-to-school supplies. Then again, for students across the country in a unique new curriculum known as Cisco Networking Academies, the Fall '97 semester was anything but your ordinary back-to-school experience.

Now in the early stages of a nationwide rollout leading to international participation, the Networking Academies is a cooperative venture between school districts and Cisco, the world leader in networking for the Internet. In a lab setting that closely corresponds to the real world, students get their hands on the building blocks of today's global information networks, learning by doing as they design and bring to life local and wide-area networks.

This innovative program is a prime example of private industry creating a mutually beneficial relationship with schools—not a short-term fix, but a relationship designed to last because of the lasting benefits it can provide. For Cisco and private industry, the program is a meaningful step toward developing sorely needed technology skills in the next generation of workers. For the schools, Cisco Networking Academies represents vital technology support and resources to supplement limited funds. And for students, Networking Academies is highly relevant preparation for the increasingly technology-dependent economy into which they will emerge.

The Challenge

The information economy will demand an unprecedented level of technology literacy from tomorrow's workers. A few statistics foreshadow a potential crisis in the American workplace:

- Currently, mid- to large-sized companies in the U.S. alone have about 190,000 unfilled technology jobs. And 82 percent of technology companies expect to increase their information technology (IT) staffs in the next several years.
- Nearly 70 percent of technology companies cite a lack of skilled IT workers as a barrier to growth.
- As teachers around the world begin to integrate the vast resources available to them on the Internet and as networks become an important tool for boosting administrative efficiency and communication, education institutions face the same shortage of network-support personnel.
- Schools are under pressure to prepare students with the necessary skills to be successful in the 21st century. Eighty-six percent of America's classrooms lack a direct Internet connection.

Background

In 1993, Cisco embarked on an initiative to design practical, cost-effective networks for schools. It quickly became apparent that designing and installing the networks was not enough—the schools also needed some way to maintain the networks after they were up and running. Cisco Senior Consulting Engineer George Ward developed training for teachers and staff for maintenance of school networks. He soon discovered that the personnel lacked the time required to learn the material, so he moved to the next population of learners in the school—the students themselves. The success of these student seminars led to requests from participating schools across the country for Cisco to develop a curriculum that could be integrated as elective courses taught in a semester format. The formalized curriculum and support activities evolved into the Cisco Networking Academies program.

The concept proved to be a powerful draw for students, many of whom initially volunteered for classes outside normal school hours. Today, thousands of students coast to coast are pioneering a school-to-work program engineered for a new global economy.

The Solution

Through the Cisco Networking Academies program, high school and college students can learn the information needed to prepare them for the Cisco Certified Networking Associate exam. This certification positions them for immediate openings in a talent-hungry job market or for engineering- and science-focused college studies. In a nutshell, Cisco Networking Academies is a complete, four-semester program on the principles and practice of designing, building, and maintaining networks capable of supporting national and global organizations.

EXECUTIVE SUMMARY

Challenge

The American economy runs on information—yet companies today face a shortage of information workers. And although America's schools are struggling to supply the needed skills, more than 80 percent of our nation's classrooms lack the basic technology tool of a direct Internet connection.

Solution

The Cisco Networking Academies program is a revolutionary partnership between Cisco Systems and schools across the nation. Through a range of information-age teaching media and methods, the Networking Academies goes beyond traditional computer-based education, helping students develop practical computer networking knowledge and skills in a hands-on environment.

Results

In its first full year, the fast-growing program will be giving thousands of students across the nation the school-to-work experience they need to take immediate positions in networking—along with a solid foundation for further study at the college level in highly sought-after technical disciplines.

Cisco provides course work for a complete range of basic through advanced networking concepts—from pulling cable through such complex concepts as subnet masking rules and strategies.

The program uses Regional Academies as hubs, each of which supports a minimum of ten Local Academies. These Regional Academies teach the teachers who oversee programs at the Local Academies under their jurisdiction. The Regional Academies funnel input to Cisco on topics such as individual school performance, curriculum quality and effectiveness, and student progress.

The format for the classes reflects the content: interactive lessons stored largely on the classroom's Cisco MicroWeb server. The academy design also accommodates diverse learning styles. For those who learn by reading, text is available. More-visual learners can focus on the course material's extensive graphics and QuickTime movies. To promote development of the personal skills that underpin successful careers, projects require students not only to resolve technical issues, but also to successfully address network users' needs.

Local Academies receive mentoring and technical support from the Regional Academies and are backed by SMARTnet™ services, a service and support program that provides a round-the-clock access to assistance from Cisco's Technical Assistance Center (TAC) and the Cisco Connection Online (CCO) Web site, plus major software and maintenance releases, product documentation updates and next-day delivery of replacement parts.

Benefits and Results

The Cisco Networking Academies program is in its first full year at schools. The pilot semester at one site, Thurgood Marshall Academic High School in San Francisco, provides an indication of the potential impact: more than 15 percent of the students involved in the school's semester program in spring 1997 secured summer jobs as a direct result of their one-semester experience.

And for teachers who have seen the early impact on students and their futures, the Academy stands as a model for school-to-work programs.

Dennis Frezzo, technology instructor at Thurgood Marshall, says, "In one leap, Cisco has helped us have the most effective school-to-work program I've seen locally, and we're proud of that."

"The energy level of these students is so high, it's hard to find the words to describe it," says Barry Williams, who oversees Regional activities for the Round Valley School District in Springerville, Arizona. "Once, about half of my students had permission to leave school about 20 minutes early. But not a single one left. I talked topologies and media for 90 minutes without a break."

Close-Up: Thurgood Marshall Academic High School Section

San Francisco, California

Thurgood Marshall Academic High School (TMAHS) was established in 1994 in the economically underdeveloped southeast corner of San Francisco. Focusing on a math, science, and engineering curriculum, the school gives students a rigorous course of academic study with an abundance of college-prep math, science, and English classes, plus three semesters of computer and technology electives.

The Cisco Networking Academies curriculum has been integrated into one of three areas for concentrated study selected by all TMAHS students after they reach their junior year. Juniors take Cisco I and II, and seniors complete the program with Cisco III and IV, supplemented by projects and courses in related engineering disciplines. "This is above and beyond what we normally do, but we thought this was an incredible opportunity for the kids," says Frezzo.

According to Jai Gosine, another Academy teacher at TMAHS, "Certification is the biggest benefit" for the school's nearly 70 Cisco Networking Academies students, who are spread among three classes. "Potential employers of students who earn their Cisco Certified Networking Associate status will feel comfortable hiring them," he says, "because they'll know these students have acquired a set of practical, valuable skills."

The Networking Academies program is also project-based, with students addressing challenges drawn from the real world of networking and finding solutions that work, not only in theory but in the model networks built and tested in the lab.

"A lot of people use these clichés, but they're really true," says Frezzo, "The old style of teaching was 'the sage on the stage.' Now we're trying to be the 'guide on the side,' helping in counseling and problem solving."

Senior Ricky Jackson notes, "The lessons aren't based on homework or tests so much. We do more hands-on work."

The project-based learning format helps truly instill skills that otherwise might be forgotten soon after the final exam, Jai Gosine explains. "A student's level of learning is determined by the form of assessment. In our case, it's not how much they can regurgitate, but how much they can do." Adds Frezzo: "Projects provide the ultimate in performance assessments. Was the job complete? Did the network work, with no excuses?"

For Jenica Lee, a TMAHS senior with tentative plans to pursue computer science in college, the interactive, project-based format of Networking Academies helps students develop into problem solvers. “I think you learn more, because you encounter problems and have to work through them to figure out the solution,” Lee observes. “It’s also more fun.”

The pride is evident in Ricky Jackson’s voice as he describes how, during their first full semester in the Academy, he and 23 fellow team members wired the San Jose Convention Center for the California Community Colleges in Education Foundation Technology Conference. Die-hard students on the project began early on a Sunday, working eight hours with teachers and Cisco mentors to provide state-of-the-art, high-speed Internet access to vendor booths and seminar rooms.

“Vendors, presenters, and the Foundation found it to be an invaluable service,” remarked David Springett, the foundation’s president. “Cisco’s partnership with the high school students demonstrated how private industry’s active involvement in education can advance students’ skills and future prospects.”

“In the advanced courses, the spirit of the curriculum is to make the network self-sustaining and apprentice students to the school district,” Gosine says. “There’s no way school districts have enough money to hire the expertise they’re going to need to maintain stable networks. This is a way to accomplish that goal. It’s a win for everyone involved.”

Academy students also will be applying their skills in local middle and elementary schools, which “makes the vision of ‘Internet everywhere’ more attainable,” Frezzo says.

Close-Up: Lakes County Service Cooperative, Fergus Falls, Minnesota

Through Lakes County Service Cooperative, an association serving some 35 districts in nine counties in West-Central Minnesota, Networking Academies is finding a home in some fairly out-of-the-way places.

“Most of the Local Academies are at small-town schools like Parker’s Prairie, with 350 students in K-12 and about 120 in high school,” says Rick Vogt, media coordinator for Lakes County. “It’s a tremendous opportunity for them to learn about and experience this technology, which might not otherwise be available—whether they get a job in networking or not.”

A can-do attitude took the Networking Academies program from possibility to reality quickly.

“There are lots of reasons you could find not to do something like this,” Vogt says. “The attitude of the schools was that they were willing to do what it takes because they felt it was that important. Local Academies found a teacher that they could spare, and they managed to fit the class into their curriculum—some after school, some before school. Some of the teachers even donated time to come for training.”

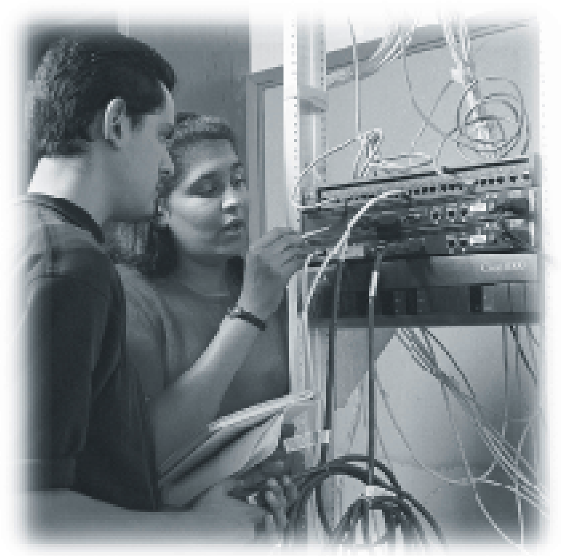
As a major plus, Vogt points to the fact that the curriculum is designed “to industry standards,” giving students the real-world networking know-how that institutions need most today.

“The instructional method is at the forefront of technology,” he says. “There aren’t textbooks that have to be changed all the time. The networked multimedia curriculum shows what’s possible with a properly designed network. The exchange of information between Academy instructors, facilitated by Internet connectivity, builds a sense of community and allows the best ideas for teaching the curriculum to be shared nationwide.”

“I think it’s an exciting program, and the teachers have said the same thing,” Vogt reports. “Everybody sees great possibilities.”

Close-Up: New Hanover County Schools, Wilmington, North Carolina

For students of New Hanover County Schools in Wilmington, North Carolina, the Networking Academies program is both college and career prep.



"There's an immediate benefit for students who just want to go out and get jobs," says Kevin Johnston, a technology instructor at New Hanover High School, who also does double duty as his area's Regional mentor. "They've got a sought-after skill. The second benefit is for students who plan on going to college."

Within Raleigh, North Carolina, is Research Triangle Park, a hotbed for technology companies and home to several universities that welcome Hanover students each year.

"Even if they're going into accounting, Networking Academies students can get better part-time jobs in the summer," he says. "They've got a really good background to start with."

The students also become a "home-grown resource" for designing, building, and maintaining the networks for Hanover itself, Johnston said. On NetDay, the Academy students will fan out across the district to help install networks in middle schools and elementary schools.

Technology-enabled learning is a familiar concept at Hanover, which receives federal funding to participate in the national "virtual school" program for distance learning and Internet communications. Becoming part of the Cisco Networking Academies program was an easy "next step."

For further information on the Cisco Networking Academies program or Cisco support for education networks, visit: www.cisco.com/edu.

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