Embedded IP(v6) Networks

The Internet of Things is on the way

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Enabling Technology – Why Now

- Advances in micro-controllers
  - Low power, more processing, lower cost
  - Thank you Gordon Moore
- Advances in RF technologies
  - 802.15.4 low power – battery operations
- IPv6
  - Addresses, Addresses, Addresses

IP Myths – Why the delay

- IP headers are too big
- IP code is too large
- IP requires too much RAM
- Gateways are easy

Why IP?

- Support for multiple Phys
  - 802.11, Ethernet, GPRS, PLC, Serial Lines
- Existing Resources
  - Tools, Protocols, Knowledge
- Established transport and application models
- Established naming and addressing

Don't reinvent the wheel

Why IPv6?

- Huge Address Space
- Stateless Address Autoconfiguration
  - DHCP servers not required
- No need for NAT
  - No NAT configuration
- No translation Gateways
  - Routers and Bridges

Wireless IP Sensors - 6LoWPAN

- A Standard
  - RFC4919 and RFC4944
  - ISA100 – Industrial Wireless Sensor Networks
  - IEEE 1451.5 – Wireless Transducers
- Efficient
  - Battery operation, header compression, small code footprint, “stacked” headers
- Available
  - Multiple independent implementations – 10+
  - Increasing number of deployments

6LoWPAN Comparison

	6LowPAN	Zigbee
Packet Size	3 to 12 bytes	14+ bytes
Code Size		
End Node (RFD)	11K	64K+
Routing Node (FFD)	17K	128K+
RAM		
End Node (RFD)	2K	8K
Routing Node (FFD)	4K-8K	8K+
Cost	OpenSource	???

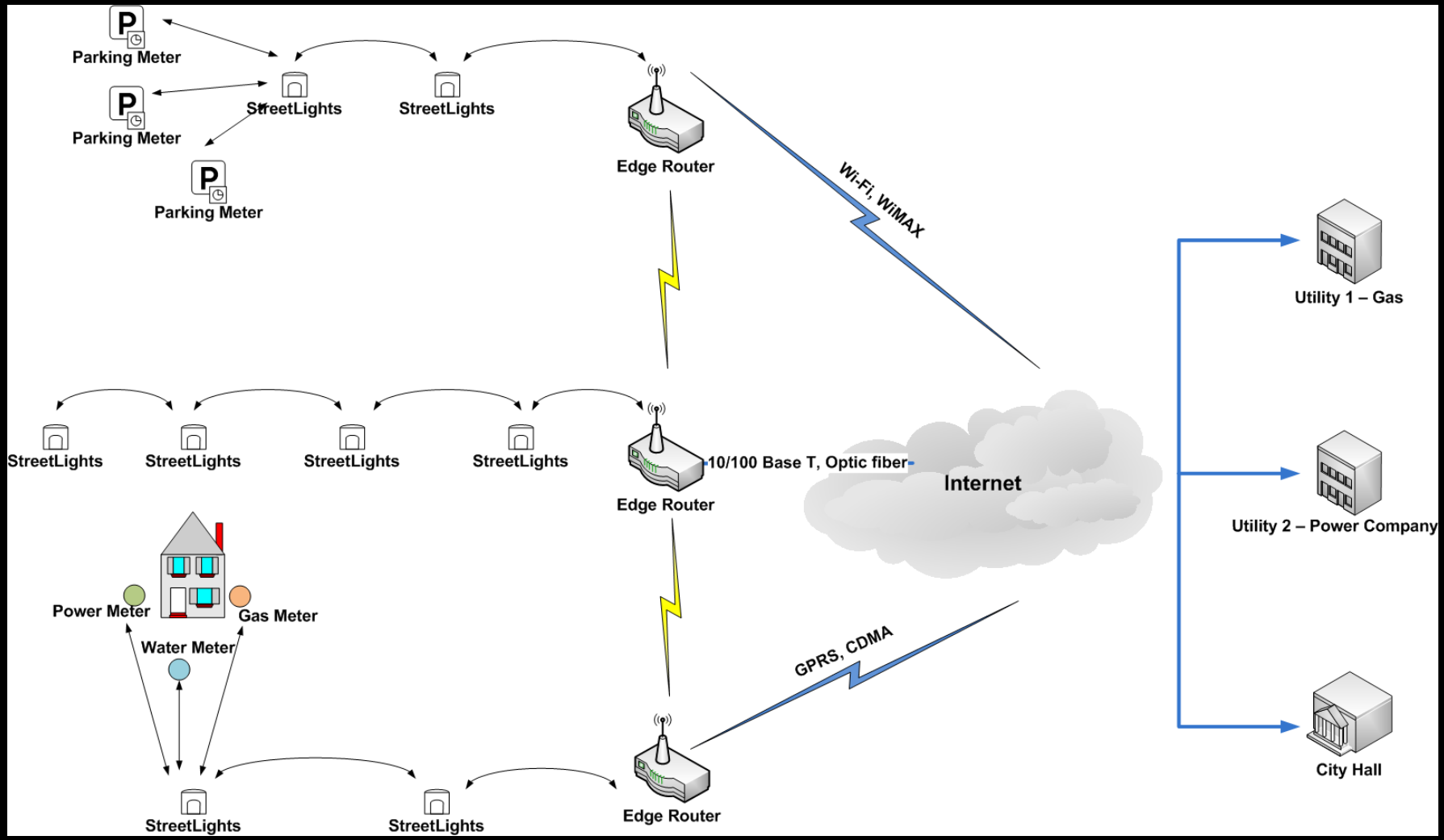
Vision: Ubiquitous Wireless Data Acquisition and Control

- Metropolitan Area Network formed of:
  - Low-cost ubiquitous IPv6 addressable sensor nodes
  - Highly scalable network
  - Support for low-power, battery operated or energy scavenging sensor nodes
  - High reliability of data delivery through advanced routing mechanisms
  - Wireless co-existence and spectrum management mechanisms
  - Leverages open standards that allow for multi-vendor interoperability
  - Guaranteed security and integrity of data transmissions

Pole-Top 6LoWPAN Network

- Nivis has deployed 100k+ IPv6 enabled wireless mesh sensor nodes in major US cities (Atlanta, New Orleans, Jersey City) as part of a Street Light monitoring and control network
- Nodes reside on top of poles as part of the lighting fixture
  - Wireless nodes operating in the 2.4 GHz band
  - Huge energy savings through remote dimming capabilities
  - Monitoring power consumption and proactive maintenance
- Sensors are organized in subnets that scale up to 20k nodes
- Battery operated gas, water and parking meters located at ground level piggy back data over the Street Light monitoring and control networks
- Yes – we have the power to remotely dim the streetlights during Mardi Gras

Applicability of the IPv6MAN



Applications

- Street Lighting Monitoring and Control
- AMR (Electric, Gas, Water)
- AMI – Smart Grid applications, automated load balancing
- Parking Meter Monitoring
- Traffic Monitoring
- Environmental Monitoring
- Premise Security Monitoring
- Homeland Security Sensor Alarms
- Bridge Stress Monitoring Alarms
- In Home Power Usage display
- Vehicle/Asset Tracking
- Tank Level Monitoring
- Storm Drain Blockage Alarms

The IPSO Alliance

"Promoting the use of IP in networks of Smart Objects"

- Create awareness of available and developing technology
- Promote and market use of IP in embedded systems
- Generate tutorials, white papers, technology demonstrations and highlight use cases
- Complement the IETF and other standards groups
- Support and organize Interoperability events
  - March 4th – 11 companies; 7 countries
  - SixXS, Hurricane and Freenet6 Tunnels

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A Quiz

Looking Forward

- Plenty of address space to embed IP in nearly everything
- Smart device to device communications
- Nodes can easily “phone home”
- The “Internet of Things”

IPv6 Inside*

*Apologies to Intel