The Connected Planet

And Opportunities for Wireless Applications

MOBICASE
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Everything Connected

The Connected Planet*   **The Internet of Things***

The Smarter Planet*

Smart Objects talking to other objects, presumably for the benefit and protection of our Quality of Life

*SOURCE: Philips for Connected Planet, European Commission for Internet Of Things, IBM for The Smarter Planet,

The Connected Planet

- **The world is mostly connected, for voice communications, thanks to the cell phone (still 2B more people to connect)**
- **The Internet and Professor Google, among others, have brought global access to information everywhere**

However

- We are only at the starting point of the *Connected Planet*
- Machine-to-machine (M2M) communications provide many services now
- But the pervasive network of <u>intelligent and connected</u> devices is coming

  - **Smart Embedded Connected Devices** will be everywhere
    - In your neighborhood
    - In your planes, trains and automobiles
    - In your home and place of business
    - In your entertainment, computing and networking devices
    - On your body, under your skin, and even traversing your gut!

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The Connected Planet

- **Machine-To-Machine (M2M) Communications**

  - Market label for alternative devices and services, wireline and wirelessly connected, often autonomous operation

  - Beyond portable handsets talking to vending machines, or WLL subscriber equipment, and PC cards for internet access

  - Typically associated with enterprise uses, except home automation and telematics

- These are <u>not</u> low-cost standardized plug-and-play solutions taking full advantage of new Web technologies and the 'Cloud'

- **Smart Device Systems must evolve to support interoperable interfaces between smart devices to enable intelligence gathering and associated action for different uses***

  *Source: Fred Yentz, CEO, ILS Technologies, Private Communication, June 2009

Smart Embedded Device Systems (SEDS)

- **Smart Systems will be a powerful driving force behind new technologies interconnecting people, devices and systems**

- **But SEDS are more than just connected wired and wireless devices sharing data from afar, with or without human intervention.**

- **This is about collecting and distributing the desired data efficiently**
  - often with real time constraints
  - using the best suited wireless spectrum and web technologies available and
  - connected to a back-end system placed anywhere in the world.

- **This is about intelligent action, based on information gathered**
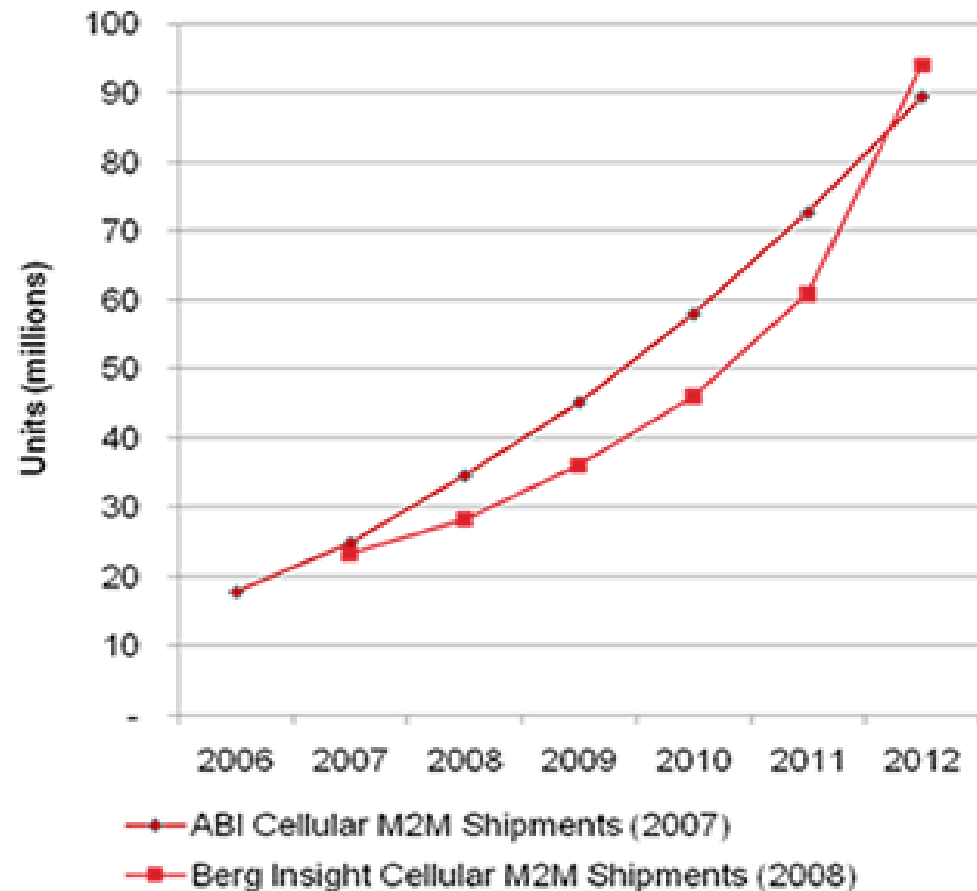
SOURCE: Mentor Graphics M2M webinar announcement Sept 17 2009

Market Opportunity *

Traditional M2M applications

- Primarily in the enterprise segment
  - This is a market that is projected to grow at over 30% CAGR,
  - attaining unit shipment levels of about 90m units/year in 2012

Analysts expect almost 100m units/year to be shipping by 2012
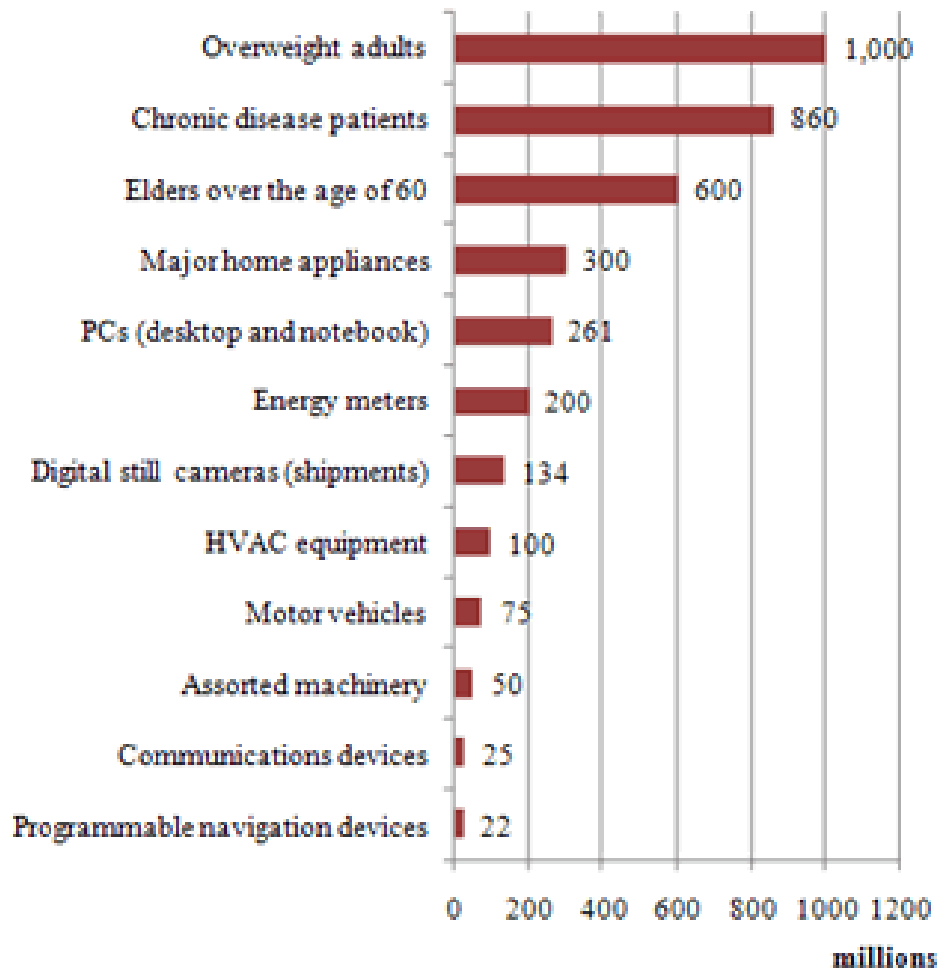

NOTE: Machine segments above are annual shipment volumes. Health related statistics indicate number of people suffering from specific conditions.
SOURCE: ABI, Berg Insight, Continua Health Alliance, IDC, Korea Investment & Securities

New Apps - Market Opportunity *

There is a potentially much larger opportunity in
new consumer and healthcare sectors

Segment	Value (millions)
Overweight adults	1,000
Chronic disease patients	860
Elders over the age of 60	600
Major home appliances	300
PCs (desktop and notebook)	261
Energy meters	200
Digital still cameras (shipments)	134
HVAC equipment	100
Motor vehicles	75
Assorted machinery	50
Communications devices	25
Programmable navigation devices	22

0   200   400   600   800   1000 1200

millions

Non-traditional M2M

- **Strong market potential especially in the consumer electronics and healthcare segments**

Machine segments at left are annual shipment volumes.

Health related statistics indicate number of people suffering from specific conditions.

SOURCE: ABI, Berg Insight, Continua Health Alliance, IDC, Korea Investment & Securities

* GSMA Report: Embedded Mobile – M2M and Beyond; PRJ/0263/STR/PSD/1B – November 2008

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The Connected Planet – Key Players

- **Global Wireless Operators/Service Providers**

    - Deploying 3G/4G technology and adding infrastructure to compete and improve service

    - Deploying femto-cellular equipment in the home

        - improves coverage holes, lowers overall infrastructure cost

    - Realize that increasing ARPU is harder

    - Need to find alternative service revenue from non-traditional subscribers

Looking to Enter M2M

- Verizon Wireless JV called nPhase, and AT&T's investment in Jasper Wireless

- GSMA, CDG attention to Embedded Mobile/Wireless

    - key reports, attention to use cases, need for standards

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The Connected Planet – Devices & Services

- **New Embedded Devices and Services**

  – Wireless and Wireline, but wireless flexibility and cost makes it viable and worth strong support

  – Existing applications in various market segments

  – Need for intelligence

  – Need for Standards

- **Need for "smart connectivity" solutions that enable intelligence**

  – ubiquitous device to enterprise communication

  – secure remote access & collaboration

  – remote device monitoring & management

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Smart Embedded Devices / M2M – Industry Segments

A Growing List

- **Industrial Automation and Monitoring**
- **Telemedicine and Healthcare ICT**
- **Security and Surveillance**
- **Utility Metering and Telemetry**
- **Asset Tracking**
- **Fleet Management**
- **Consumer Telematics**
- **Advertising**
- **Consumer Applications**
- **Wireless Data Modules (embedded)**

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Smart Embedded Device Uses

- Industrial Automation and Monitoring
  - **Factory Line Equipment Operation/Usage Tracking/Diagnostics/Service requests,**
- Telemedicine and Healthcare ICT
  - **Body Sensor and Diagnostic Reporting**
  - **Remote Physician consultation (non-voice, patient vitals/xray data access)**
- Security and Surveillance
  - **Home and enterprise security sensor monitoring, alerts, remote access & thermostat control, video feeds**
- Telemetry
  - **Smart Meters, Smart Homes, Smart Buildings, Sensors for energy industry,**
- Asset Tracking
  - **Inventory control, Geo-fencing**
- Fleet Management
  - **location and availability, Repossession and lockdown, Sales Force Tracking**
- Consumer Telematics
  - **In-vehicle entertainment/navigation, remote Diagnostics/Safety/Concierge Services, Vehicle Diagnostics**
- Advertising
  - **Digital billboards, in-store offers, special events**
- Consumer Applications
  - **Home monitoring, Financial and Retail POS/Kiosks**
  - **Digital cameras, e-readers, media players, gaming devices**
- Wireless data modules for laptops, netbooks, UMPCs, etc.

Smart Embedded Device Communications
## Types Of Devices - 1

Autonomous M2M Applications

- These devices typically communicate autonomously with other machines connected to the Internet, or directly.

- The device would typically be 'single-function'

- There will usually be no end-user interaction with the device itself

- Would support monitoring, tracking, autonomous management, feedback/reporting

- These devices will typically be stationary, not nomadic

- Examples: Industrial Automation, Smart Grid / Smart Meters, Automated Meter Infrastructure, Home automation controllers, Security and Surveillance, Point-of-Sale machines, etc

Smart Embedded Devices for Industrial Automation

- Smart Embedded Devices in the manufacturing line permit **remote monitoring control from anywhere across the Cloud/Web**

- Native device drivers enable **direct communication with devices** - PLCs, RFID Readers, Cameras, Sensors etc.

- **Handle multiple vendor devices** with "normalized" view of disparate devices

- Embedded standardized client enables connectivity to 3rd party devices

- Local database for **data logging, caching**

- Powerful **edge processing** to offload work from enterprise applications

- Support database & message based communication protocols to enable **direct connection to enterprise applications & databases** - Oracle, MySQL, DB2, SQL Server, Sybase, MQ, MQTT, SIB, TCP, SMTP

- **GUI driven configuration & management system** (Workbench) enables rapid deployment & efficient, effective management

- Policy based **security** enables user privileges & data access control

Rockwell Manufacturing Automation
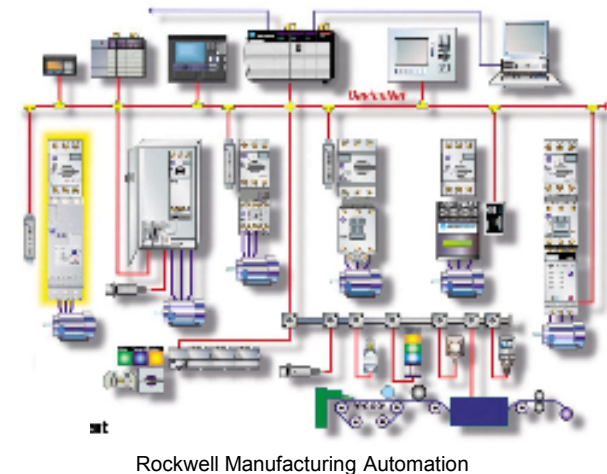
ILS Technology's deviceWISE product is a software framework that enables intelligent and secure Connectivity from devices to enterprise systems

*Source: ILS Technologies, June 2009
Image from Rockwell website

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Smart Embedded Devices - Smart Grid/Telemetry

The smart electric grid refers to **smart computing** (information technology) and **digital communications** capabilities **overlaid on the electric distribution network** to enable utilities for the first time to have **real-time visibility** into their end-to-end electric distribution networks.

The technology turns every point in the existing network – including **every meter and transformer** – **into a potential information source**, able to instantly feed performance data back to the utility.

Simply put, it provides utilities with the intelligence required to implement real-time, self-monitoring networks.

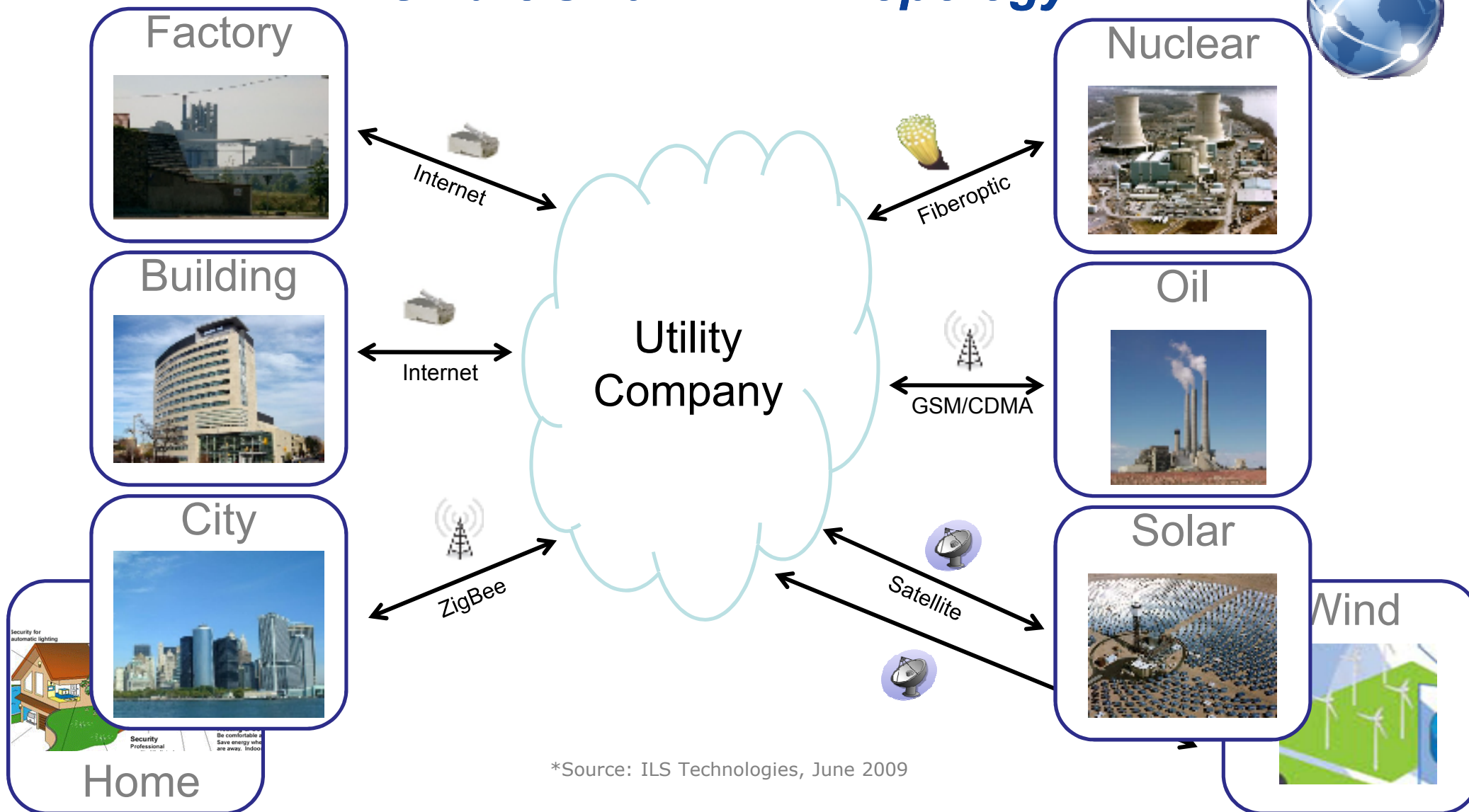(U.S. DoE Smart Grid Report, July 2009)

SOURCE: Text from **US DOE Smart Grid Report July 2009**
Images from CleanTechSanDiego and G. Arnold/D. SU of NIST July 2009
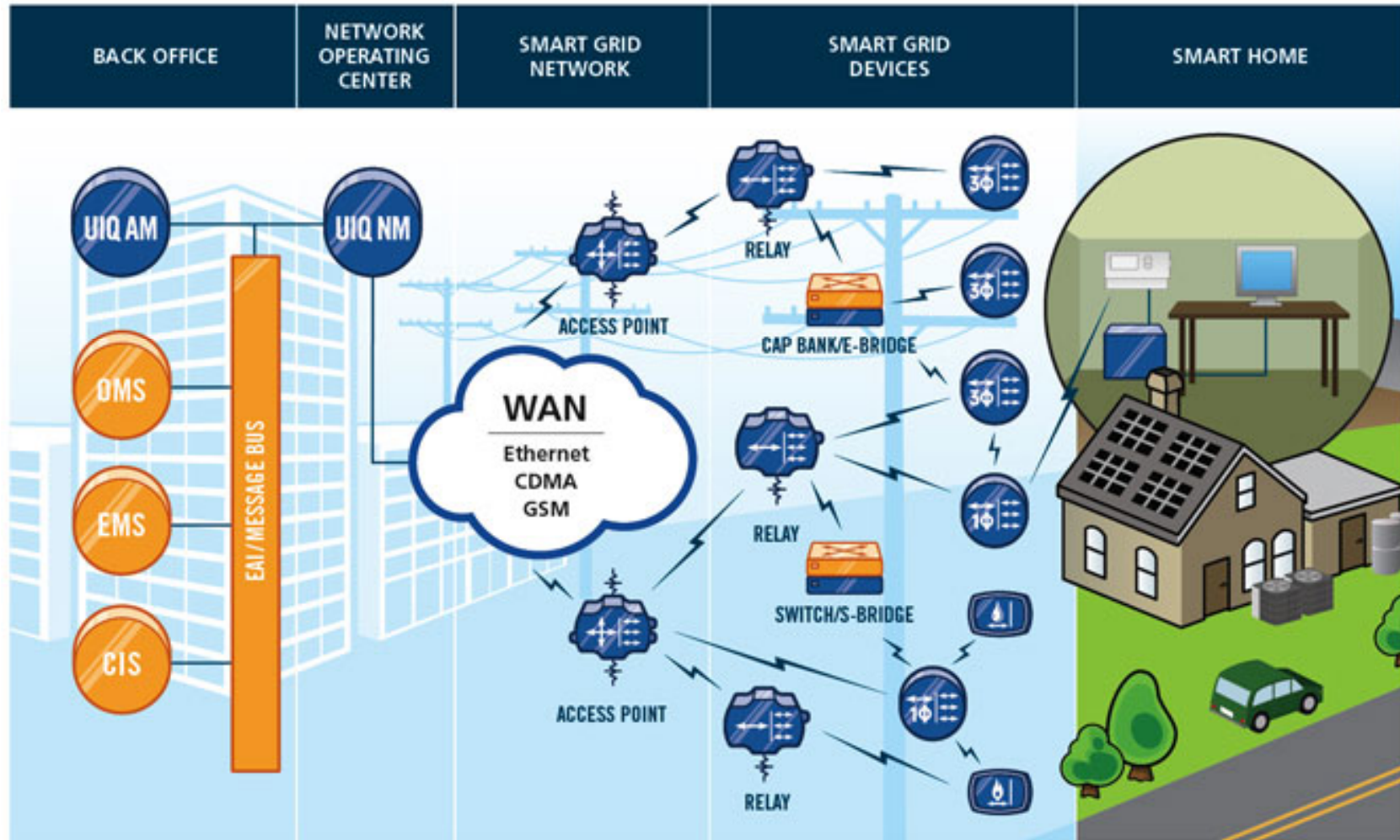
Smart Embedded Devices – The Smart Grid

- **Sharing data and passing events** between Power Producers, Utilities, and Power Consumers, allowing more intelligent decisions

- **Automatic Demand Response** (ADR) is used to describe the signals between the parties about power production/ consumption/ cost

- **Power Plants signal the Utilities** when their capacity changes.

- The **Utilities signal the Consumers** (homes, businesses, factories) of any events of decreased capacity.

- If Consumers do not reduce electricity usage, blackouts/brownouts will occur.

- Utilities use **"Dynamic Pricing"** to incent Consumers to reduce their electricity usage (changes by the minute, pricing signals to consumers)

The Role Of Smart Embedded Devices – Smart Grid – ADR Topology

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Factory

Internet

Building

Internet

City

ZigBee

Home

Utility Company

Nuclear

Fiberoptic

Oil

GSM/CDMA

Solar

Satellite

Wind

*Source: ILS Technologies, June 2009

Smart Embedded Devices In The Smart Grid

SOURCE: eco.microsiervos.com

Smart Embedded Devices - Smart Grid/Telemetry

Advanced Metering Infrastructure (AMI)

- "Smart" devices (e.g., communicating thermostats, clothes washers and dryers, microwaves, hot water heaters, refrigerators) use **signaling software or firmware** to communicate with the grid

- Smart Devices coordinate with the energy facility's energy-management system to **adjust operational controls**, within specified limits, based on energy prices

- Smart Devices play a role in energy generation as well e.g. some wind turbines have as many as 18 processors

SOURCE: Text from **US DOE Smart Grid Report July 2009**
Images from CleanTechSanDiego & D. Su of NIST

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The Role Of Smart Embedded Devices – Smart Homes

• Home automation, remote security monitoring, intelligent energy monitoring, streaming media connections, interface to telematics in parked cars, interface to healthcare ICT devices

Web Communicator

Web Customer Interface

Wireless Backhaul

Internet Web-link II allows you to control and see status of your HAI System from anywhere via the web

Telephones Control your System and get status via any phone at home or away. Also, get a call to advise on temperature, security and more.

Motion Detection Serves a dual purpose: Security for intrusion, occupancy for automatic lighting

Pool & Spa Control filters, timers, heating, temperatures, solar control and more

Wireless Camera

Health Sensors

Healthcare Sensor

Home Control

Smart Meter

Remote Commander

Vehicle Detection Announce Visitors, turn on lights, and switch on TV to view driveway, etc.

Lighting Architectual quality lighting control, passive security for "lived-in" look

Security Professional quality UL-listed security is built-in to Omni-family controllers

Irrigation HAI controllers can control your irrigation solenoid values for lawn sprinklers, plus inputs for rain sensing.

Heating & Cooling Be comfortable at home. Save energy when you are away. Indoor/Outdoor temperature and energy management.

Multi-Room Audio Control music selections & volume around the house with your Omni.

Smart Thermostat Communicating thermostats for heating & cooling control. Displays time and outdoor temperature.

Emergency Assistance Wristband Transmitter Pendant Transmitter

Courtesy: Automated Lifestyles

The Role Of Embedded Devices In Smart Homes

Key Features – supported by existing and emerging technologies in the advanced home

- Monitor entire house including all major appliances

- Access device status and control them from anywhere in the world

- Sense and report motion anywhere in the premise

- Measure and report ambient light anywhere in the premise

- Configure devices to respond to various alarms including demand, consumption, motion and light

- Configure and organize devices into convenient zones to better manage them

- Set timers to control individual devices

- Set recursive schedules to individual or groups of devices

- Store, aggregate and report all the historical data for individual devices, premises, ZIP codes, substations, districts and regions

- Provide management dashboard

Courtesy: Pacific Star Homes

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The Role Of Embedded Devices In Smart Homes

Key Features

- Can **communicate with any home appliance** or electrical device to allow **remote control through Internet** via computer, laptop, or mobile phone.

- **Medical assistance** available through remote monitoring services and smart healthcare ICT device monitoring: set alarms to contact emergency personnel

- **Video surveillance** and monitoring of your home through Internet including alarms that will contact you by phone, email, or other alerts to notify you of security breach in your home.

- Automate your home to **control lights** as you move through the house, schedule events for certain appliances

- Control your energy bill by setting alarms and notifications that notify you of daily, weekly, or monthly usage and **monitor the energy use** of every electronic device in your home.

- **Download movies, music, and games** from the Internet directly to your home entertainment system through online content providers.

Courtesy: Pacific Star Homes

Smart Embedded Device Communications
Types Of Devices - 2

Consumer Electronic (CE) Applications

- These devices would **communicate with application servers** and other CE devices connected to the Internet through **autonomous or user-initiated** mechanisms.

- These devices would perform multiple functions depending on the type of device.

- There may be **significant end-user interaction** with the device itself.

- These devices can be stationary and/or nomadic.

- Examples: **Digital cameras, e-book readers**, netbooks, netphones, and tablet PCs, digital media players, and gaming devices. Special attention to **Healthcare ICT devices**

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The Role Of Smart Embedded Devices – Consumer Applications

E-Books

- **Smart downloads on specified date using WWAN/WLAN networks**

  – **Books and newspapers**

  – **Semi-autonomous operation**

  – **Reach out and delete capability too!**

- **Reading has changed**

  – **Power browsing**

Sony e-reader

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The Role Of Smart Embedded Devices – Consumer Applications

Connected Digital Cameras

- **Equipped with WLAN, BlueTooth and DLNA capability**

  - **Digital Living Ntwk Alliance interface allows connecting to other DLNA devices like HDTVs, PCs**

  - **Upload images via WiFi to others, Facebook, YouTube**

- **Geotagging w GPS**

  - **Locatable 24/7**

SONY

Smart Embedded Devices In Healthcare ICT

- Enabling proactive Personal Telehealth* and enhance patient/physician convenience
  - **Remote Monitoring, diagnostics and reporting systems**
    - People can transmit their vital signs - blood pressure, heart rate, oxygen saturation, glucose levels, temperature, weight, respiration - seamlessly from home to their health professional
    - get real-time feedback on their condition
  - **In-body** drug delivery systems and sensors
  - **On-body** Smart peel-and-stick "Band-Aids"
  - Wireless-controlled drug delivery; wireless pills
  - fitness management devices and applications
- Personal health and medical devices must be **fully interoperable** with each other and with other information sources.
- Broad interoperability has yet to be achieved

Gary & Mary West Wireless Health Institute

Continua HEALTH ALLIANCE

* Source:Continua Health Alliance site

Web images from Continua, CardioNet

![wirefreeCom logo]

Smart Embedded Devices – Healthcare ICT

Healthcare ICT / TeleHealth Smart Devices

- Devices slowly appearing in the market

- Can use the WWAN technologies to transmit vital signs data, or use WLAN, or collect&store data offline for transmittal when home via BlueTooth wireless

Digital Pill from
Proteus Biomedical

CardioNet™ monitoring with
CDMA enabled PDA**

**"Take Two Digital Pills and Call me In
The Morning" – WSJ Aug 4, 2009**

The UA-767PBT-C is a Continua
Certified™ professional blood
pressure monitor with Bluetooth®
wireless technology

BandAid
from Corventis

Nonin Onyx II 9560 Wireless
Fingertip Pulse Oximeter w
BlueTooth®

Cambridge Consultants Vena
BP monitor w BlueTooth®

•Source: Continua Alliance
•** **Source: CardioNet Inc**

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Smart Embedded Device Communications
Types Of Devices - 3

Telematics and Public Safety Applications

- These devices will typically **communicate with application servers** connected to the Internet or emergency services personnel and first responders.

- These devices would perform **autonomous functions** such as vehicle diagnostics, location tracking, or crash incident reporting, as well as **user-initiated** functions such as vehicle navigation, and concierge services.

- There will be some end-user interaction with the device itself.

- These devices will typically be **nomadic**

- They may require support for inter-operator wireless roaming.

- Examples: Vehicle diagnostics, Navigation, and Asset Tracking

Smart Embedded Devices For Consumer Telematics

The Fully Networked Car integrates new capabilities

- GPS/Navigation with map downloads, real-time traffic information, points of interest, coupons
- Shopping from the vehicle, entertainment downloads controlled through a Web interface
- **Automatic Crash Notification** to Monitoring Center with GPS data, just as done now
- Electronic control units throughout the car constantly monitor wheel slip, engine temperature, fuel mixture and hundreds of other variables, while regulating the anti-lock brakes, traction control systems and other safety and control features (Omnitracs-like features)
- Regular diagnostics automatically scheduled while parked, reports uploaded to Service Ctr.
- The Vehicle connects to the terrestrial cellular or satellite networks with hi-gain antennas for a broadband data link
- The vehicle is a mini WiFi hot spot, and can link with a network at the user's home -- when it is parked in the garage, for example, allowing information to be uploaded into the vehicle.
  - The user could load a series of street maps, favorite songs and even a few videos to watch on a long trip, for example, or configure automatic daily uploads of traffic and weather information.
- Vehicle interface to **driver and passengers' healthcare monitoring** through standardized Near-Field Communications (NFC) wireless interface

Smart Embedded Devices For Consumer Telematics

The Fully Networked Car – User Interface Features

- Voice recognition, text-to-voice system to interpret e-mail messages and read them aloud.

- Composing and sending e-mail using just voice commands

- Ability to interface to the vehicle via a secure hosted Web portal, provisioned to allow users to log in and run a complete set of diagnostics of their car,

- Provisioning to connect to a WLAN (in parking garage) to get daily uploads, or subscribe to new services.

Telematics as a way to integrate your car into your life

in new and exciting ways

Source: Hugher Telematics Systems, Vision of Erik Goldman
Image from Robert Horvitz, View from Europe, 2008, Source TMC

Smart Embedded Devices – Asset Tracking

- **Smart Devices have been part of Fleet management services like OmniTracs**

- **Accurate position location is key**

- **Active and passive wireless devices are being used to track equipment shipments (RFID tags)**

- **Wireless and Ultrasound smart devices track patients in hospitals**

- **New capabilities and associated enhanced management systems**

- **Power usage and cost are challenges**

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The Connected Planet –
Entrepreneurial Opportunities

- **Development of communications hardware and software for edge-resident smart devices, including new features - product**

- **Operations management systems, including middleware and dashboard systems development - product**

- **Sensor network management systems - product**

- **Testing and certification of systems – engineering svcs**

- **Customer support for enterprises & individual customers - Svcs**

- **Demonstrate Improved Return On Investment (ROI), or Return on Asset (ROA) in the Supply Chain**

The Connected Planet –
What are the Challenges?

- Venture funds not readily available for businesses focused on communications infrastructure, including management systems

- Market dynamics between incumbents and new entrants in the telematics, industrial automation, home automation and healthcare ICT

- Proprietary Systems prevent scaling and cost-effective solutions; also competitive posture preventing sharing of information

- Timely availability of trained installation teams

- Global Regulations on maintaining privacy of subscriber information

- Customer acceptance of and comfort with innovative systems

The Connected Planet –
Possible Solutions

- **Education of VC community on the global promise and market potential**

- **Piggybacking on the needs of high profile Fortune 500 enterprises making investments in Smart Services/M2M**

- **Establishment of new cross-discipline coalitions to bring together existing and 'wannabe' market players**

  - **Vendors, service providers, after-market services, and regulators**

- **Identify common requirements between market segments; Develop international standards for Smart Devices/Services, fostering adoption of best-in-class approaches**

- **Timely availability of trained installation teams**

- **Global Regulations on maintaining privacy of subscriber information**

- **Customer acceptance of and comfort with innovative systems**

Thank You

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