



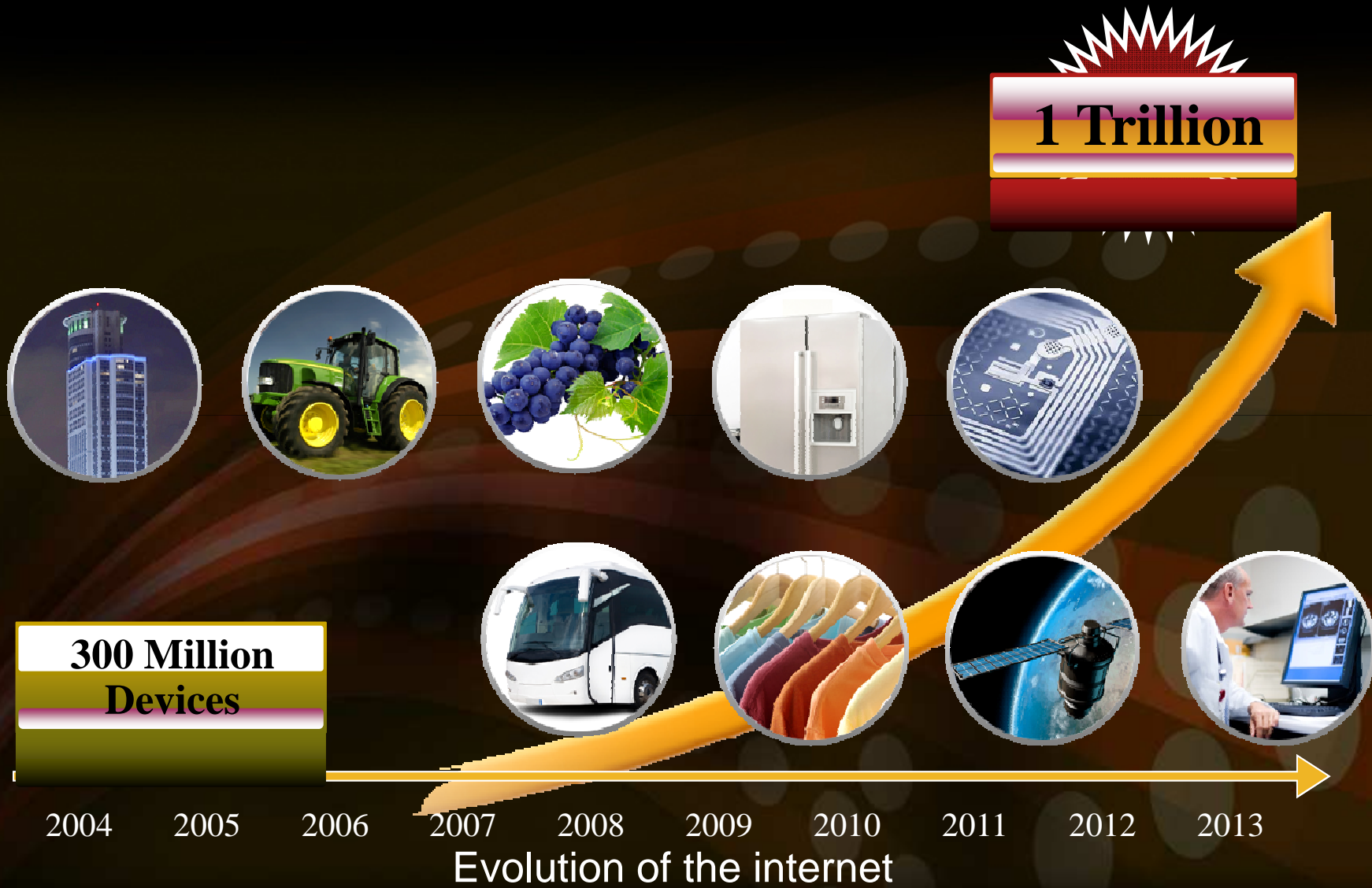
IP end-to-end in Smart Grid Networks / Standardization Update April 2011

JP Vasseur (jpv@cisco.com)
Cisco Fellow

Co-Chair of the IETF ROLL Working Group
Chair of the Technology Advisory Board – IPSO alliance

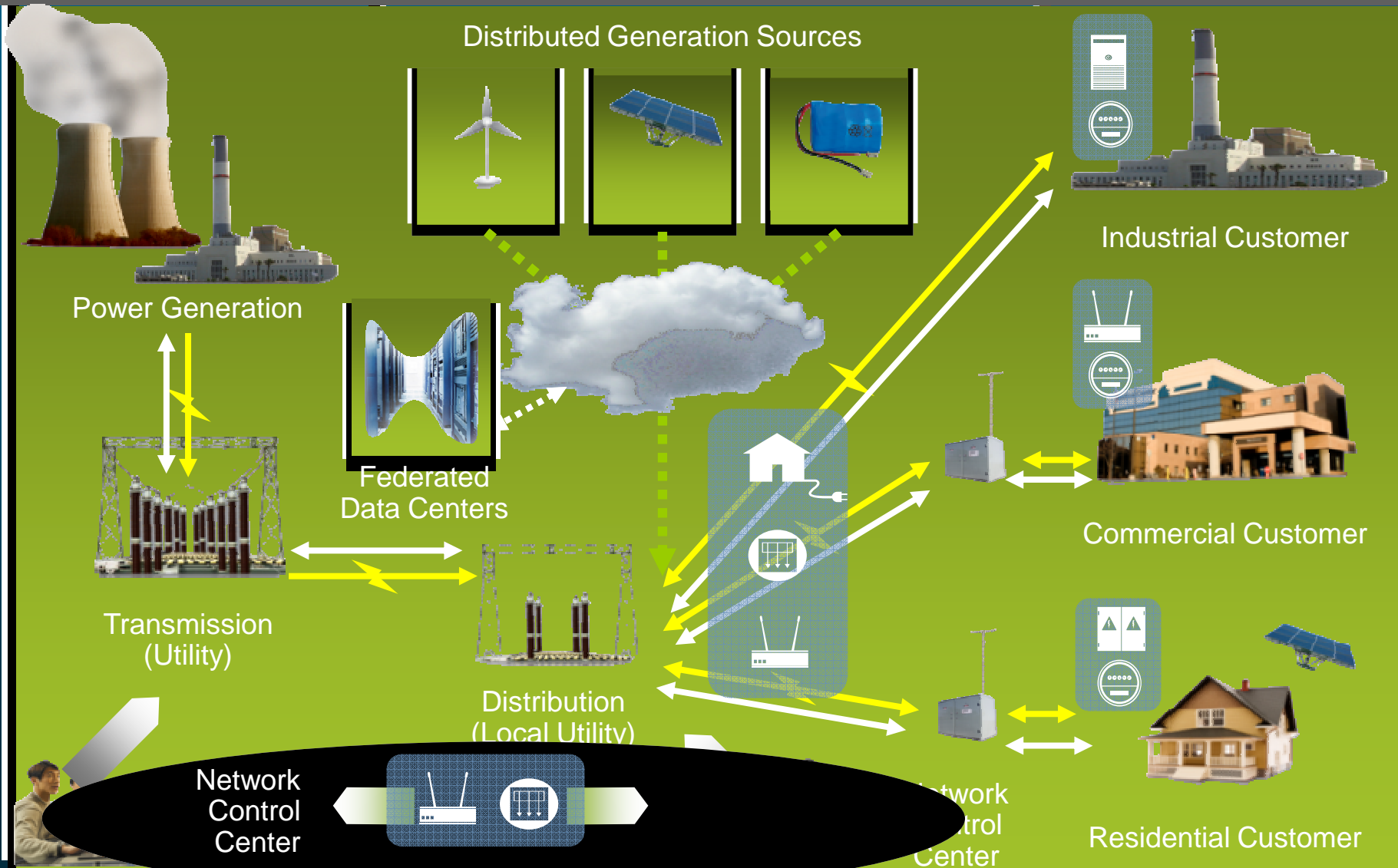


Everything Becomes Connected

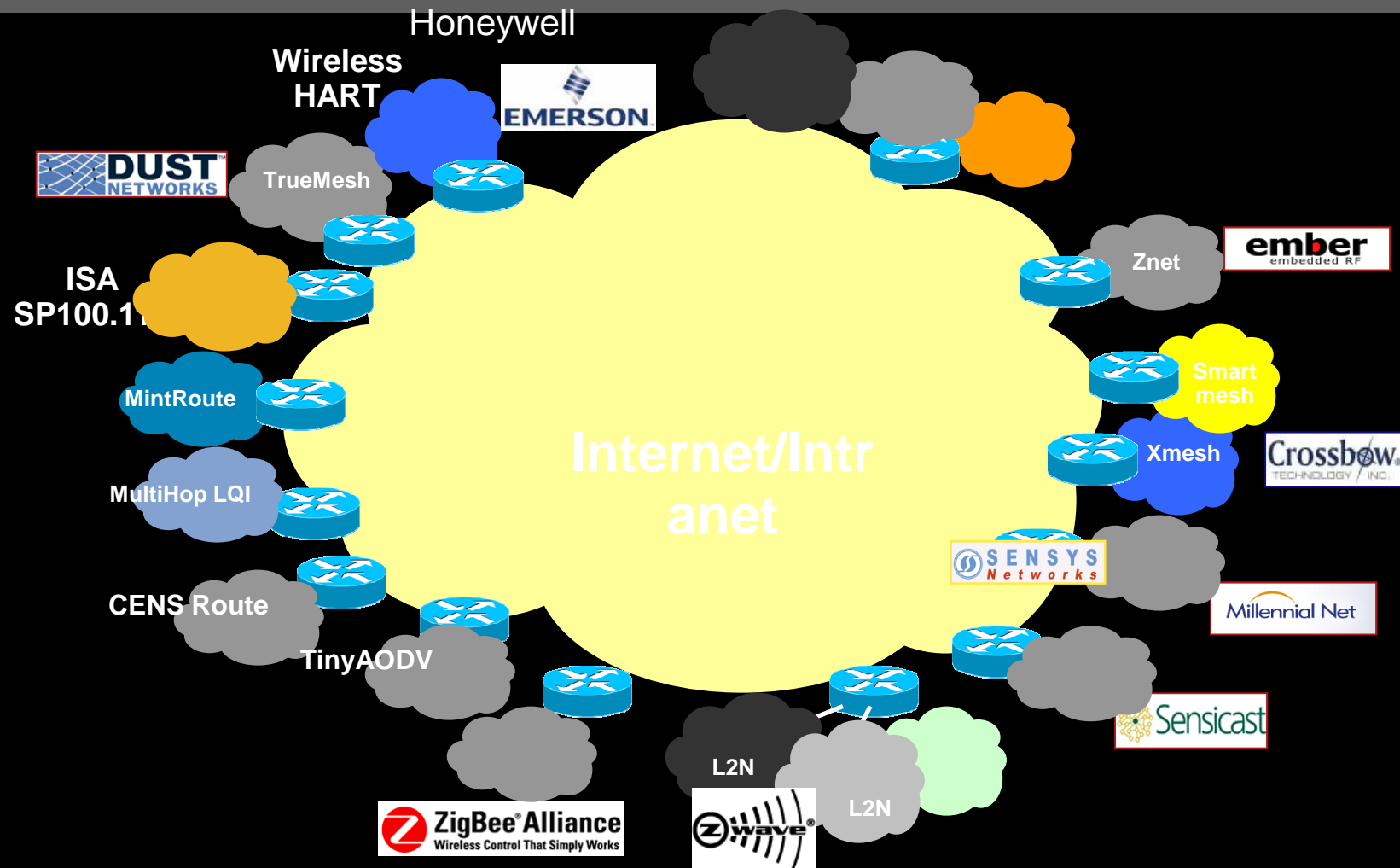


Smart Grid: A network of Smart Objects

→ Energy ← Information



Trend as of IETF – 2007



Most promoters of non-IP solutions have understood that IP was a MUST: they call this "IP convergence": A protocol translation gateway ! Or Tunneling ...

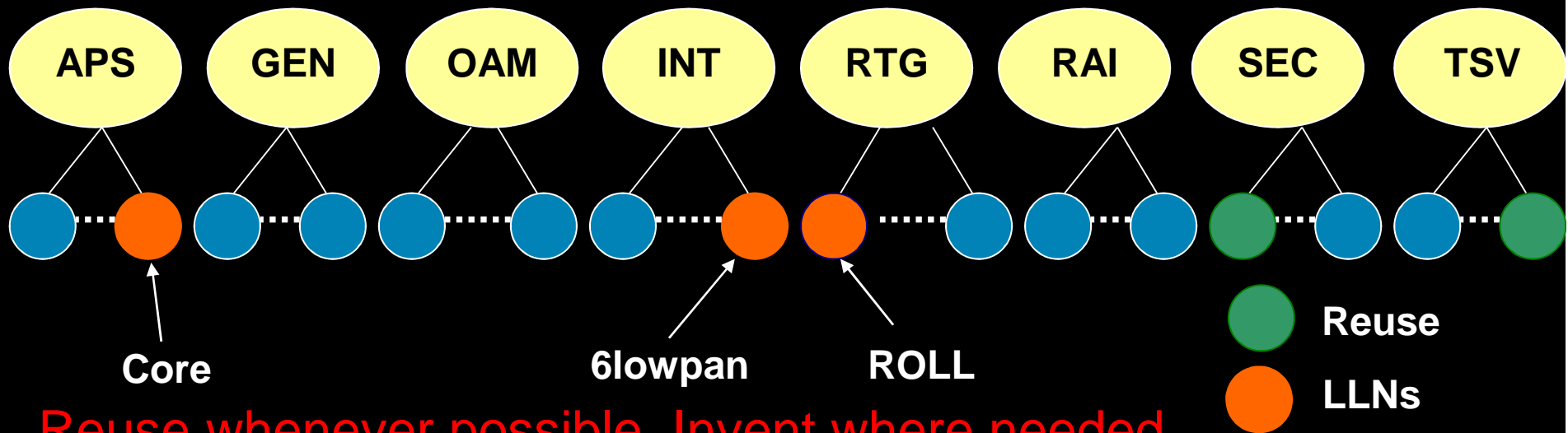
Learn from the Past



- Tunnelling and protocol gateways are not the answer
 - Easy way out for vendors to declare they are compliant
- **Protocol translation gateways is the wrong approach for the “Internet of Things”:**
 - Expensive and difficult to manage (CAPEX and OPEX)
 - Number of technical issues: lack of QoS end-2-end, fast convergence consistency
 - Force down the path of the least common denominator
 - Clearly not an enabler for innovation
 - Different scale !
 - Security holes ...
- Use of IP allows access anywhere anytime anything
 - Allows consistent architecture and protocols**

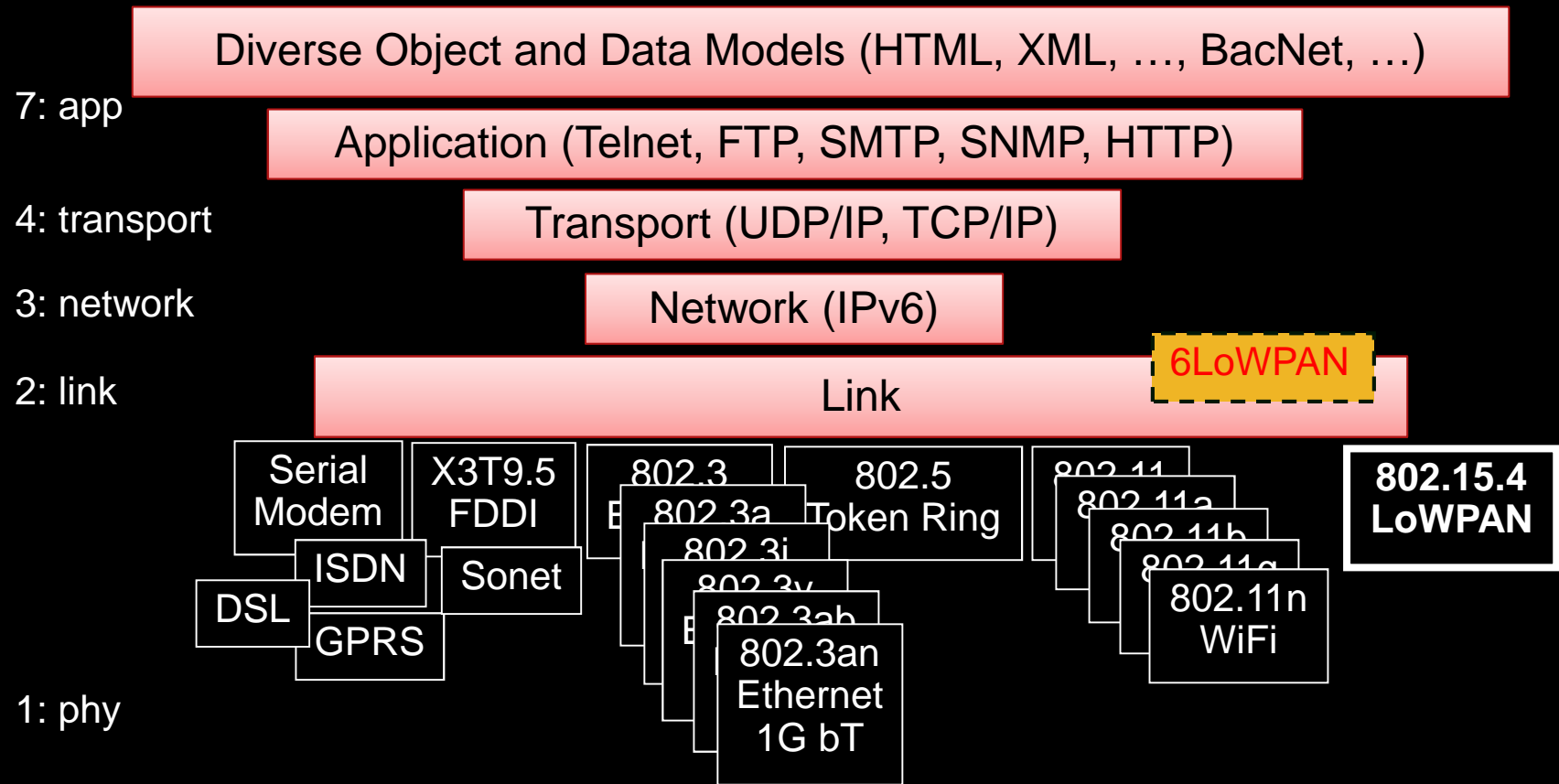
IETF Update

- IETF formed in 1986,
- Not considered as important for some time :-)
- Not government approved :-)
- Involving people not companies
- Motto: ***“We reject kings, presidents and voting. We believe in rough consensus and running code”*** Dave Clark (1992)
- Organized in areas made of WGs,



Reuse whenever possible, Invent where needed

6LoWPAN is an Adaptation Layer

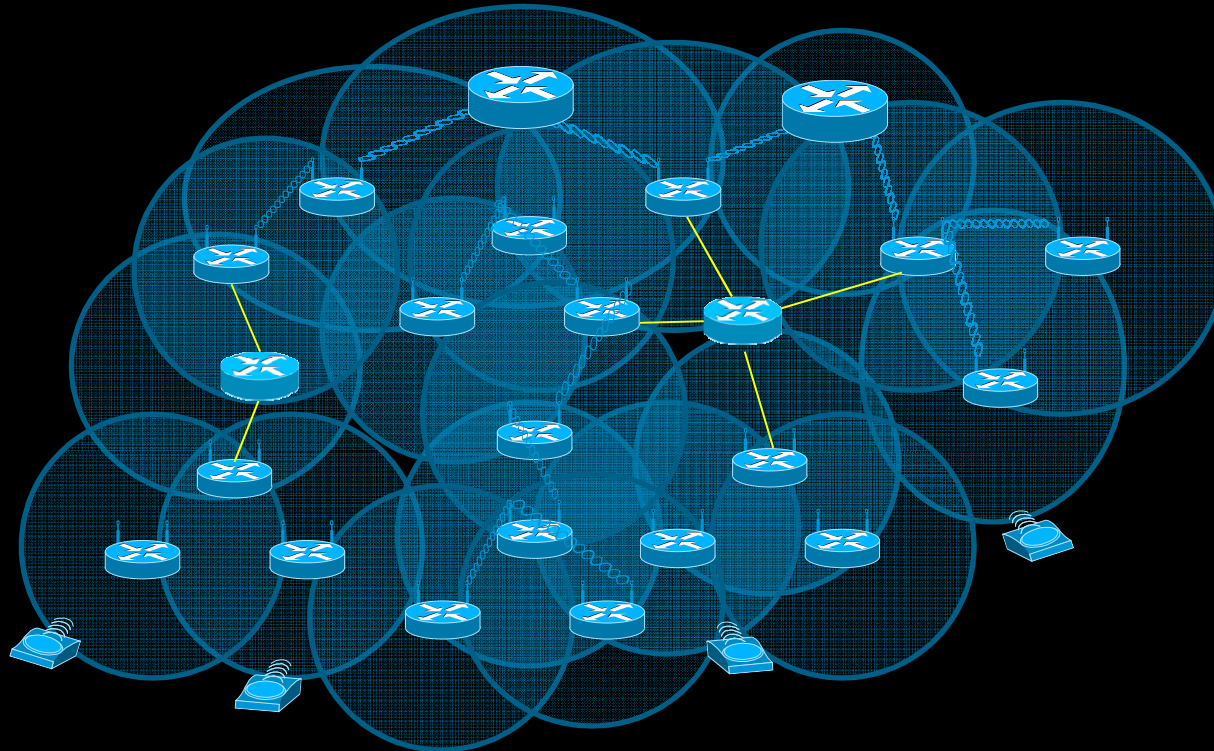


Source: IPSO Alliance webinar
Jonathan Hui Cisco, David Culler UC Berkeley
Zach Shelby Sensinode

Routing Over Low power and Lossy Link (ROLL) WG

- Working Group Formed in Jan 2008 and **re-chartered once**
<http://www.ietf.org/html.charters/roll-charter.html>
Co-chairs: JP Vasseur (Cisco), David Culler (Arch Rock)
- **Mission**: define Routing Solutions for LLN (Low power and Lossy Networks)
- Very active work with a good variety of participants with at first little IETF background
- Rechartered to specify the routing protocol for smart objects networks (after protocol survey)
- Several proposals: one of them adopted as WG document: RPL
- **RPL has just been approved as an IETF standard !**

RPL: a DV routing protocol building a colored DAG



RPL is specified in
draft-ietf-roll-rpl

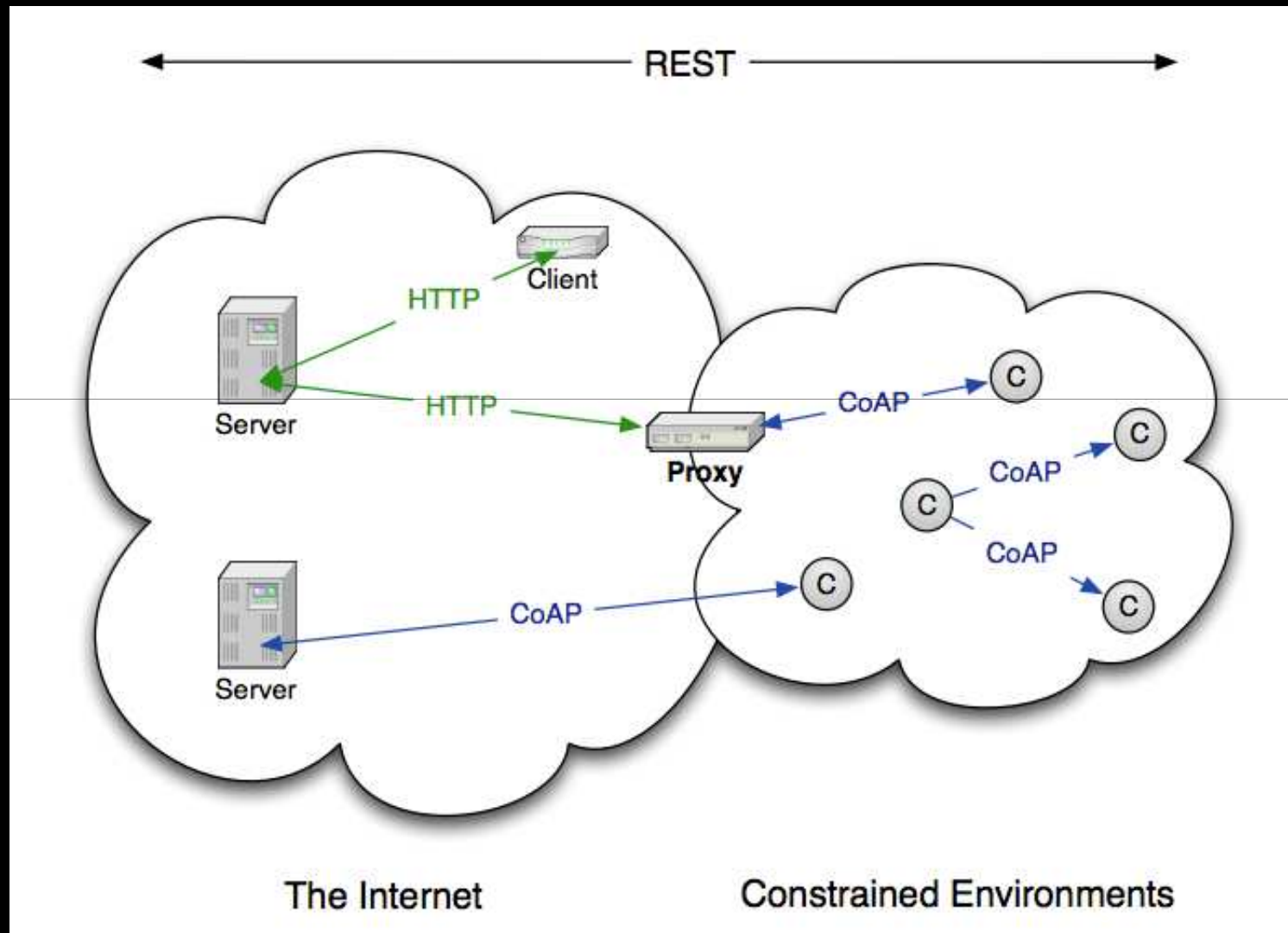
An IP routing protocol
(not just WSN)

- RPL: DV Based Routing Protocol – DAG Formation
- The DAG is colored (Constrained Based Routing)
- Rules for parent selection based on metric, OF and loop avoidance
- Under-react is the rule !! (local versus global reroutes) to cope with transient failures
- Governed by Trickle Timers

The IETF CoRE Working Group

- Working Group Formed in 2010 <http://www.ietf.org/html.charters/core-charter.html>
 - Co-chairs: Cullen Jennings, Carsten Bormann
- Mission: Provides a Framework for resource-oriented application intended to run on IP constrained network
- Applications to monitor/control IP smart objects (create, read, update and delete of resources)
- Definition of a simple protocol (CoAP) running over UDP to manipulate resources of a device => First plugfest at the last IETF!
- Definition of a proxy handling mapping between CoAP and REST APIs.
- CoAP supports caching (useful for sleepy devices)

The CoRE Architecture



Webinar
Lach Energy Conclude
Gilman Tolle Cisco

IP – an Open Layered Architecture

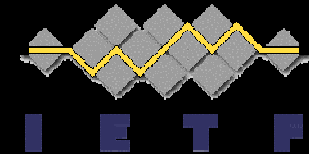
Applications (Telnet, SSH, SNMP,...)
Web Services (SOAP, XML, REST), CoAP



TCP

UDP

IP v6



over Foo adaptation layer (Ethernet, 6LoWPAN,...)

IEEE 802.15.4
868/915 MHz, 2.4GHz

IEEE 802.11
a/b/g/n WiFi
Low power

IEEE 802.3
Ethernet

HomePlug
PLC





Promoting the use of IP in networks of Smart Objects

<http://www.ipso-alliance.org/>

Objectives of IPSO



- Create awareness of available and developing technology with IP for Smart Objects
- Generate tutorials, white papers and highlight use cases
 - <http://www.ipso-alliance.org/Pages/DocumentsAndWhitePapers.aspx>
- Complement the IETF which defines standards, but does no marketing
- Link companies that support IP based sensing and control systems
- Coordinate and combine member marketing efforts
- Support and organize interoperability events

COMPLIANCE program (Based on IPv6 forum)

Zigbee/IP

- Group within Zigbee in charge of the certification of an IP-based solution (not all Zigbee groups are IP-based) for energy management
- Good liaison with the IETF
- Selection of IP protocols to build a solution “package” based on:
 - Main interest in IEEE 802.15.4 (for the time being)
 - 6LoWPAN: HC (Header compression) and 6LoWPAN ND
 - RPL (Routing)
 - MDNS (Discovery)
 - Applications of their own
- Active interoperability testing: successful test event with 15 implementations (15.4, 6lowpan, RPL, ...)

Wavenis

- Wavenis-OSA is an alliance specifying a PHY/MAC for ULTRA low-power communication, long range
- PHY:
 - GFSK modulation, RSSI,
 - RF: 868MHz (Europe), 915MHz (North America), 433MHz
 - High sensitivity (BER=1%)
- MAC
 - Frequency hopping, CSMA/CA, ACK, CRC, Handle fragmentation, Sophisticated power management (preamble detection, low energy listening mode), EUI-64 address (no need for DAD)
- Layered architecture, with networking layer based on IPv6 and RPL for routing

Conclusion

- Smart Grid networks is with no doubt one of the most critical applications that will more likely be N times larger than the current Internet

Production Networks, primary/secondary substation and pole-top, AMI, HAN, EV, ...

- Major progress during the last three years in standardizing new IPv6 protocols in support of IP smart Objects used in Smart Grid Networks
- Thus avoiding costly, hard to manage multi-protocol gateways and providing a highly scalable architecture
- Momentum in using IPv6 in Smart Grid Networks



**Thank you for
your attention**

Questions?

