



Setting the Standard for Automation™

M2M Goes Mainstream

What Happens When Moore and Metcalfe's Laws Meet the Internet of Things

Standards
Certification
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Mike Fahrion – director of product management at B&B Electronics

- Has 20 years of design and application experience in data communications.
- Oversees development of the company's rugged M2M connectivity solutions for wireless and wired networks.
- Speaker and author, including his “politically-incorrect” monthly newsletter, eConnections.



Pyramids

- Alien intervention?
- Or ordinary humans who wanted to build something very large and impressive?
- Made possible by new technology. The invention of agriculture produced large workforces.



Technology shapes culture

The pyramid form was rendered obsolete by the invention of the arch.



Obvious in hindsight

- Why do we give students summers off?
- Was commercial radio broadcasting inevitable?
- Why did Blockbuster Video collapse?



Unclear in transition

- Email is obsolete - if you're under 25.
- Voice calls flat, texting slowing down.
- Rise of cheaper message services like Facebook, Twitter, Skype and iMessage.
- All changing human communications and relationships.

Powerful trends are at work



- **Metcalfe's Law**

States that the value of a network increases proportionally with the square of the number of nodes.

- **Moore's Law**

Describes the amount of time it takes for the number of transistors that can be placed on an integrated circuit to double.

Powerful trends are at work

Geometric increases in value and decreases in cost are driving tremendous growth in network expansion:

- First, in computing devices
- Then, in people
- Now, in things

We've already seen how the "Internet of Communications" changed the way we work.

We're on the verge of discovering how the "Internet of Things" will change the way we live.

Certain enablers are clear

- Standards-based “Tier 1” wireless technologies
 - Wi-Fi, Bluetooth, Cellular
- Application-focused wireless standards
 - ISA100, WiHart, ZigBee,
- Low power design & innovative power technologies
- Network architecture
 - IPv6, 6LowPAN

Enablers: Tier 1 wireless technologies



- Commercial Ethernet ended the field-bus wars. Top tier wireless standards will dominate M2M communications.
- Commercial market volumes drive costs down.
- Large, competitive markets drive tremendous R&D spends; next-generation parts coming in 18-month cycles.
- Standards-enabled, market-driven, 100% interoperability.

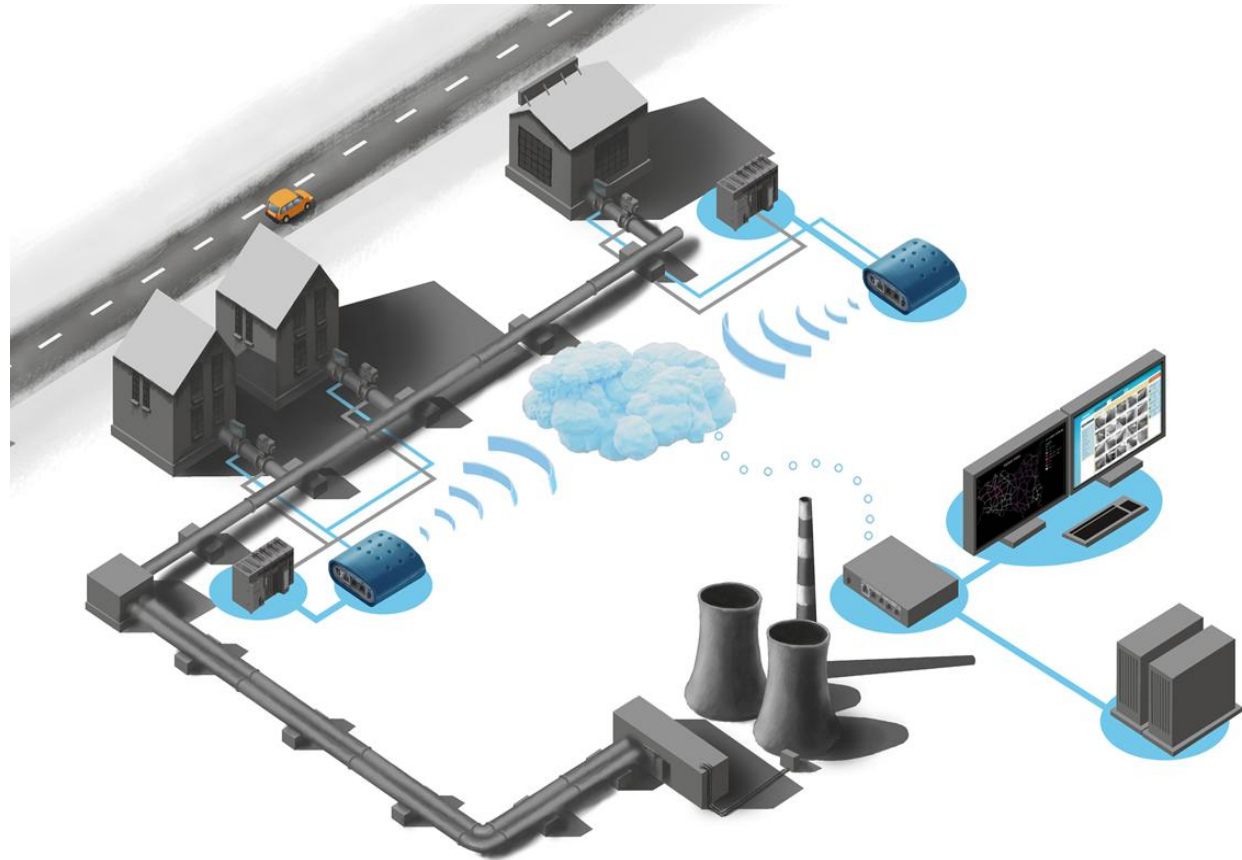
Enablers: Wireless - WWAN - Cellular

- Cellular provides managed infrastructure with very good (almost great) reach.
- Data plans are becoming more M2M friendly.
- Strategic market for wireless carriers – their growth relies on machines using the phone.
- One cellular backhaul connection can support hundreds of local sensors.
- Approximately 2 billion chipset shipments 2011.

- Backhaul
 - Cellular data connections can serve as primary Ethernet infrastructure where cable or Wi-Fi are impractical.
- Failover
 - Cellular data connections can take over when land lines fail.
- Out-of-Band Connections
 - Cellular out-of-band connections give offsite IT staff immediate access during network outages.

Cellular Case Study: Heat Distribution Network

- 49 plants, 664 km pipeline, 265K+ customers, with wired connections impossible at many locations
- Automated the manual reading of remote heat meters using cellular routers to connect and transmit remote data to central server via GPRS/EDGE network
- Annual savings = hundreds of thousands of Euros

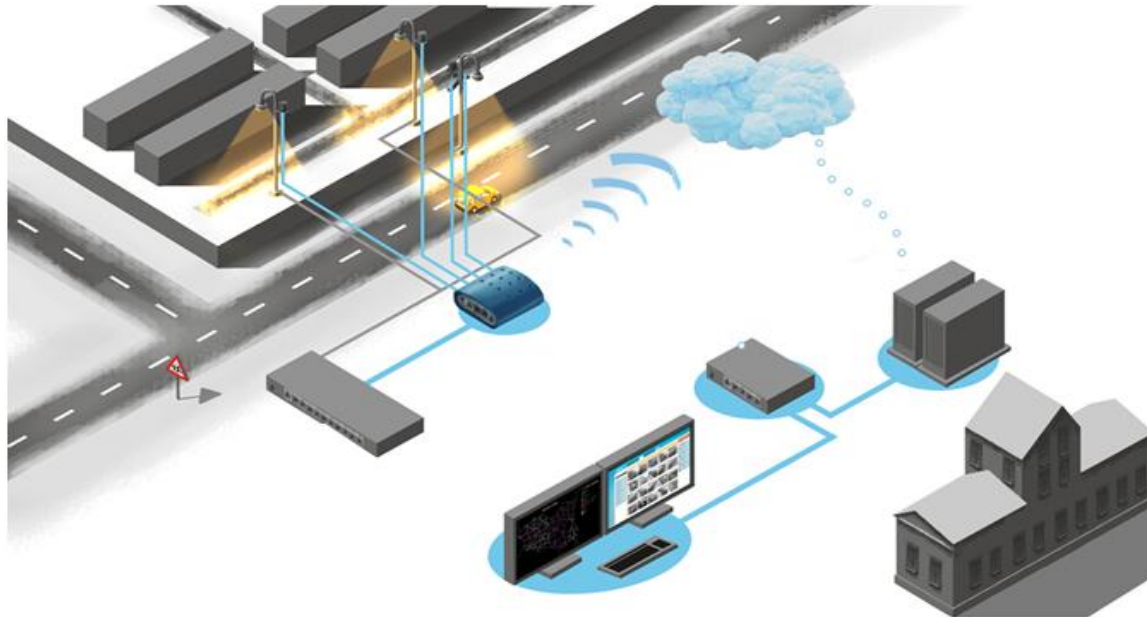


Prague Heat Distribution Network

Cellular Case Study: Public Light System



- Goals: cut energy use/operating expenses, extend electric bulb lifespan
- Remote monitoring/control system using GPRS/EDGE routers, photo and motion sensors capture/transmit diagnostic data (energy use, remaining bulb life, problems) so operator can optimize processes in real time.
- Operator reduced energy use/operating expenses by 60%.

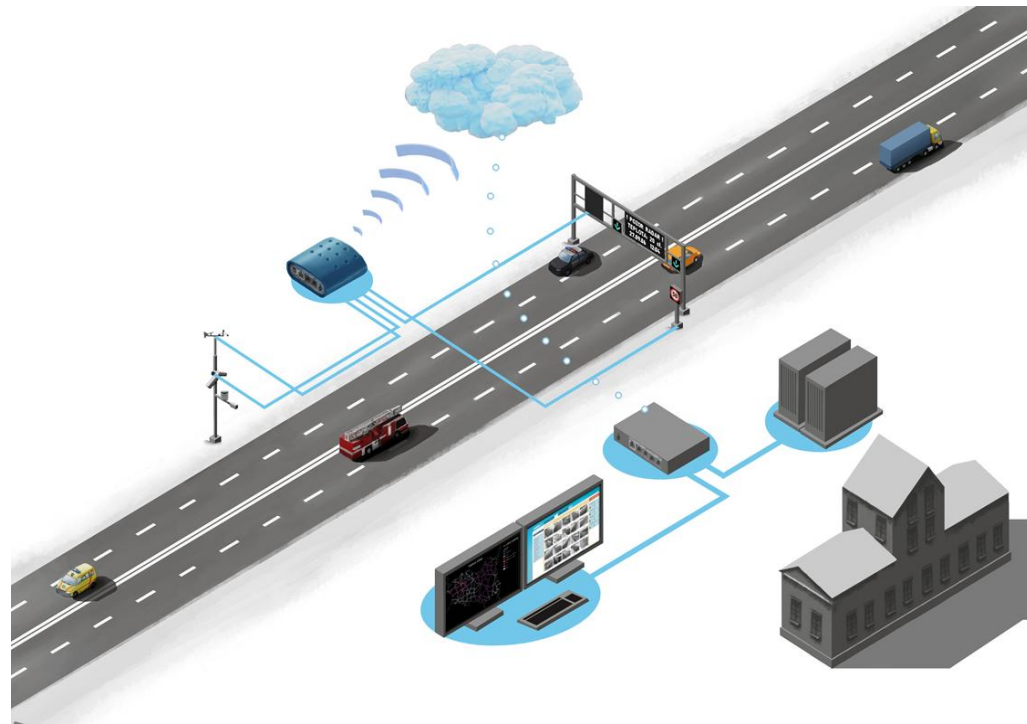


Country-wide
public lighting
system

Cellular Case Study: Traffic Control

- Goal: two-way communication between remote devices and monitoring center in geographically-dispersed area where cable is impractical.
- Video stream for diagnostics requires high-speed HSPA+ cell network.
- Monitoring/control system uses UMTS/HSPA+ routers, security cameras, meteorological sensors and dynamic road signs to access/analyze traffic and weather conditions and alert drivers in real time.

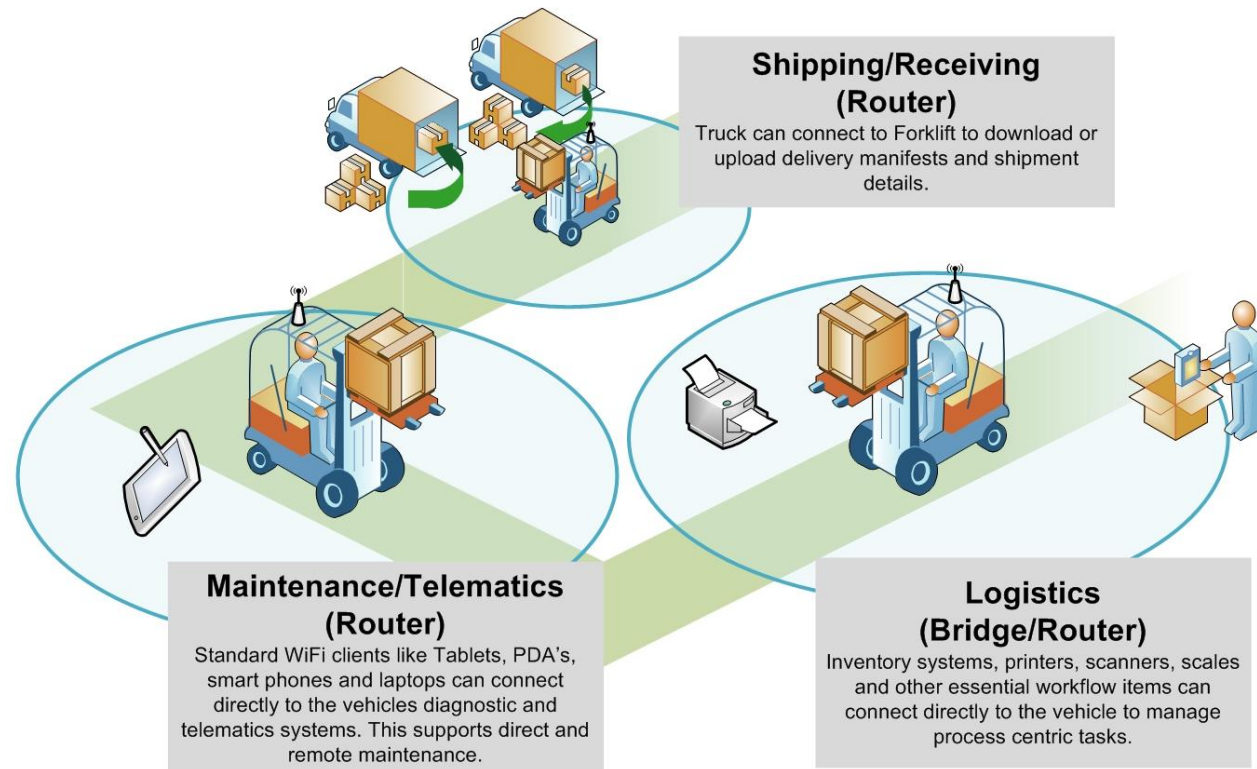
Intelligent,
Interactive Traffic
Control System



- Pervasive, interoperable, “free” infrastructure – but your own responsibility.
- Beginning to address sensor market with “lite” chipsets adapted to micro power and low BW requirements.
- Winner of the “convert to IP” strategy race.
- More than one billion chipsets shipped in 2011.



- In applications like shipping and receiving, Wi-Fi wireless access points can keep mobile M2M equipment connected as it moves around a plant



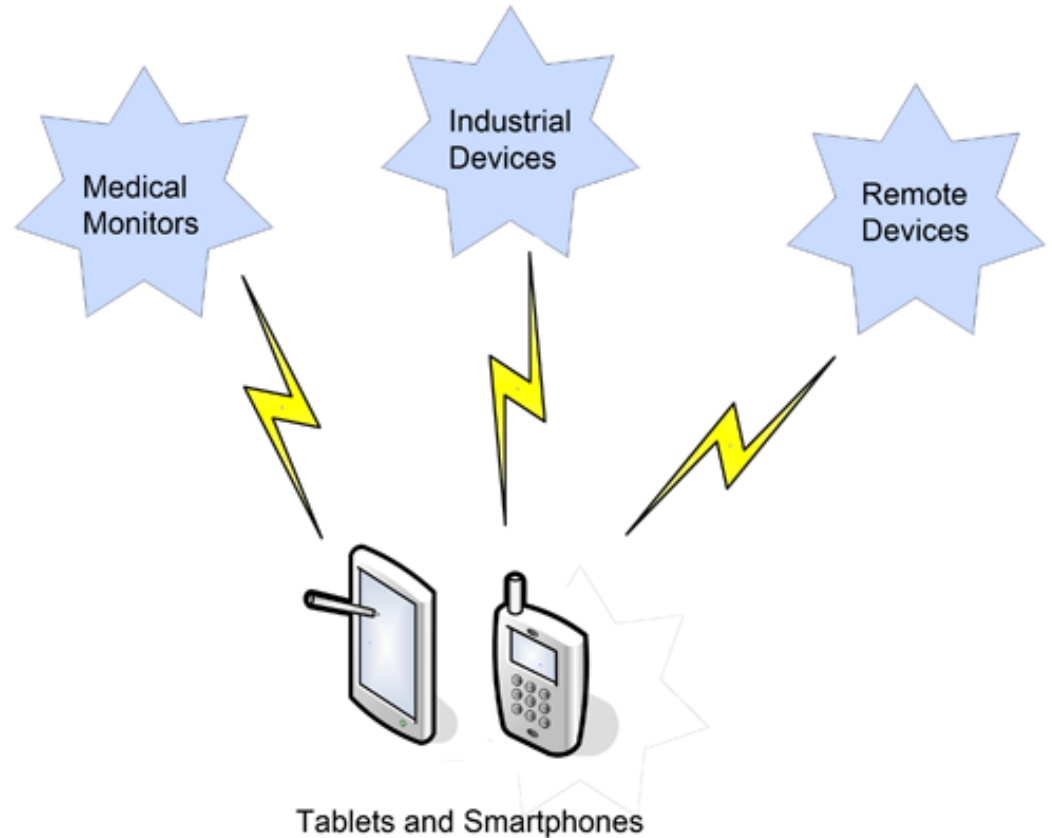
Wi-Fi Applications: Network-Enable Legacy Devices



- **Problem:**
 - Communicating with serial devices as fewer laptops or computers come equipped with serial ports.
- **Solution:**
 - Embeddable Wi-Fi access point (AP) technology can turn serial devices into self-sufficient communication hubs for M2M networks.
 - Handheld Wi-Fi clients can then connect using Android, Apple iOS, or Microsoft Windows OS.

- Bluetooth 4.0 – enabling micro-power applications.
- Maximum component volumes, R&D.
- Smart phones & tablets are ubiquitous gateways to IP.
- Chipset integration: where goes Wi-Fi, so goes BT4.0.
- 10-300 m range, low latency, high efficiency.
- Optimized for sensor data.
- Nearly two billion Bluetooth chipsets shipped 2011.

- Eliminate the need for expensive HMI equipment.
- Low power and localized intelligence.



Enablers: Application-specific wireless standards



- ZigBee – The origin of the buzz about wireless sensor networks (WSN) and mesh. Lighting/Building automation adoption, some crossover into smart energy sub-metering apps.
- WiHart and ISA 100 – a tale of two paths; vendors and process industry response to WSN needs not addressed by ZigBee.
- Each based on 802.15.4 chipsets; 100+ million chipsets shipped 2011.

- Every technology is making strides in reducing power, with remarkable gains in Wi-Fi and Bluetooth 4.0.
- When coupled with sensible system design, several technologies have reached viable micro-power states.
- “Lifetime” batteries, power harnessing techniques = key enablers to rapid growth in wireless applications.

- Metcalfe's Law: Devices must be able to communicate in order to expand the value of the network.
- Design strategy: Push IP-based protocols to the edge of the network:
 - When IP-interoperable networking benefits kick in, vendor dependencies fall out.
 - IPv6 removes addressing limitations.
- 6LoWPAN brings IP to low-bandwidth applications based on 802.15.4 and other wireless technologies.

Driving changes in architecture and design

- Building a “Five Nines” network is possible. But do you really need to pay for a network with 6 sec/week downtime?
- What percentage of applications, if properly engineered, could utilize a 99% network, or less?
- Network design should drive node functionality towards eliminating dependency on “Five Nines” of uptime.

99.999

99.000

What does it mean to node design?



- Power and size constraints require nodes to become intelligent:
 - Local data storage used to overcome network realities
 - Internal business logic used to keep devices off the network until they have something meaningful to say
 - Situational awareness logic – the state of the network, surrounding nodes, power availability and the state of the system are all inputs to local device behavior
- Moore's law makes it more economical to burden the node than the network – freeing us to consider many new network topologies.

More on node design...

- Report on exception – don't burden a network or sacrifice power to transmit redundant information.
- Advanced algorithms & statistical modeling at the node.
- Add inputs to the algorithm – network bandwidth, availability, power availability.
- Utilize data from surrounding nodes – situational awareness.
- Store and forward model – network conflicts/outages should never result in data loss.
- Heartbeat/health reporting mechanism – eliminate dependencies on polling.
- Security mechanisms – authentication and encryption.

What it means to system design

The priority of design constraints has changed

1. Network design
2. Power constraints dictate system topology and technologies
3. Security

Conclusions

- We are on the cusp of the next shift in society, both enabled and driven by technology.
- Leaders aren't just adopting new technology – they're dramatically shifting architecture and design to leverage the opportunity.



Thanks and Questions



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