Directions for multimedia networking:
Applications and the capabilities they need

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Themes of this talk

-Multimedia communications initiatives in the past:
Guesses good, bad, and premature.

-The interactions of applications, social motivations, and technologies.

-Energy conservation and environmental responsibility as the urgent new requirement.
(Mainly a digression into Smart Grid and P1901 power line communications)

-My guesses for promising "hot" areas for multimedia applications and their supporting technologies.

Multimedia communications initiatives in the pre-Internet past (mainly from my Bellcore experience): Guesses good, bad, and premature.

-Picturephone

Demonstrations as early as 1930 Bell Labs NY to Washington

-VideoWindow

-Video on Demand

-”Any service, anywhere, any time”

Picturephone

-Almost launched by AT&T in the early 1970s as an expensive service mainly for business customers.

Analog signal would use special 1 MHz access.
Service canceled partly because of pressure from public utility commission in NY State to fix problems with telephone service first.

Used 3 twisted pairs: Video upstream, video downstream, and telephone (two-way).

VideoPhone

-Revived in early 1990s as a residential appliance, using compressed digital audio and video, with low frame rate and resolution, over a normal dialed telephone channel.

-An expensive appliance (price initially $1000 or more) that could function as a telephone or videophone.

-Quality to cost ratio too low for a desirable consumer product.

VideoPhone, 1992 brochure

Video Window

-An experiment at Bellcore in the 1980s with large-screen teleconferencing, intended to encourage informal interactions between collaborating groups in different locations.

-Used uncompressed digital video, with B-ISDN (155Mbps service) as a likely access network.

-Well received, including a demo at the Smithsonian Institution in Washington, D.C.

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Video Window

-Helped identify a variety of facts and challenges for group-to-group teleconferencing, including

+Voice quality is much more important than video quality.

+There can be anxiety about people off-camera who cannot be seen by the group at the other end.

+Good goal of easy social interaction, but not a practical solution – the Internet's social networking was still far away.

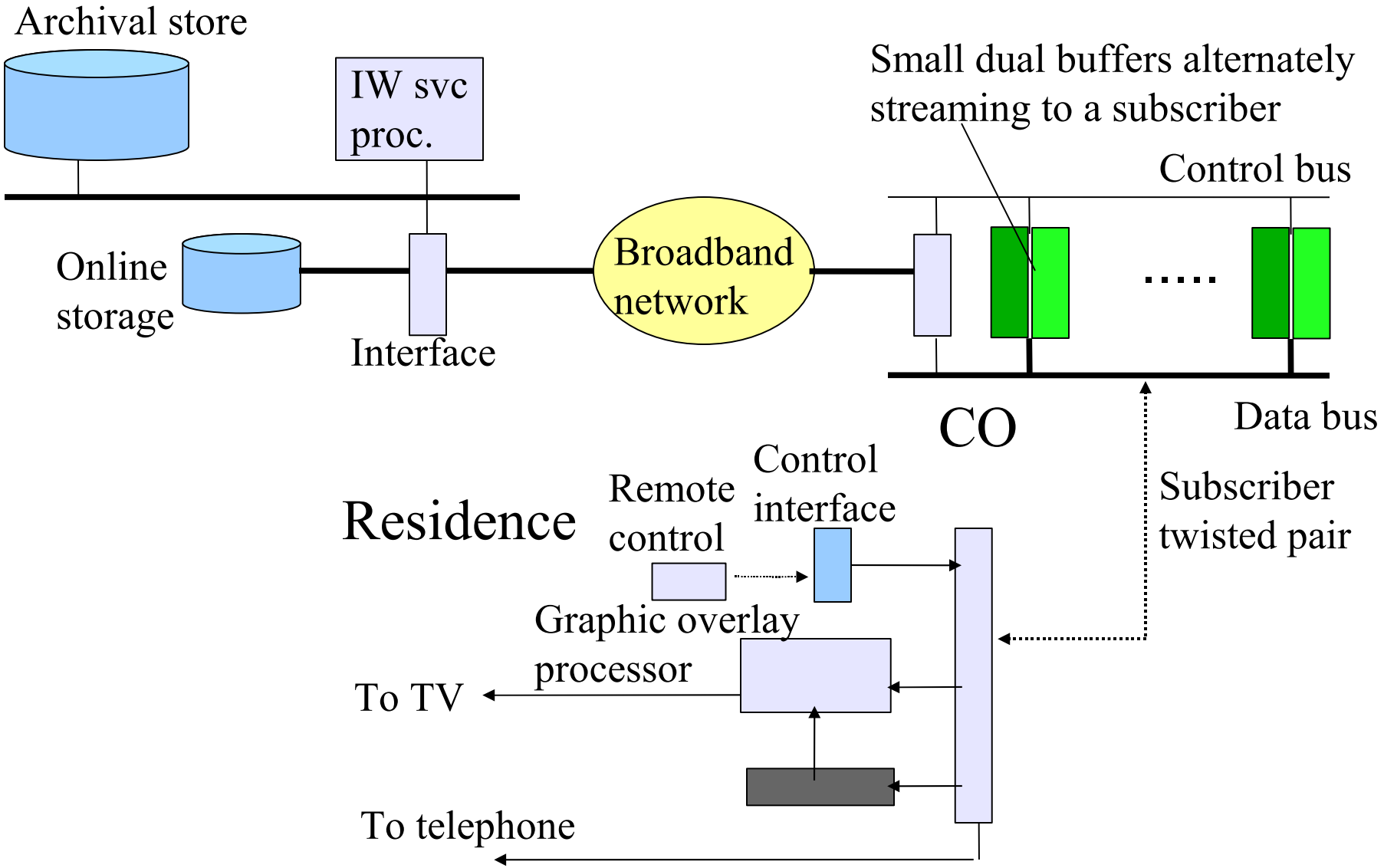
Video on Demand

-Conceived in the mid-1980s as a killer application for B-ISDN (155Mbps access) using uncompressed digital video, but investment could not be covered by prices competitive with video rental stores. Pay-per-view (not VoD) offered by cable systems was also a competitor.

-More promising compressed video over DSL (with B-ISDN backbone network) developed by Alex Gelman and others at Bellcore around 1990.

Ref: U.S. Patent #5,371,532, Dec. 6, 1994, A. Gelman et.al., "Communications Architecture & Method for Distributing Information Services"

Bellcore's ADSL-based VoD



“Any service, anywhere, any time”

-A favorite slogan beginning in the late 1980s-early 1990s.

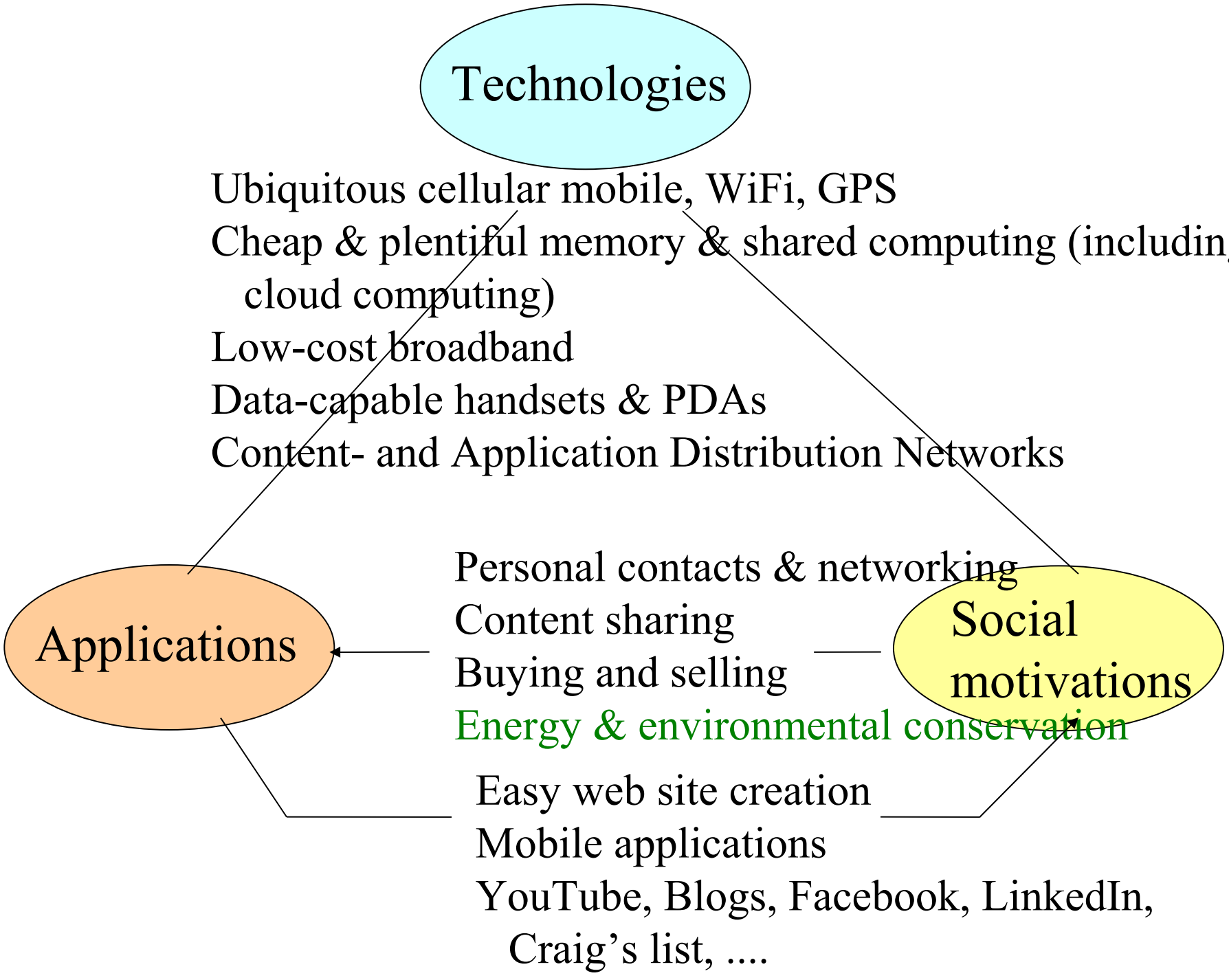
-Rooted in intelligent network, still connected primarily with landline service rather than cell phones.

-But did introduce concepts of virtual addresses, media translations, synchronized multimedia, content delivery networking.

-Premature, had to wait for data-oriented cellular mobile, WiFi, and the broadband Internet.

Applications, social motivations, and technologies drive and inspire each other

Back-and-forth influences; it's often impossible to say which is the cause and which the effect.


Technologies
Ubiquitous cellular mobile, WiFi, GPS
Cheap & plentiful memory & shared computing (including cloud computing)
Low-cost broadband
Data-capable handsets & PDAs
Content- and Application Distribution Networks
Applications
Personal contacts & networking
Content sharing
Buying and selling
Energy & environmental conservation
Social motivations
Easy web site creation
Mobile applications
YouTube, Blogs, Facebook, LinkedIn, Craig's list, ...

Energy conservation and environmental responsibility in communications and information networking

The new imperative.

What does it mean?

-Consuming less energy in personal devices and appliances, servers, cellular base stations, sensor networks, ...

-Life cycle product/service planning to minimize environmental harm.

-Environmental monitoring to detect problems.

-Travel cost displacement (via electronic meetings)
(Subject of a study by a current IEEE Ad-Hoc Committee.)

-A communications and sensor infrastructure facilitating facilitating better management of energy (and other) resources.
A major current example: Smart Grid

Smart Grid – A new architecture for the electrical power distribution network

-Automated metering

Two-way communication with the user-premises equipment
End user choice of service parameters and costs
Automated load control including price differentials and time- and demand-sensitive appliance control.

-Control of devices within the transmission grid

Operate devices with greater efficiency with respect to outages, recovery, connects/disconnects

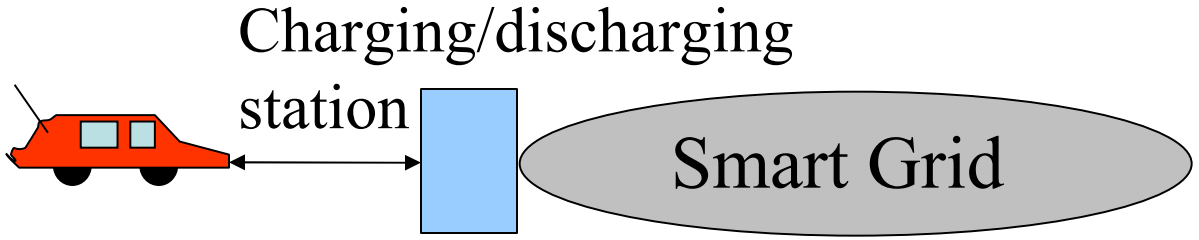
Ref: Video from IEEE Energy 2030 Conference
www&ieee&org/portal/site/ieeetv/menuitem.6ce799f946c20d660374ca695bac26c8/index.jsp?&pName=ieee.tv.viewer&path=membport/ieee_tv&file=SPC_SmartGrid.xml&vid=107465&play=true

-Exploitation of distributed and varied resources

Examples:

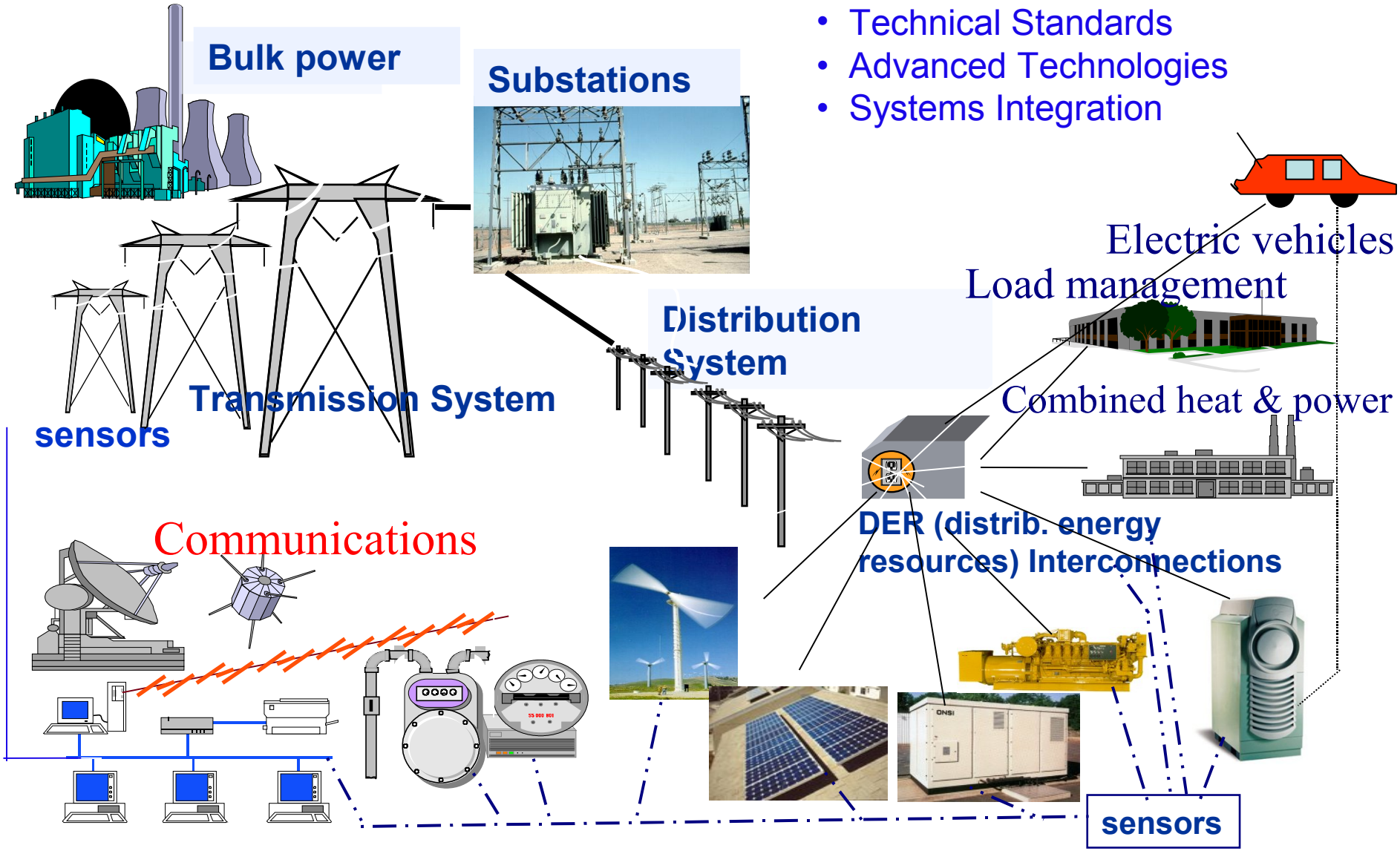
-Load-balancing among different energy sources (wind, solar, gas, coal, nuclear, ...) with an eye toward minimizing overall environmental impact.

-Charging electric cars when energy is cheap, drawing from charged electric cars when energy is expensive.



Systems Approach_

- Interconnection & Interfaces
- Technical Standards
- Advanced Technologies
- Systems Integration



Source: grouper.ieee.org/groups/scc21/dr_shared/2030/

IEEE's role in smart grid

Numerous IEEE standards relate to the smart grid.

standards.ieee.org/announcements/sgapproved.html

A new standard, IEEE P2030

Directly addresses smart grid requirements.

Collaboration with NIST

The IEEE Standards Association is cooperating with the U.S National Institute for Standards and Technology (NIST) on a Smart Grid Interoperability Standards Roadmap.

A new quarterly journal beginning in 2010:

IEEE Transactions on Smart Grid (sponsored by PES)

IEEE Smart Grid Standard P2030 (launched May, 2009)

IEEE P2030 Draft Guide for Smart Grid Interoperability of Energy Technology and Information Technology Operation with the Electric Power System (EPS), and End-Use Applications and Loads

Task forces set up by the working group:

TF1 Power Eng. Technology (Sam Sciacca & Tom Prevost)

TF2 Information Technology (Bob Grow and Jeffrey Katz)

TF3 Communications Technology (Stefano Galli and Bob Heile)

grouper.ieee.org/groups/scc21/2030/2030_index.html

Chair: Dick DeBlasio, National Renewable Energy Laboratory, Golden, CO

ComSoc getting into Smart Grid

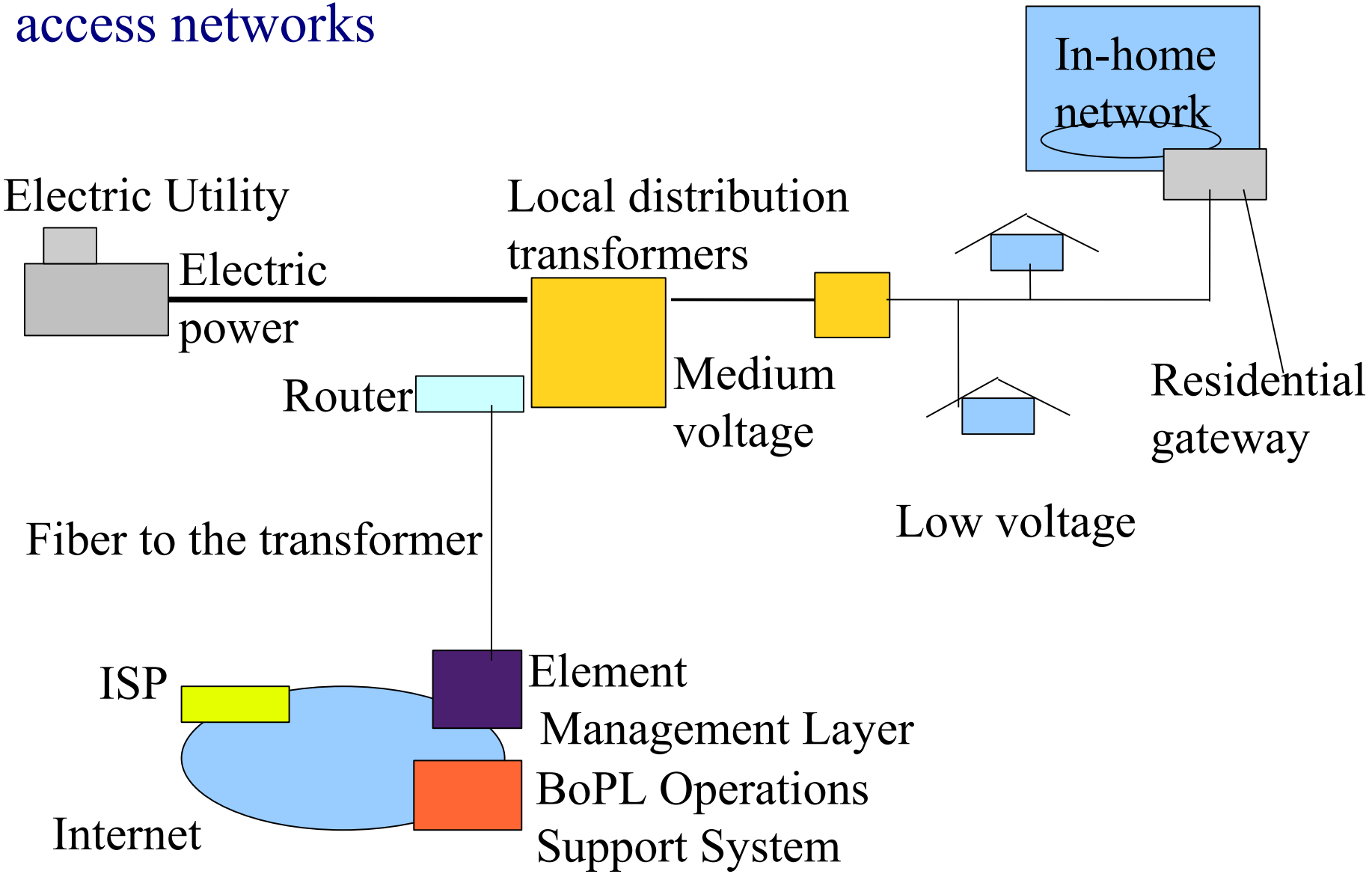
Web page ww2.comsoc.org/Smart-Grid

P1901 power line communications standard

Smart Grid Communications Workshop at ICC 2010
(May 2010, Capetown, South Africa)
www.smartgridcomm.org

IEEE P1901

Broadband communication in residential and access networks



P1901

-For general data communications in residences and the access network, not just for Smart Grid applications.

-Access capacity perhaps as high as 100Mbps per subscriber.

-Provides “seamless integration with other communication media, such as Wi-Fi and Ethernet” and will carry Internet traffic.

P1901 Progress and Bumps Along the Road

-On track for the first approved standard in 2010

-Two incompatible PHYs (FFT-based OFDM, wavelet-based OFDM)

-ITU-T developing its own home networking standard, G.hn, that will probably be incompatible with P1901

Ref: www.smartgridaustralia.com.au/index.php?mact=News,cntnt01,detail,0&cntnt01articleid=112&cntnt01returnid=15

G.hn PHY recommendation: ITU-T G.9960 (Jan. 2009)

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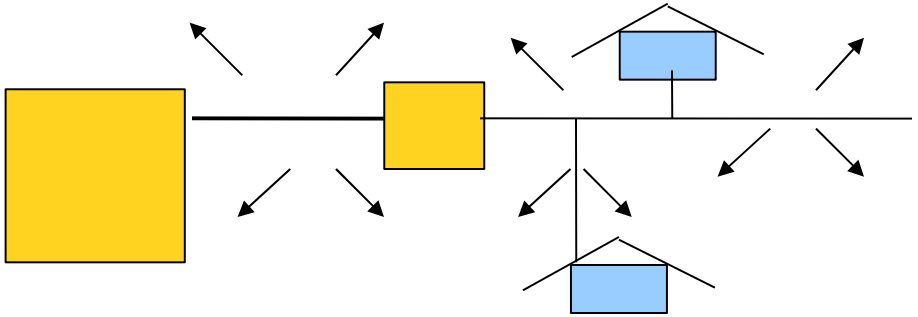
-Unresolved interference problem – Power lines are a giant radiating antenna



The ARRL (American Radio Relay League) won a court suit in April, 2009 over FCC procedure in setting rules permitting PLC, but rules are still in effect.

"FCC dealt setback in broadband-over-power-lines push", CNET News, April 28, 2008, news.cnet.com/8301-10784_3-9930223-7.html?tag=nefd.lede

P1901 contains mechanisms to selectively avoid using parts of the spectrum where it would interfere with existing services. OFDM facilitates this.

Promising "hot" areas for multimedia applications and their supporting technologies

1. Social Networking

-Share media objects and “what I am seeing and hearing” with distant friends.

-Location mapping of social events and friends.

-Perhaps voice-to-texting (but even this may be risky if you are driving a car, train, or plane)

-Fancier content capture and display capabilities

-Additional location and navigational capabilities

Social networking, shared experiences.

"Nokia announced Surge social networking device for AT&T"
www.phonenews.com/nokia-announces-surge-social-networking-device-for-att-8428/

Another one.

Sony-Ericsson Satio mobile “phone” with 12 Mpixel camera & video recording, large screen, WiFi, GPS, Bluetooth, ...

www.sonyericsson.com/cws/corporate/products/phoneportfolio/specification/satio

2. Medical

-Consultations including sharing of large medical images and video

-Patient monitoring

-Patient information and education

-Medical records transfer including large images and video

(more)

-Remote surgery (maybe not tomorrow)

Remote medical diagnosis, patient monitoring.

Technology challenges for medicine include:

-Authentication of patients, medical personnel, medical information objects

-Support of lower-bandwidth access (such as from mobile devices) with zooming/panning and other resolution-controlling solutions.

-Simple and easy to use interfaces for both medical personnel and patients (including very young, very old, and sick people).

-Very high reliability.

3. Real-time monitoring of house, child, traffic, weather, ...

4. System, industrial, and environmental sensors and controllers

-Systems such as Smart Grid.

-Early detection of problems in manufacturing and other industrial systems.

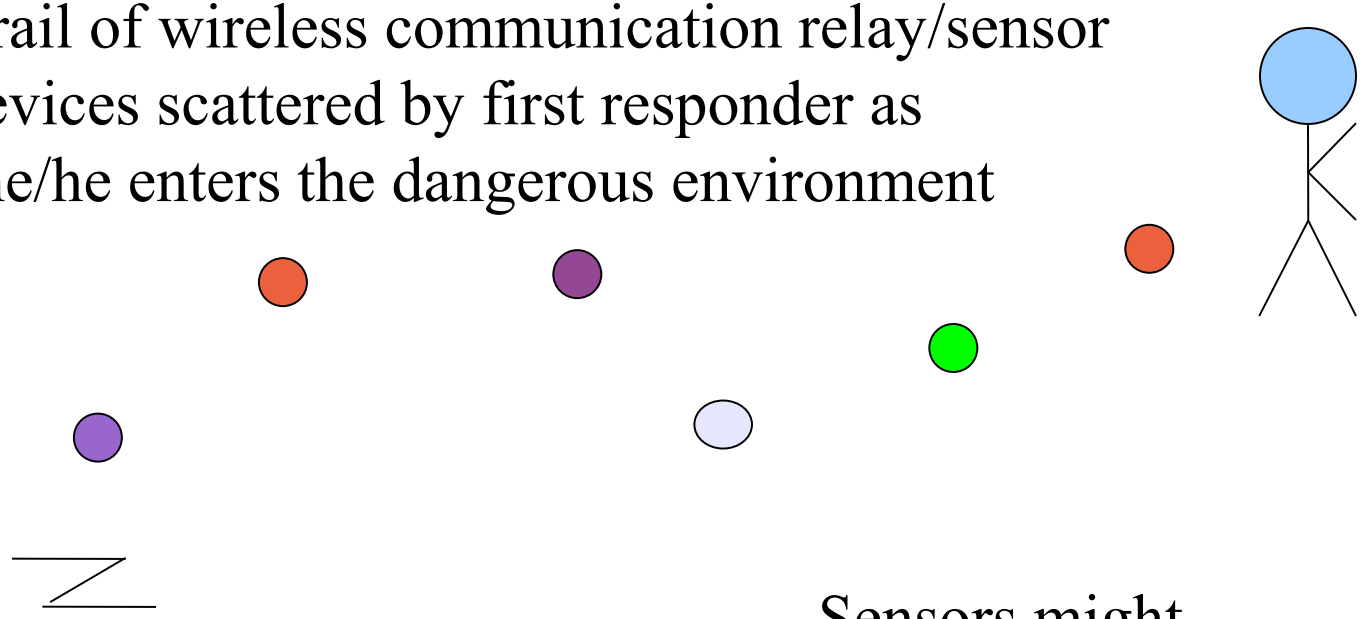
-Monitoring of environmental conditions.

-Sensor networks coupled with emergency communication networks for first responders to natural or man-made disasters.

My pet "lifeline" concept that no one wanted to fund

First responder (or soldier)
in dangerous environment

Trail of wireless communication relay/sensor devices scattered by first responder as she/he enters the dangerous environment



Communication with outside systems

Sensors might
-Detect heat
-Detect dangerous chemicals
-Detect sounds
-Transmit video of surroundings

5. Purchases of goods and services from wireless handheld devices

(which will, in many cases, include multimedia information delivery to the customer and will extend to major purchases).

images.pingmag.jp/images/article/vencmode.jpg

“Mobile Commerce” in the wireless Internet

-Requires strong authentication and security capabilities and fast response time.

-Great opportunity for location-dependent advertising.

-Could develop ancillary services (e.g., Consumer Reports).

6. Distributed games, shared virtual environments.

Example: Turret Wars, a multi-player, peer to peer network battle game.
forums.mactalk.com.au/34/40167-turret-wars-mp-1-1-released.html

7. Broadcasting to mobile devices

-Television news, sports events, entertainment.

-Seamless handoff of a program between mobile and fixed locations.

Requires transcodings and measures to maintain consistent QoS, billing, etc. across network boundaries

Nokia DVB-H phone

8. Interactive education, both real time and archived.

Online university and high school course materials are just the beginning of distant education.

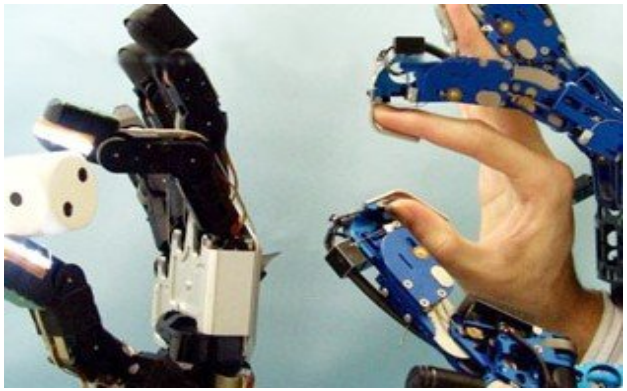
www.ferris.edu/library/mediaprod/images/samples/distance/Interactive-Classroom2.jpg

Some technology considerations

-”Green” computing and communications needs research on architectures, management strategies, and design of devices, subsystems, computers, data centers, sensor networks and control mechanisms.

-Cloud computing can provide virtual computing environments dynamically allocated to meet user needs. Enterprise applications can be quickly built from distributed data and computing resources, with reduced cost of ownership and better sharing of resources.

-Haptics may come back for remote control, medical therapy, sensory experience.



-User interfaces adapted to the user: Button/text size; speed-adaptive gesture recognition; location/environmental sensitivity.

Larger, more targeted objects for older users

-Intelligent wireless base stations (including femtocells discovering and using local resources)

-Adaptive resource allocation for wireless multimedia sessions.

-Creative application-oriented use of fine-granularity time-frequency-space modulation systems

-Semantic routing capabilities.

-Security, privacy and authentication

+Protection of user privacy with the growth of network-based caching of personal/business information and cloud computing.

+Authentication of media objects, for protection of intellectual property (commercial objects) and for protection of personal security and privacy (e.g., medical images).

+Protection against imbedding of malware in media objects.

+Protection against theft of user identity and privileges.

+Protection against spoofing of legitimate wireless access points, especially for mobile commerce.

Conclusions?

-It's a complex world and engineers should be more aware than ever of the human and social implications of their work.

-Ideas have their time, and concepts should be re-examined every few years to see if their time has come.

-The interactions among social motivations, applications, and technologies will continue to produce a rich soup of new possibilities for human communication and access to knowledge.

Thank you for your attention