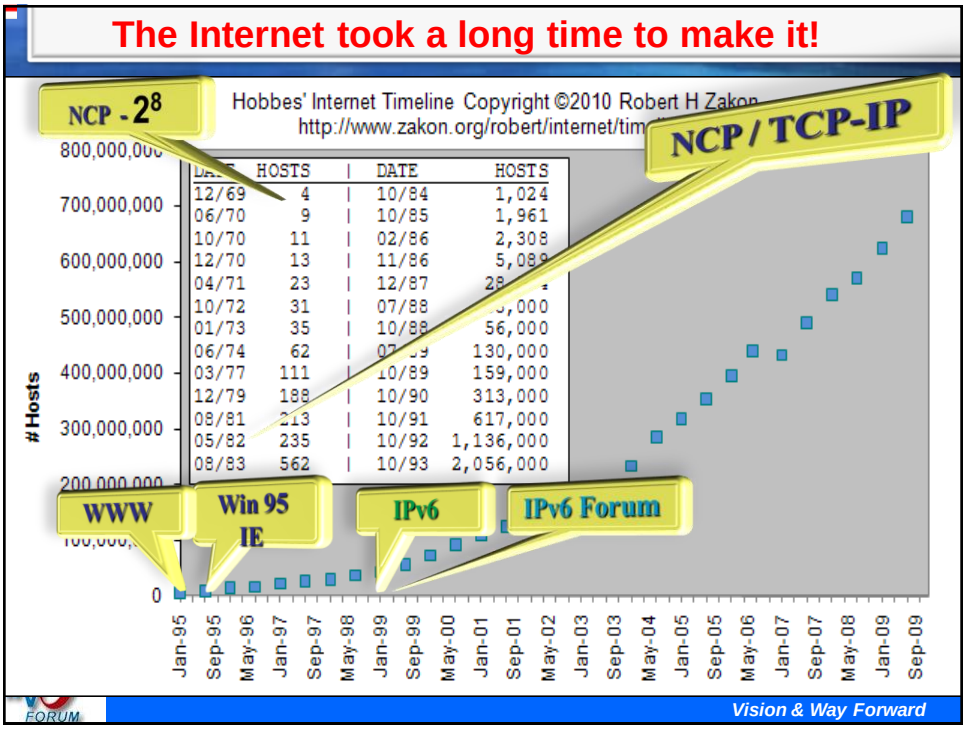
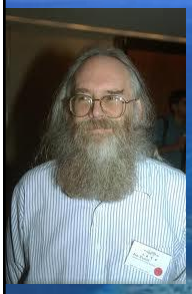

Australian IPv6 Summit 2010
isoc -au
IPv6 FORUM Australia
AUSTRALIAN INDUSTRY GROUP
IPv6 FORUM
Melbourne 2010
Cloud Computing
Internet of Things
SmartGRID
IPv6 FORUM
Vision & Way Forward


The Internet took a long time to make it!
NCP - 2^8
Hobbes' Internet Timeline Copyright ©2010 Robert H Zakon
http://www.zakon.org/robert/internet/tim
NCP / TCP-IP
DATE HOSTS | DATE HOSTS
12/69 4 | 10/84 1,024
06/70 9 | 10/85 1,961
10/70 11 | 02/86 2,308
12/70 13 | 11/86 5,089
04/71 23 | 12/87 28
10/72 31 | 07/88
01/73 35 | 10/88 56,000
06/74 62 | 130,000
03/77 111 | 10/89 159,000
12/79 188 | 10/90 313,000
08/81 213 | 10/91 617,000
05/82 235 | 10/92 1,136,000
08/83 562 | 10/93 2,056,000
#Hosts
800,000,000
700,000,000
600,000,000
500,000,000
400,000,000
300,000,000
200,000,000
0
WWW
Win 95 IE
IPv6
IPv6 Forum
Jan-95 Sep-95 May-96 Jan-97 Sep-97 May-98 Jan-99 Sep-99 May-00 Jan-01 Sep-01 May-02 Jan-03 Sep-03 May-04 Jan-05 Sep-05 May-06 Jan-07 Sep-07 May-08 Jan-09 Sep-09
Vision & Way Forward



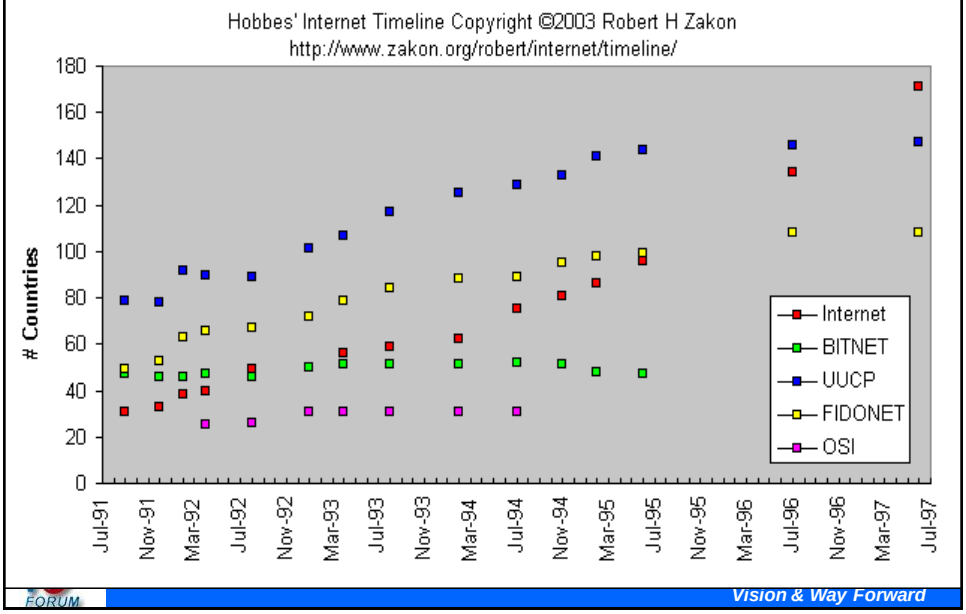
RFC801 – NCP / TCP Transition Plan

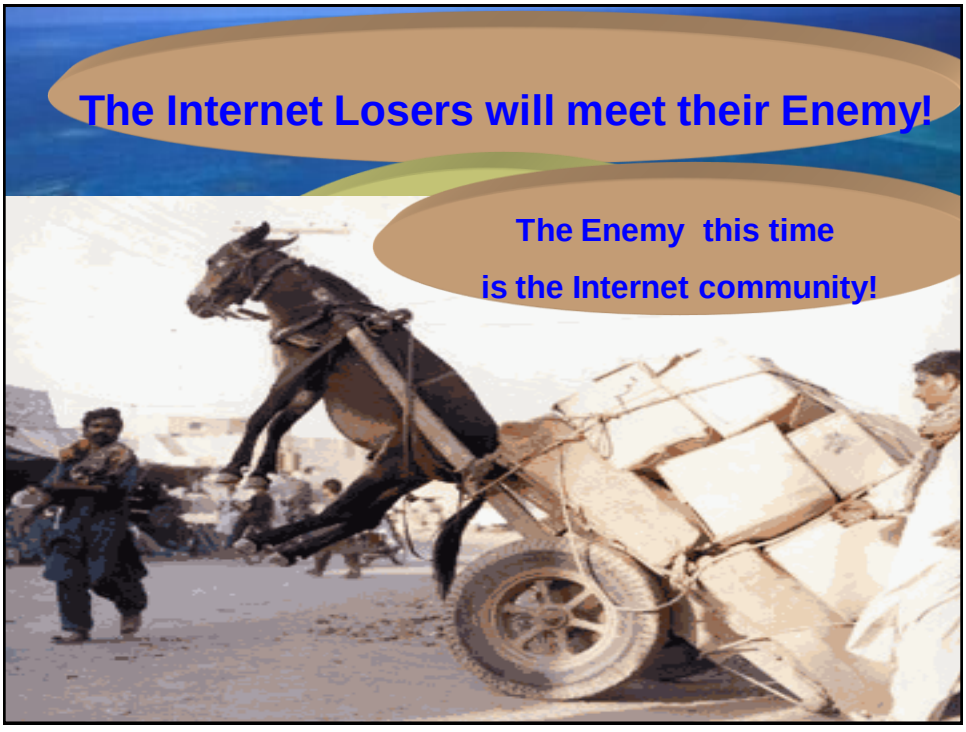
Network Working Group
Request for Comments: 801

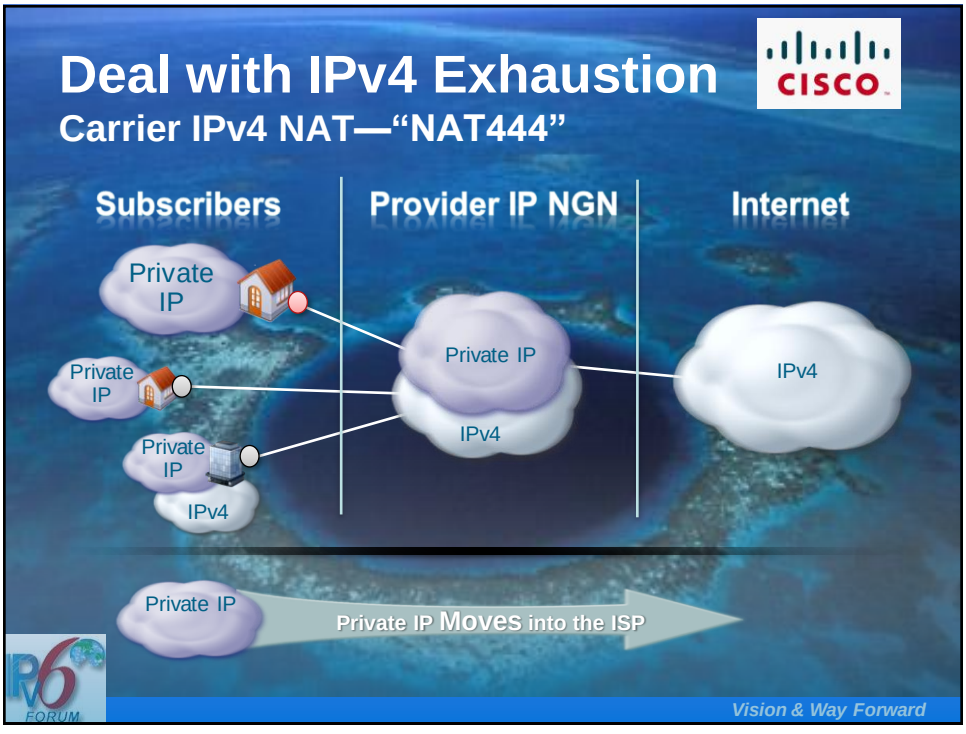
J. Postel
ISI
November 1981

Total Hosts	Dual Hosts	NCP Hosts	TCP Hosts	"Load"	Date
200	20	178	2	356	Jan-82
210	40	158	12	1896	Mar-82
220	60	135	25	3375	May-82
225	95	90	40	3600	Jul-82
230	100	85	45	3825	Sep-82
240	125	55	60	3300	Nov-82
245	155	20	70	1400	Dec-82
250	170	0	80	0	31-Dec-82
250	0	0	250	0	1-Jan-83

Internet was Competing against others




The Internet Losers will meet their Enemy!
The Enemy this time
is the Internet community!


Deal with IPv4 Exhaustion
Carrier IPv4 NAT—"NAT444"
cisco
Subscribers
Provider IP NGN
Internet
Private IP
Private IP
Private IP
IPv4
Private IP
IPv4
IPv4
Private IP
Private IP Moves into the ISP
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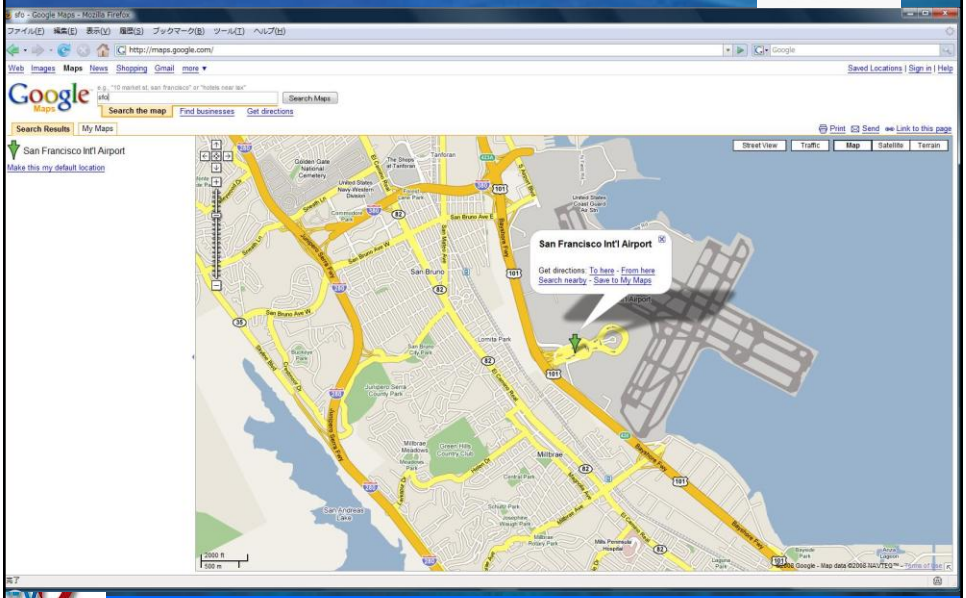
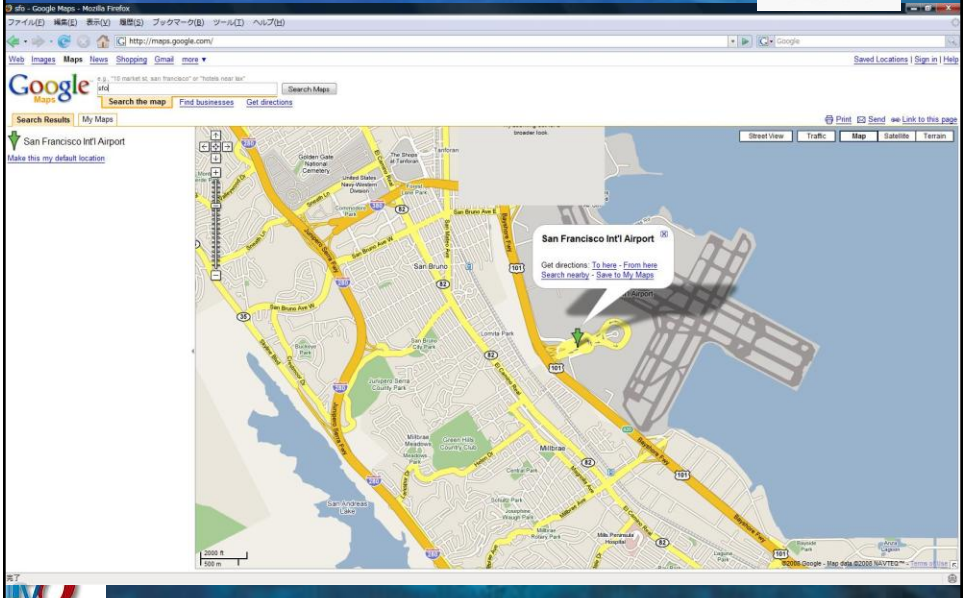
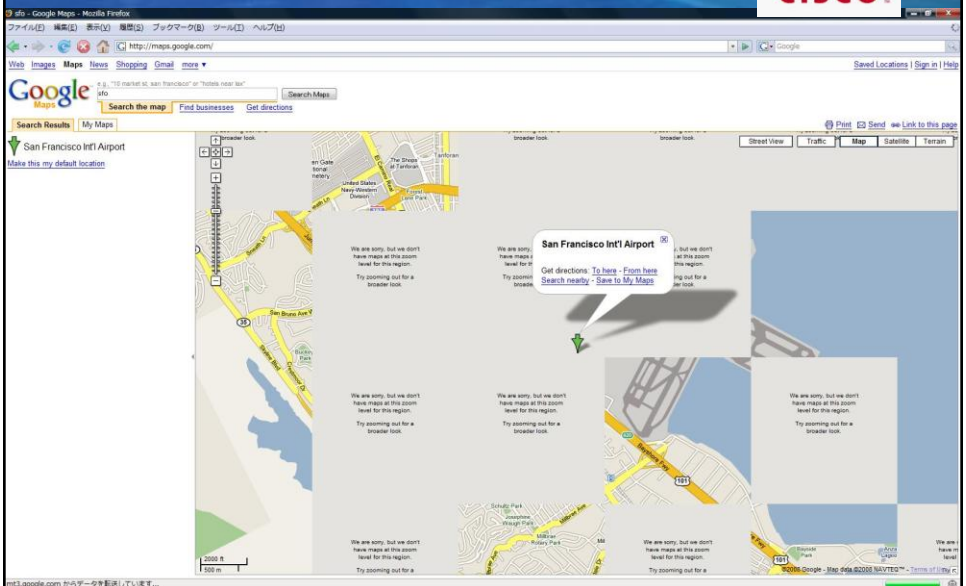
Max 30 Translations



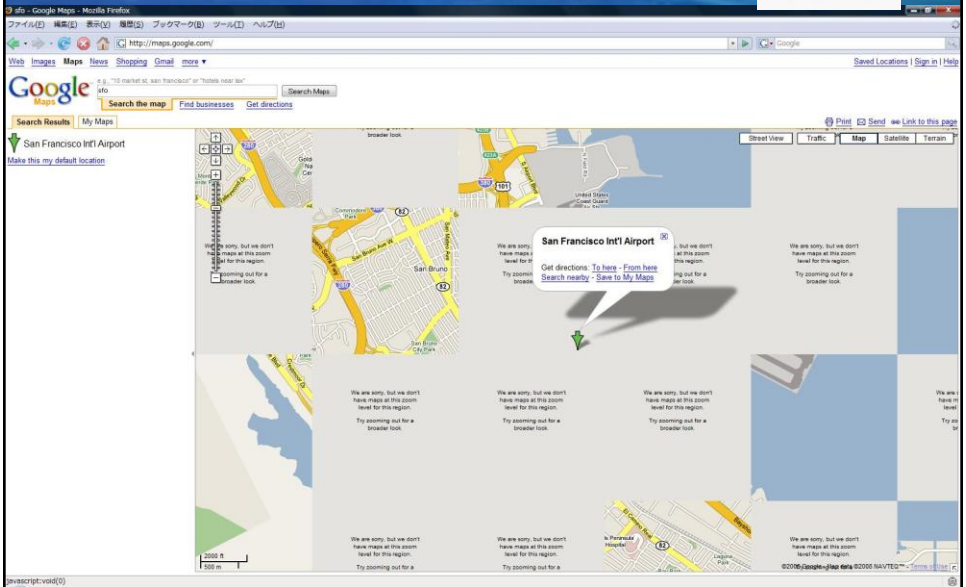
Max 20 Translations



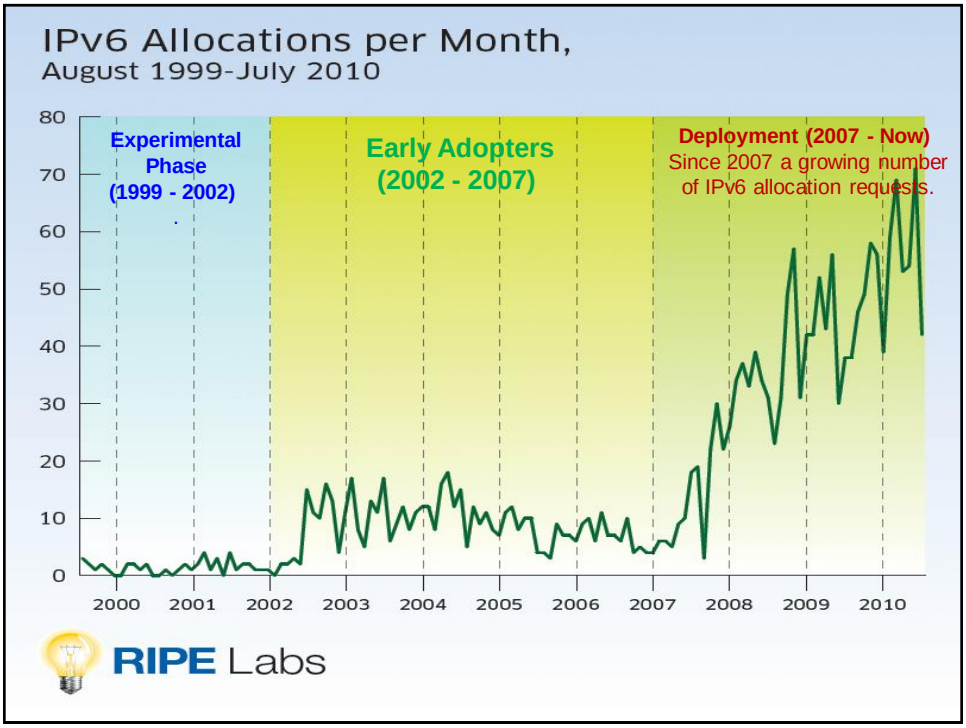
Max 15 Translations

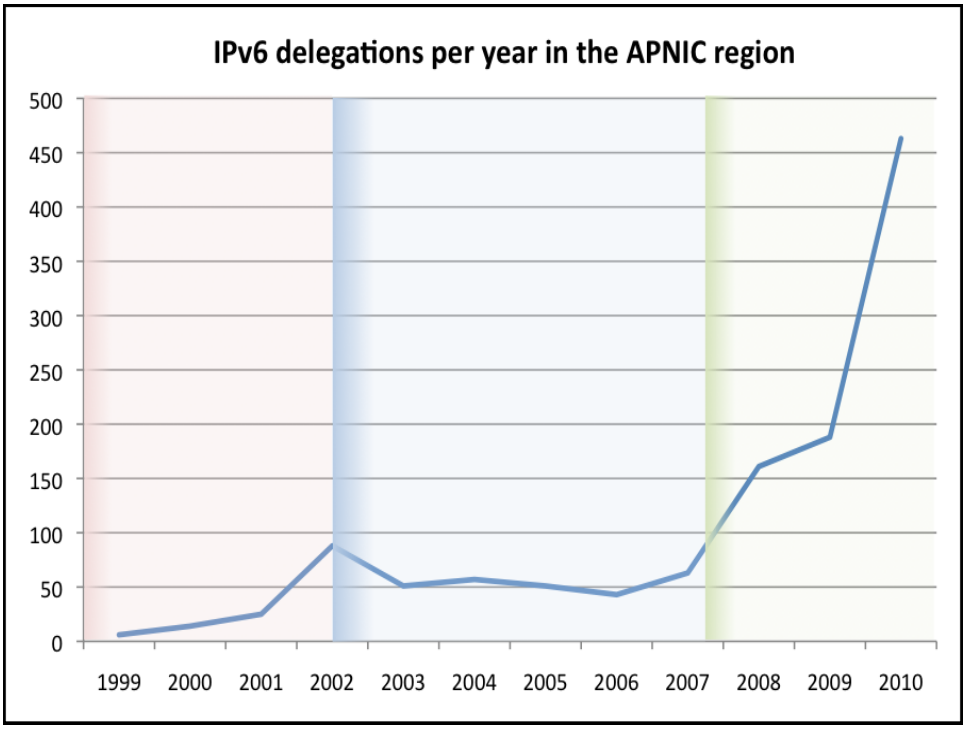


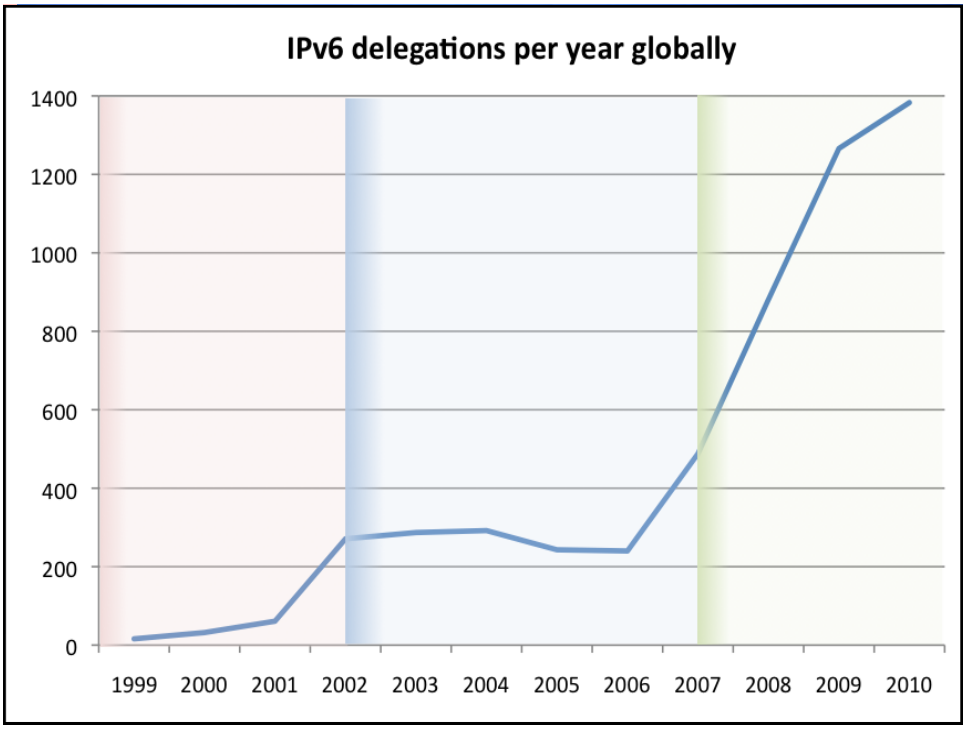
Max 10 Connections

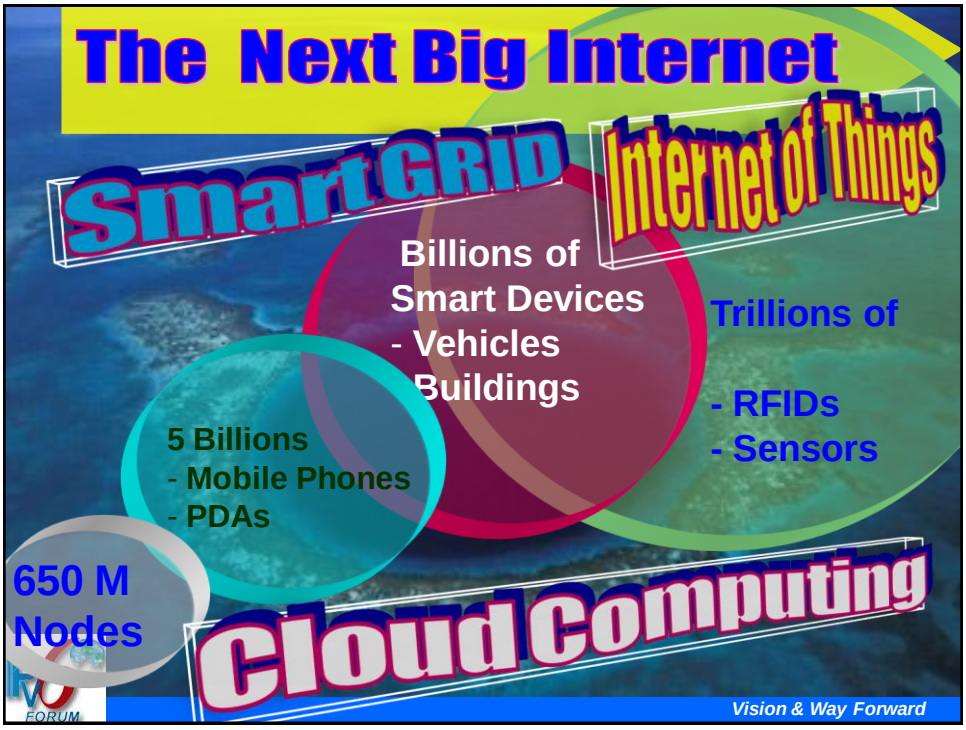


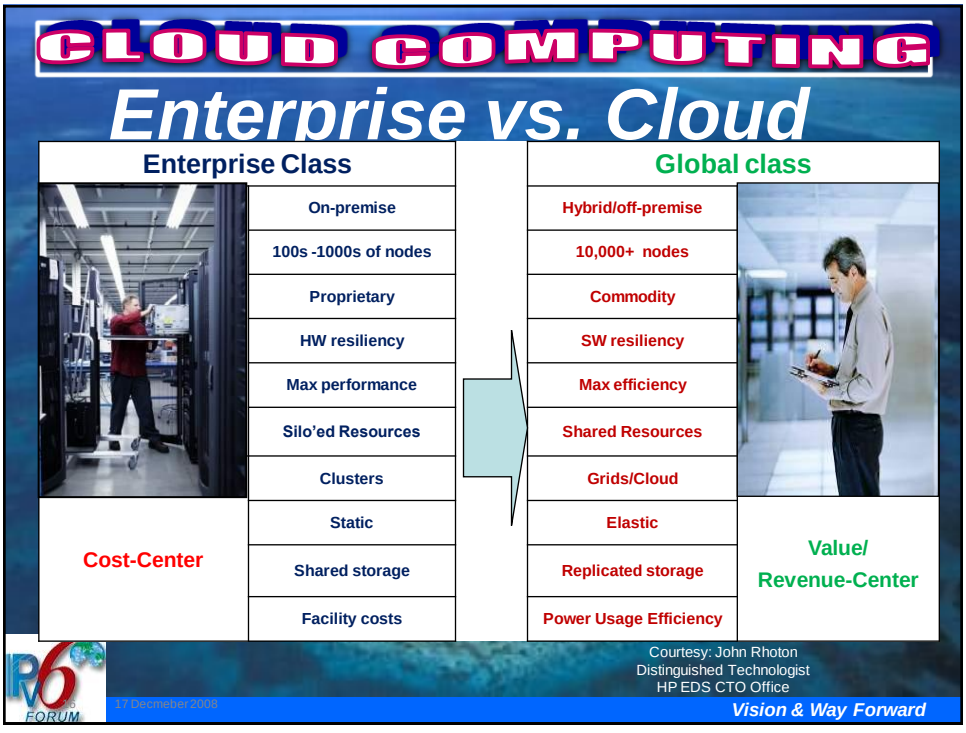

All ISPs will have to take off like this!"
Anonymous 2010
Vision & Way Forward

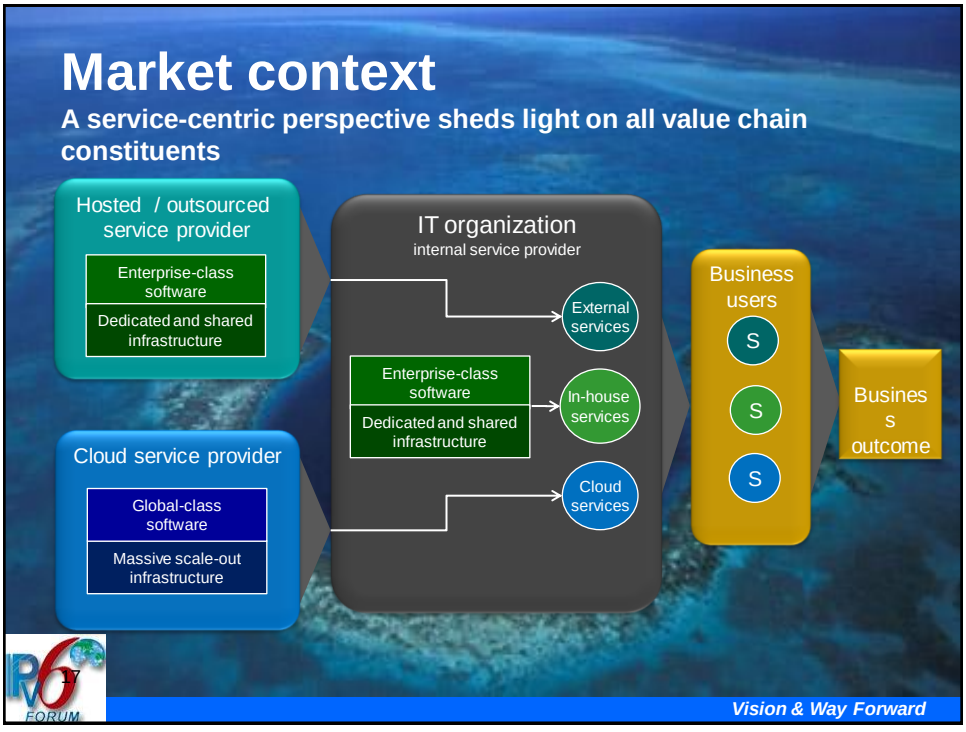

IPv6 Allocations per Month,
August 1999-July 2010
Experimental Phase (1999 - 2002)
Early Adopters (2002 - 2007)
Deployment (2007 - Now)
Since 2007 a growing number of IPv6 allocation requests.
80
70
60
50
40
30
20
10
0
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
RIPE Labs

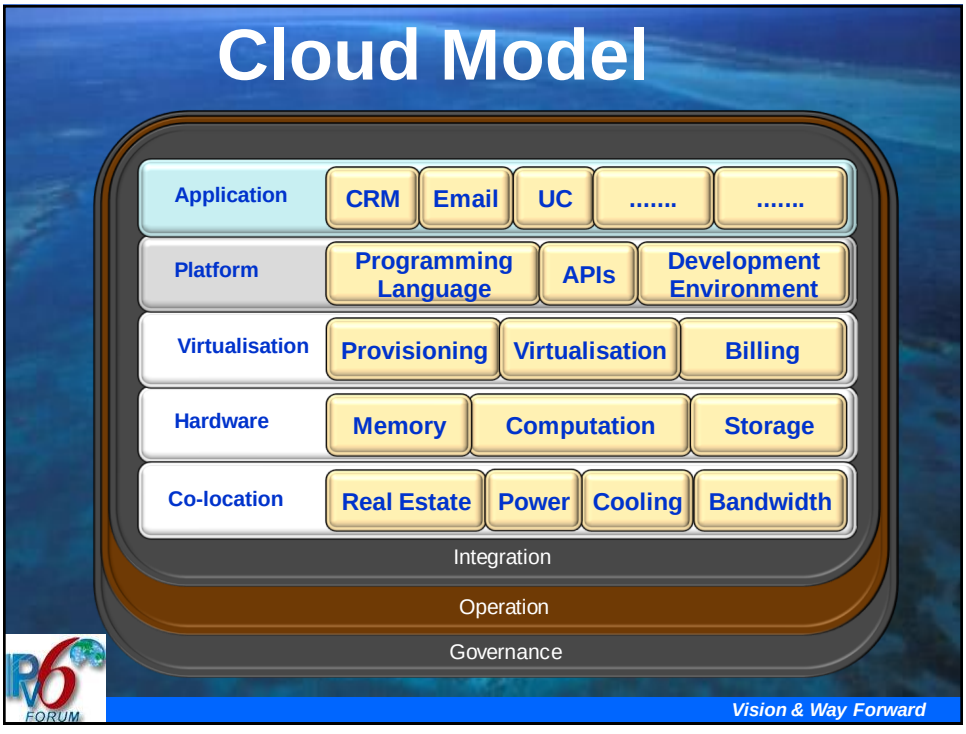

IPv6 delegations per year in the APNIC region
500
450
400
350
300
250
200
150
100
50
0
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010


IPv6 delegations per year globally
1400
1200
1000
800
600
400
200
0
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010

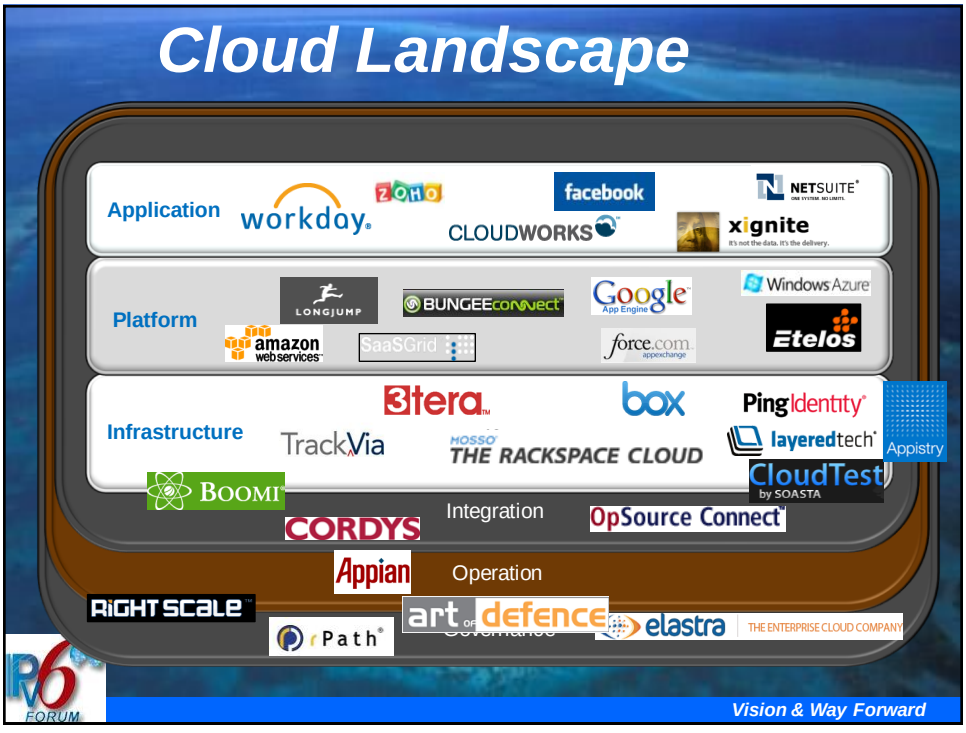

The Next Big Internet
SmartGRID
Internet of Things
Billions of
Smart Devices
- Vehicles
Buildings
Trillions of
- RFIDs
- Sensors
5 Billions
- Mobile Phones
- PDAs
650 M
Nodes
Cloud Computing
Vision & Way Forward


CLOUD COMPUTING
Enterprise vs. Cloud
Enterprise Class
Global class
On-premise
100s -1000s of nodes
Proprietary
HW resiliency
Max performance
Silo'ed Resources
Clusters
Static
Shared storage
Facility costs
Hybrid/off-premise
10,000+ nodes
Commodity
SW resiliency
Max efficiency
Shared Resources
Grids/Cloud
Elastic
Replicated storage
Power Usage Efficiency
Cost-Center
Value/
Revenue-Center
Courtesy: John Rhoton
Distinguished Technologist
HP EDS CTO Office
17 Decmeber2008
Vision & Way Forward


Market context
A service-centric perspective sheds light on all value chain constituents
Hosted / outsourced service provider
Enterprise-class software
Dedicated and shared infrastructure
Cloud service provider
Global-class software
Massive scale-out infrastructure
IT organization
internal service provider
Enterprise-class software
Dedicated and shared infrastructure
External services
In-house services
Cloud services
Business users
S
S
S
Business outcome
Vision & Way Forward


Cloud Model
Application
CRM
Email
UC
.....
.....
Platform
Programming Language
APIs
Development Environment
Virtualisation
Provisioning
Virtualisation
Billing
Hardware
Memory
Computation
Storage
Co-location
Real Estate
Power
Cooling
Bandwidth
Integration
Operation
Governance
Vision & Way Forward


First Cloud of Cloud Computing
force.com appexchange
Google App Engine
Microsoft Windows Azure
YAHOO!
ZOHO
amazon web services
HOSSO THE RACKSPACE CLOUD
Vision & Way Forward


Cloud Landscape
Application
workday.
ZOHO
facebook
CLOUDWORKS
NETSUITE
xignite
Platform
LONGJUMP
BUNGEEconnect
Google App Engine
Windows Azure
amazon web services
SaaSGrid
force.com appexchange
Etelos
Infrastructure
3tera
box
PingIdentity
TrackVia
HOSSO THE RACKSPACE CLOUD
layeredtech
Appistry
CloudTest by SOASTA
BOOMI
Integration
OpSource Connect
CORDYS
Appian
Operation
RIGHTSCALE
art of defence
elastra
THE ENTERPRISE CLOUD COMPANY
rPath
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Why Cloud Computing?

Cost Reduction

- ✓ Benefit from economies of scale and experience curve
- ✓ Predictability of spend
- ✓ Avoids cost of over-provisioning
- ✓ Reduction in up-front investment

Risk Reduction

- ✓ Offload risk of running the data-centre, data protection, and disaster recovery
- ✓ Reduces risk of under-provisioning

Focus on core competency

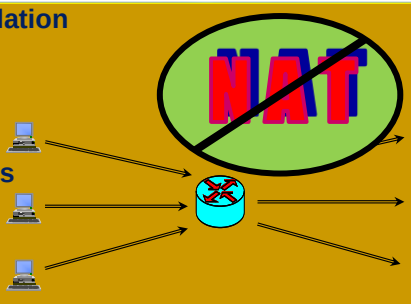
- ✓ Reduce effort and administration related to IT
- ✓ Automatic service evolution

Flexibility

- ✓ Roll-out new services, retire old
- ✓ Scale up and down as needed; quickly
- ✓ Faster time to market: Lower barriers to innovation
- ✓ Access from any place, any device, any time

Major Problem of CC is NAT

- Overhead of unnecessary translation
- Protocol incompatibilities
  - IPsec,…
- Breaks peer-to-peer applications
  - Instant messaging
  - Interactive games
  - VoIP
  - Real-time collaboration and sharing
    - Netmeeting, BitTorrent, Groove
- Limits implementation of application servers
  - How far can you distribute your web-services?
  - Grid computing



Building work-arounds for everything NAT breaks is an unnecessary and inefficient effort!

Synergies between CC & IPv6

Scalability

- ✓ Massive scalability
  - ➢ Hierarchical internal address space of provider
  - ➢ Avoid connection brokers (ALG/NAT)
- ✓ No "need" for NAT
- ✓ Always connected user experience Mobile IPv6
- ✓ Customer connectivity
- ✓ "Easier" implementation
- ✓ Unified Communications

- ✓ Large number of virtual interfaces
- ✓ Beyond capacity of CGN
- ✓ Direct connectivity required
  - • Impossible to distinguish between internal and external systems
    - ○ Intra-cloud
    - ○ Inter-cloud
    - ○ User-access
- ✓ P2P potential

Always-on & Seamless

Mobility

- ✓ Seamless user experience
- ✓ Always Connected users
  - • Move from one access network to another
- ✓ Cloud Abstraction
- ✓ Workload rebalancing
  - Virtual Machine relocation

Automatic Deployment

- ✓ Ease of provisioning
  - • Stateless auto configuration
  - • Dynamic renumbering
- ✓ Dynamic allocation of capacity
  - • Auto configuring virtual machines based on demand fluctuation
- ✓ Mandated encryption and authentication helps a lot in IPv6

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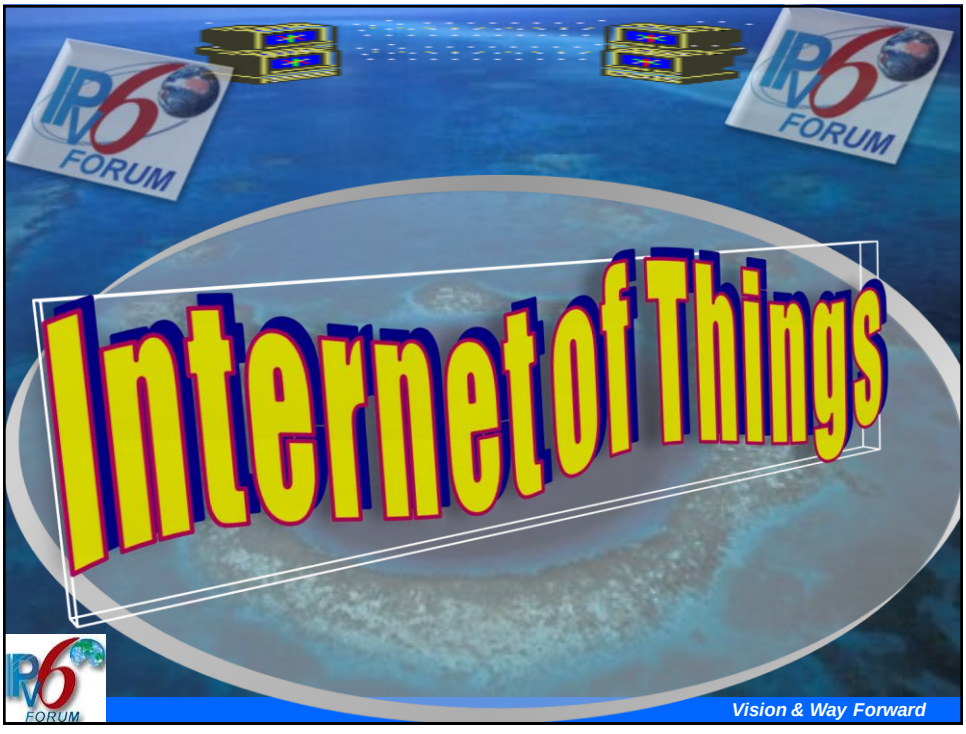

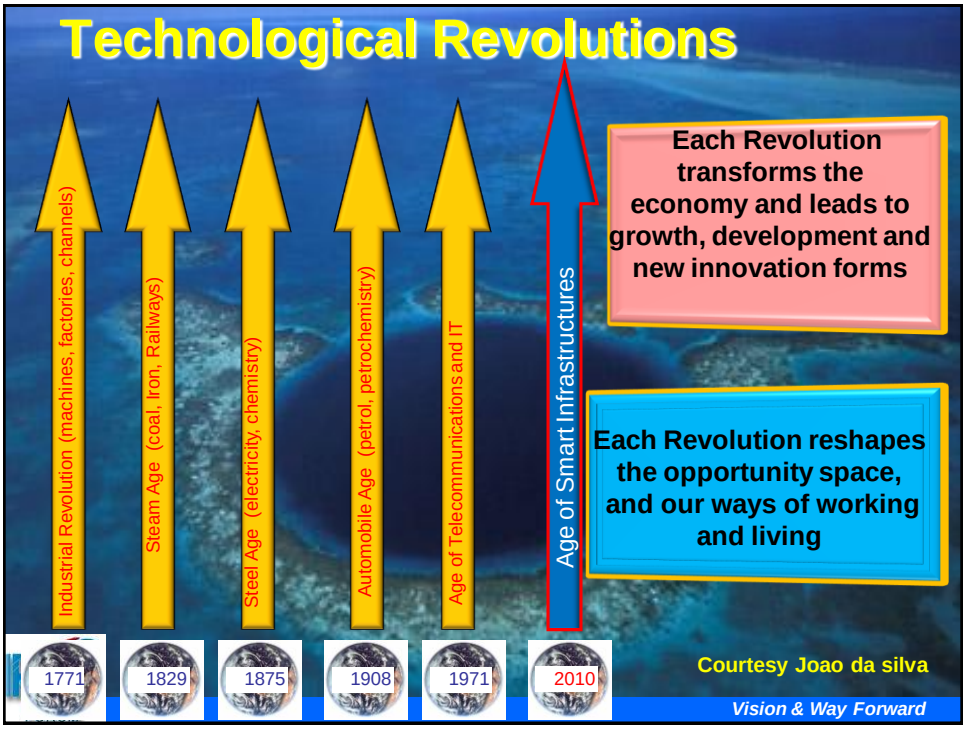
Technological Revolutions
Industrial Revolution (machines, factories, channels)
Steam Age (coal, Iron, Railways)
Steel Age (electricity, chemistry)
Automobile Age (petrol, petrochemistry)
Age of Telecommunications and IT
Age of Smart Infrastructures
Each Revolution transforms the economy and leads to growth, development and new innovation forms
Each Revolution reshapes the opportunity space, and our ways of working and living
1771
1829
1875
1908
1971
2010
Courtesy Joao da silva
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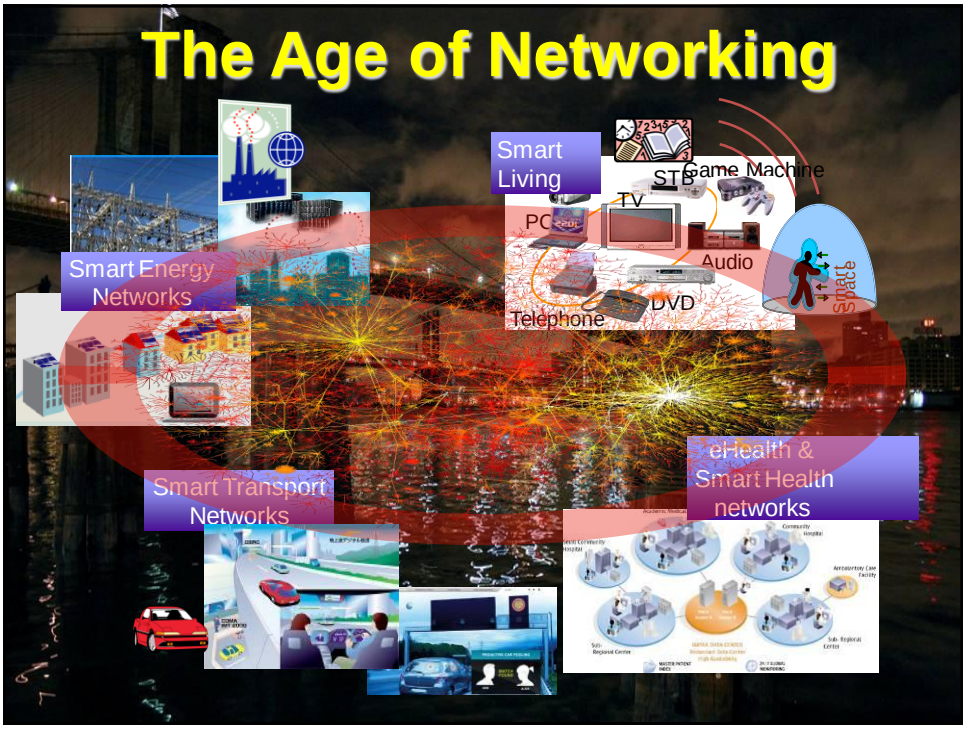

The Age of Networking
Smart Living
STB
Game Machine
TV
PC
Audio
DVD
Telephone
Smart Energy Networks
Smart Transport Networks
eHealth & Smart Health networks

Internet of Things

Courtesy Gerald Santucci

How It All Got Started

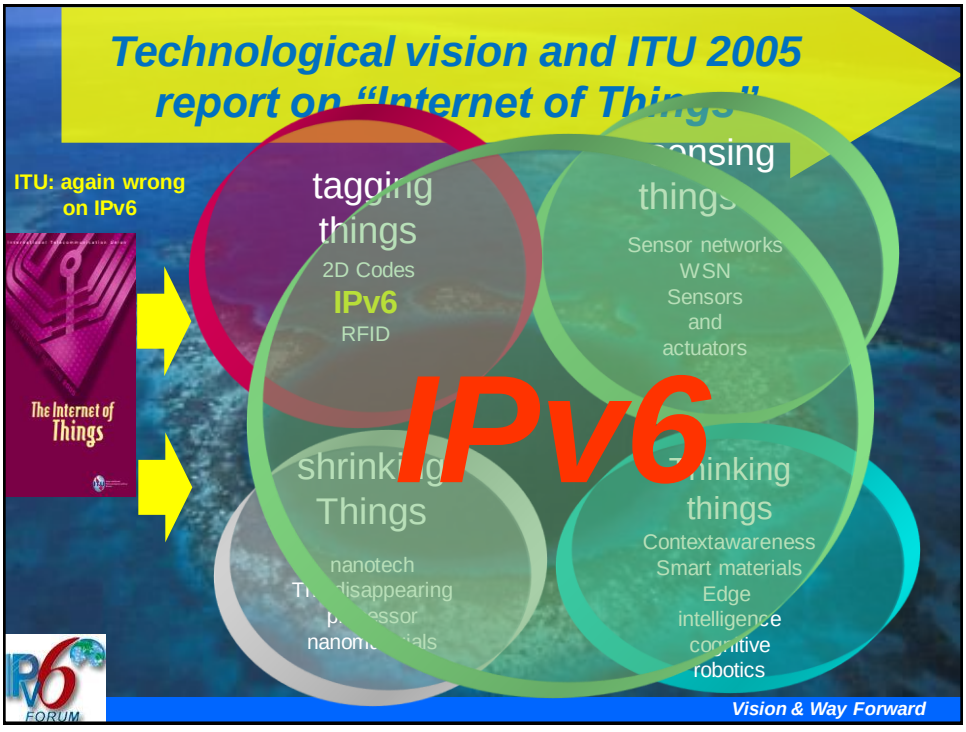
- Kevin Ashton, Auto-ID @ MIT, 1998
- EPCglobal , 2003
- ITU Report, 2005
- EC Communication on RFID, 2007
- EU Presidency Conferences
  - Berlin (DE) and Lisbon (PT), 2007
  - Nice (FR), 2008
- Telecom Council Conclusions on Future Networks and the Internet, 2008

"The Internet of Things has the potential to change the world, just as the Internet did. Maybe even more so."
Kevin Ashton, 2009

What Are "Things"?

Not Only RFID?

- Static information appliances: computers – fixed, portable, mobile; servers, etc.
- Mobile information appliances: cell phones, digital cameras, PDAs, scanners, Web Tablets, pocket PCs, games, iPods, talking books, DVD players, mobile devices that use services such as GPS, digital maps and IVR, etc.
- Mobile networks: vehicle cargo containers, tankers, supply chain assets (stock-keeping-units – SKUs), etc.
- Static devices: medical devices, HVAC (heating, ventilation, airconditioning systems for climate control in buildings), industrial machinery, distributed generation, etc.
- Controllers: industrial controllers, appliance controllers, etc.
- Smart sensors: accelerometers, pressure gauges, flow/position/speed/temperature biosensors, etc.;
- Microprocessors and microcontrollers: 8-, 16-, 32-, 64-bit chips, etc.
- Internet of Devices (M2M)
- Internet of Things
  - 6,000-7,000 objects surrounding each of us in our daily life!


Technological vision and ITU 2005 report on "Internet of Things"
ITU: again wrong on IPv6
The Internet of Things
tagging things
2D Codes
IPv6
RFID
sensing things
Sensor networks
WSN
Sensors
and
actuators
IPv6
shrinking Things
nanotech
disappearing
nanomaterials
thinking things
Contextawareness
Smart materials
Edge
intelligence
cognitive
robotics
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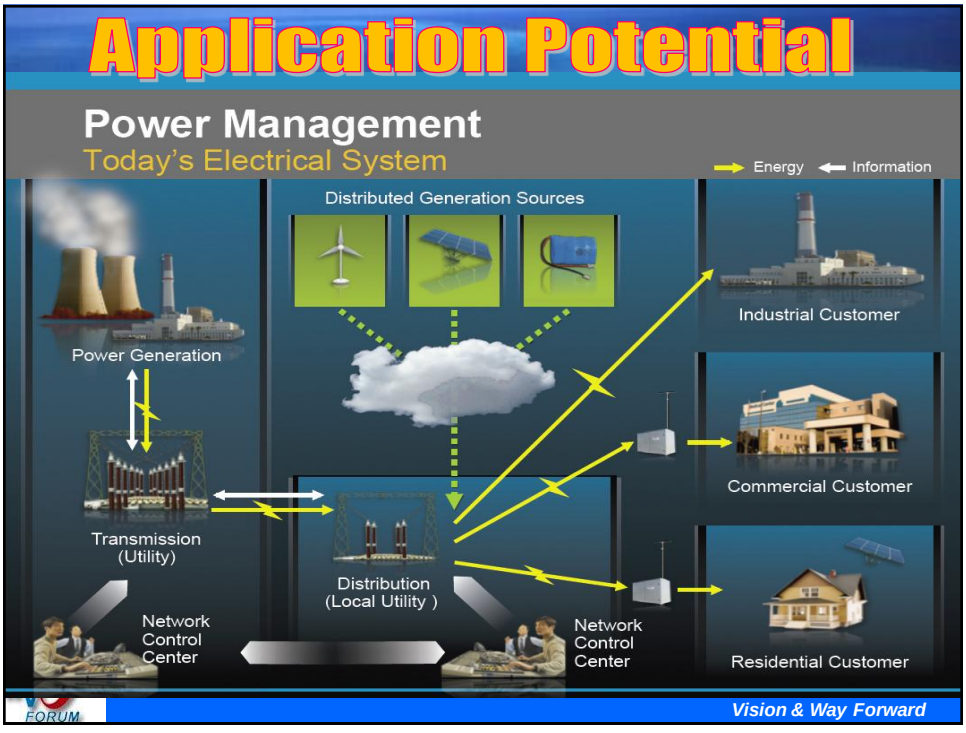
Application Potential
Power Management
Today's Electrical System
Energy
Information
Distributed Generation Sources
Power Generation
Industrial Customer
Commercial Customer
Transmission (Utility)
Distribution (Local Utility)
Network Control Center
Network Control Center
Residential Customer
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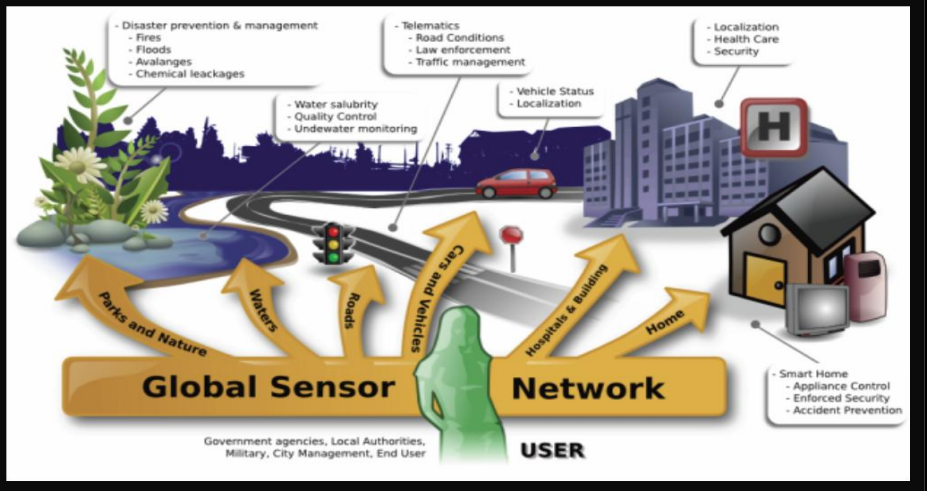
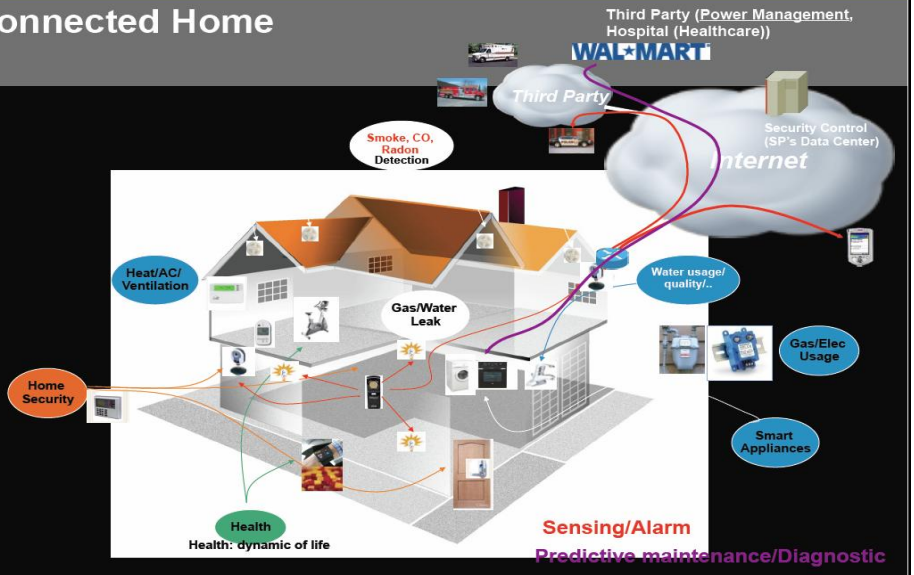
Application Potential

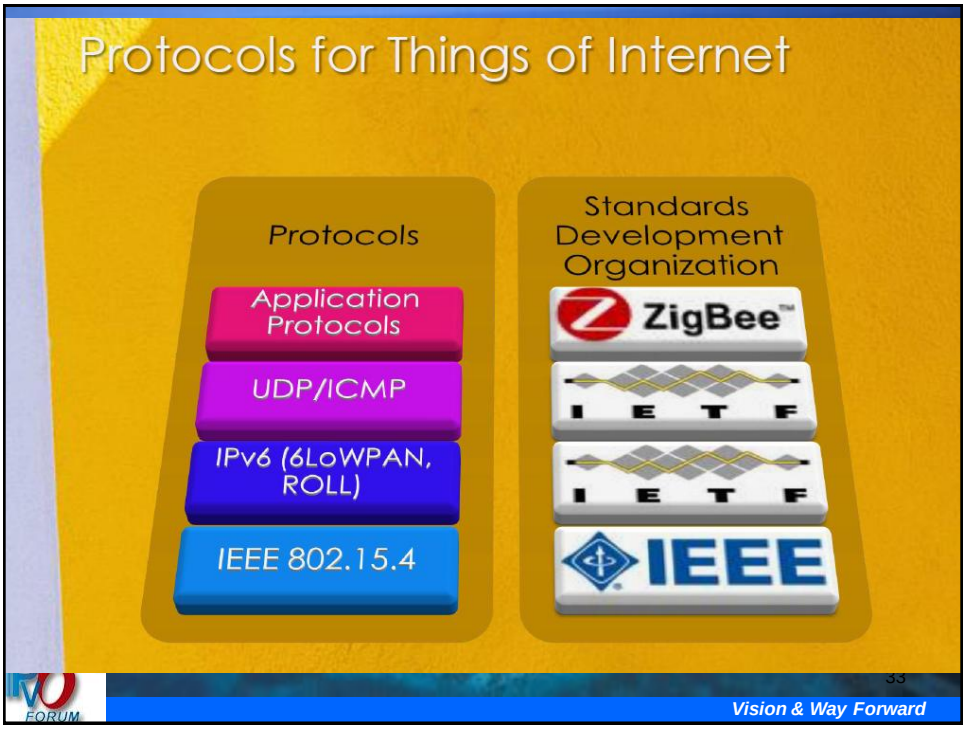
Smart+Connected Communities



Application Potential

Connected Home




Protocols for Things of Internet
Protocols
Application Protocols
UDP/ICMP
IPv6 (6LoWPAN, ROLL)
IEEE 802.15.4
Standards Development Organization
ZigBee
IETF
IETF
IEEE
33
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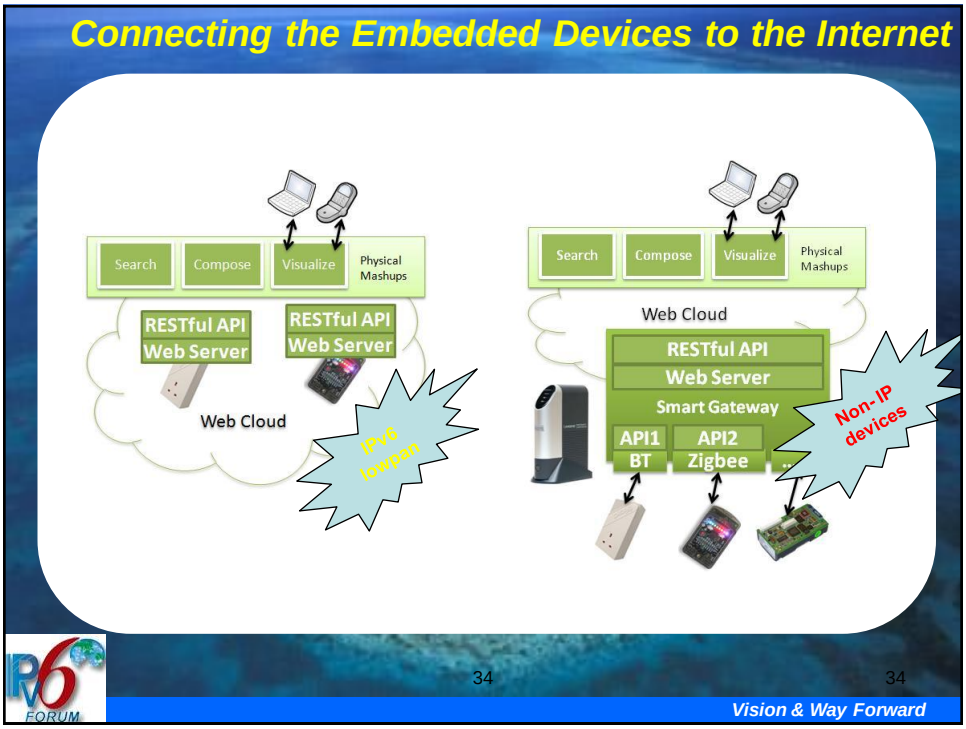
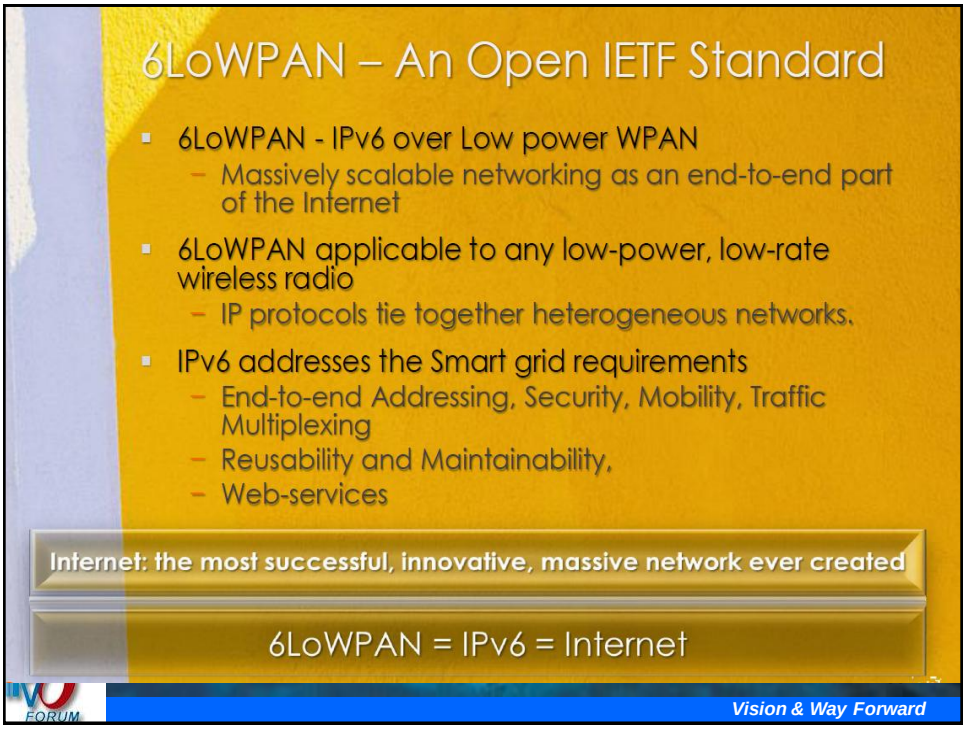

Connecting the Embedded Devices to the Internet
Search
Compose
Visualize
Physical Mashups
RESTful API
Web Server
RESTful API
Web Server
Web Cloud
IPv6 lowpan
Search
Compose
Visualize
Physical Mashups
Web Cloud
RESTful API
Web Server
Smart Gateway
API1
BT
API2
Zigbee
Non-IP devices
34
34
Vision & Way Forward


6LoWPAN – An Open IETF Standard
6LoWPAN - IPv6 over Low power WPAN
Massively scalable networking as an end-to-end part of the Internet
6LoWPAN applicable to any low-power, low-rate wireless radio
IP protocols tie together heterogeneous networks.
IPv6 addresses the Smart grid requirements
End-to-end Addressing, Security, Mobility, Traffic Multiplexing
Reusability and Maintainability,
Web-services
Internet: the most successful, innovative, massive network ever created
6LoWPAN = IPv6 = Internet
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Government Perspective
EU: - Communication in 2007 on IoT – RFID (IPv6)
USG: NIC: 6 Disruptive Civil Technologies – IoT in 2008 -v6?
China: Premier Wen in August 7, 2009:
"Internet + IoT = Wisdom of Earth"
Dec 9, 2009, Zhou Hongren, Exe. Vice Chair ACSI - "Advised Guangdong Province to deploy IPv6" (watch this space!)
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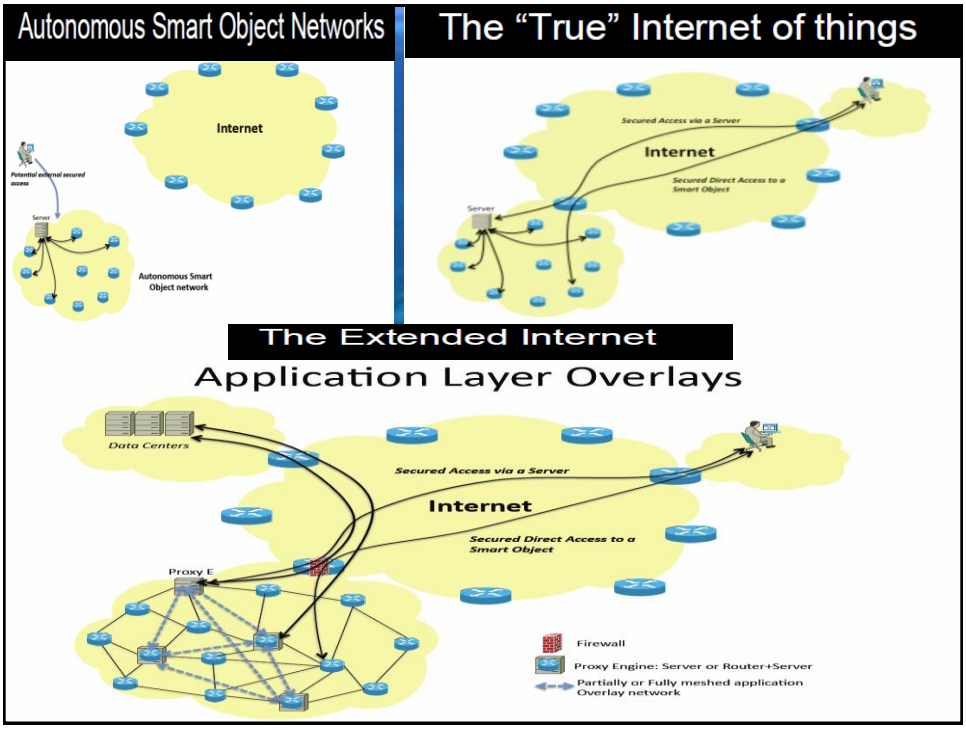
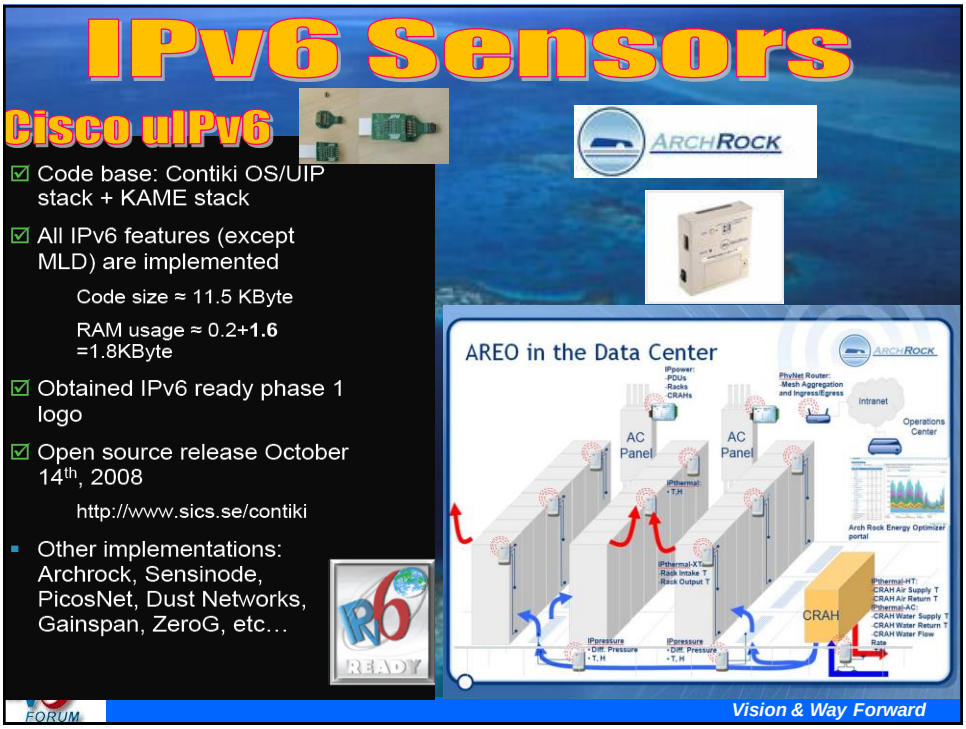
Vision & Way Forward


Autonomous Smart Object Networks
The "True" Internet of things
Internet
Potential external secured access
Server
Autonomous Smart Object network
Secured Access via a Server
Internet
Secured Direct Access to a Smart Object
Server
The Extended Internet
Application Layer Overlays
Data Centers
Secured Access via a Server
Internet
Secured Direct Access to a Smart Object
Proxy E
Firewall
Proxy Engine: Server or Router+Server
Partially or Fully meshed application Overlay network


IPv6 Sensors
Cisco ulPv6
Code base: Contiki OS/UIP stack + KAME stack
All IPv6 features (except MLD) are implemented
Code size ≈ 11.5 KByte
RAM usage ≈ 0.2+1.6 =1.8KByte
Obtained IPv6 ready phase 1 logo
Open source release October 14th, 2008
http://www.sics.se/contiki
Other implementations: Archrock, Sensinode, PicosNet, Dust Networks, Gainspan, ZeroG, etc…
READY
ARCHROCK
AREO in the Data Center
AC Panel
AC Panel
Intranet
Operations Center
CRAH
Arch Rock Energy Optimizer portal
FORUM
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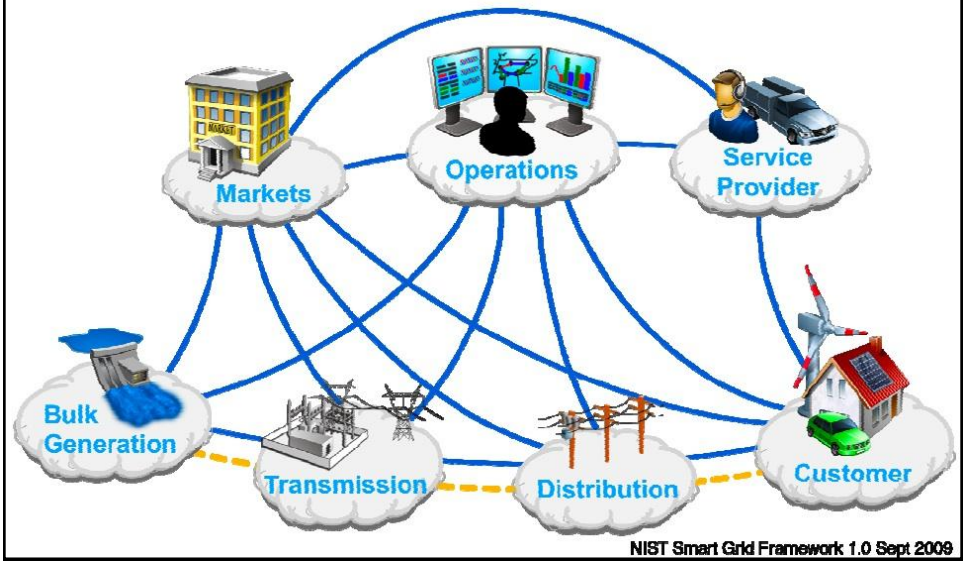
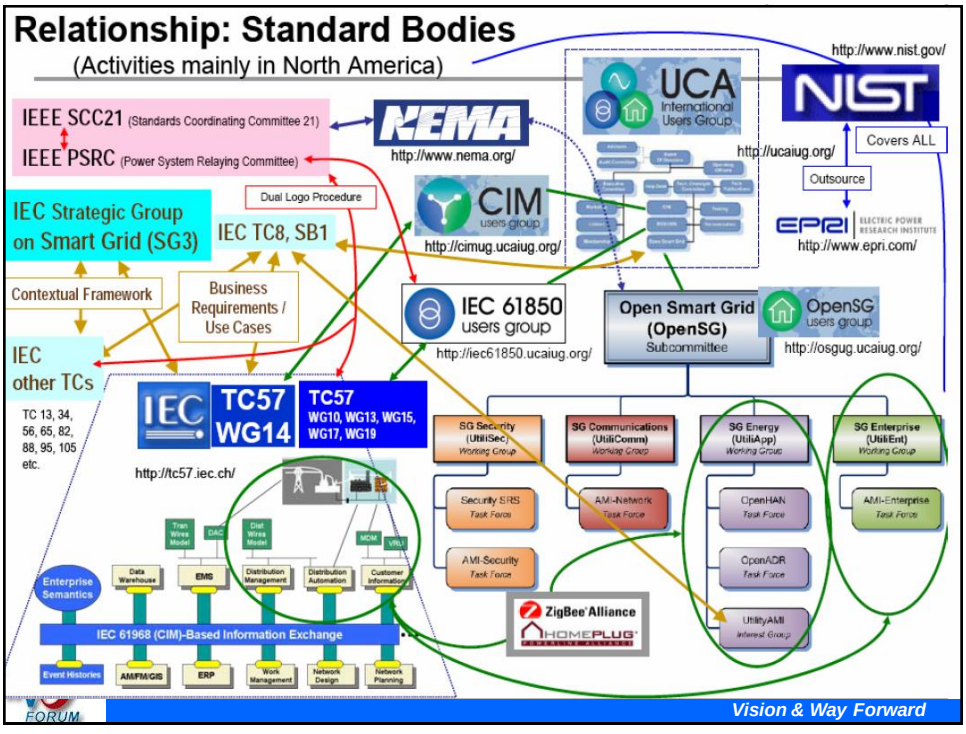
Main Policy Challenges

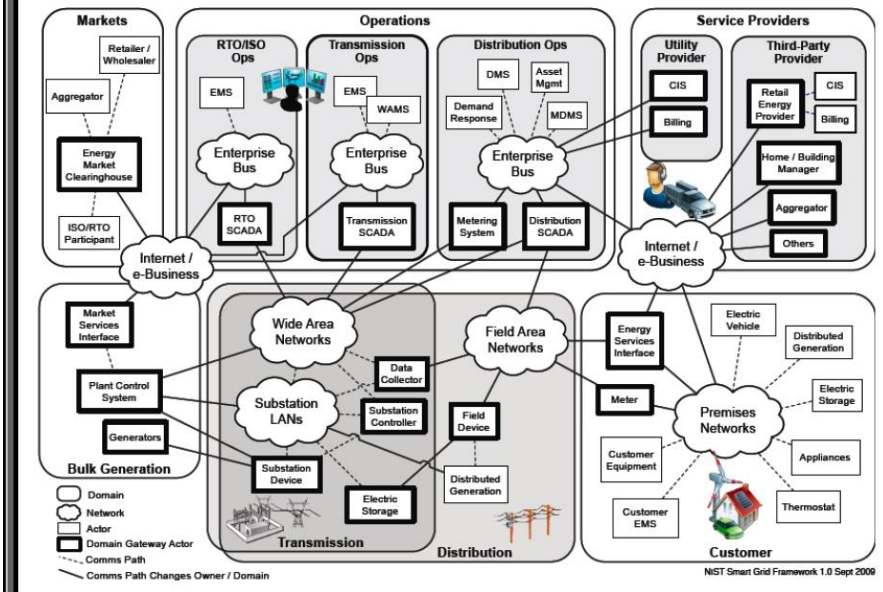
- **Security and confidentiality**
- **Privacy and data protection**
- **Management of critical global resources**
- **Naming and meaning on digital networks**
- **Standards-setting and interoperability**
  - Harmonisation is needed to ensure smooth development and widespread adoption
  - Spectrum, communication protocols and tag formats
- **Social and human impacts**
  - Better personal safety, more efficient care of human health
  - Better environmental protection
  - Internet of Things should support individuality and self-expression, not create a (perceived) societal/individual surveillance
  - Impact of technology on human relationships and intimacy

Smart Grid operational domains





Smart Grid Framework



NIST Smart Grid Framework 1.0 September 2009

Smart Grid Standards

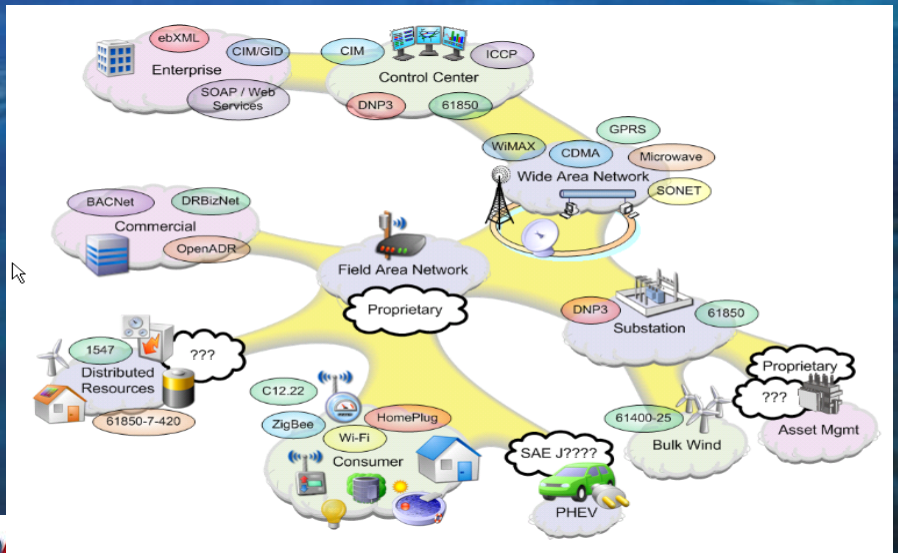


Figure 4: Domain Decomposition

NIST asked the IETF

Network Architecture in the Smart Grid

Architectural Requirements in the NIST Framework and how to meet them

Architectural designs

Internet Architecture

Application	Application Protocol, encoding, AAA, identity, encryption
Transport	End to end reliability
Internet	End to end routing, VPN, Network AAA, identity, encryption
Data Link	Link encoding on physical layer
Physical	Physical Interconnect

"1-2-7" Architecture

Application	Application Protocol, encoding, AAA, identity, encryption, End to end reliability, end to end routing
Data Link	Link encoding on the physical layer
Physical	Physical Interconnect

Examples

Internet Architecture

- **The Internet**
  - **IPv4 or IPv6**
- **The ISO OSI Reference Model**
  - **breaking the application into several layers**
- **Novell Netware**
- **AppleTalk**
- **DECNet**
- **XNS Internet Transport**
- **etc**

Designed to work in Enterprise and general networks

"1-2-7" Architectures

- **IEC 14908**
  - **Implements 7 layers, but in the application protocol**
- **Zigbee 1.0**
- **Many others in the Grid**

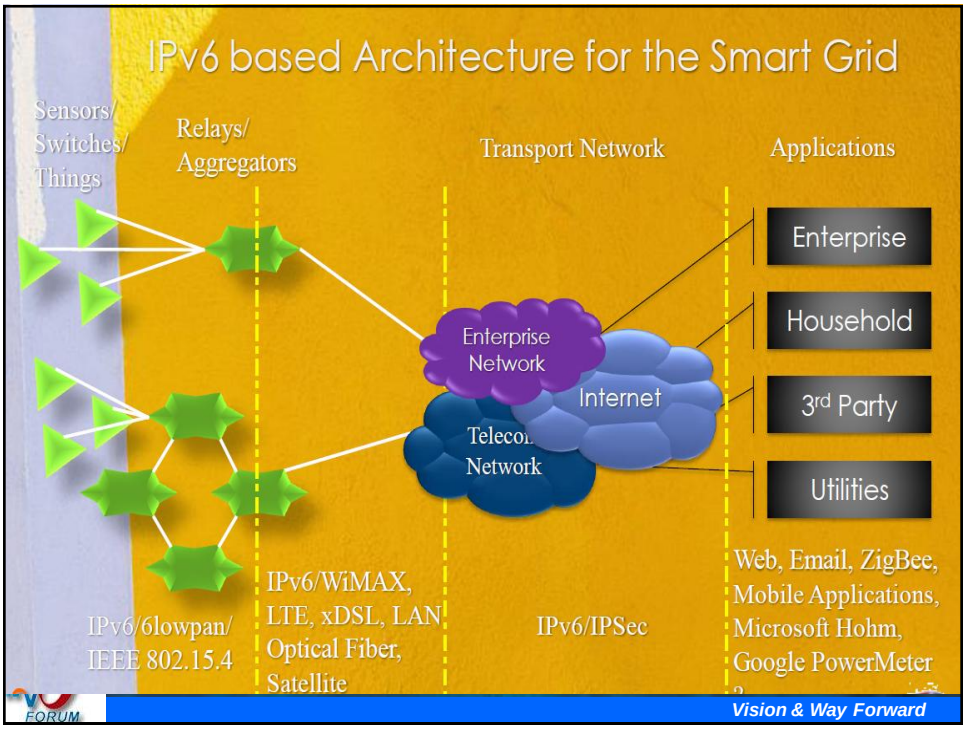
Wire replacement, designed to work in local networks

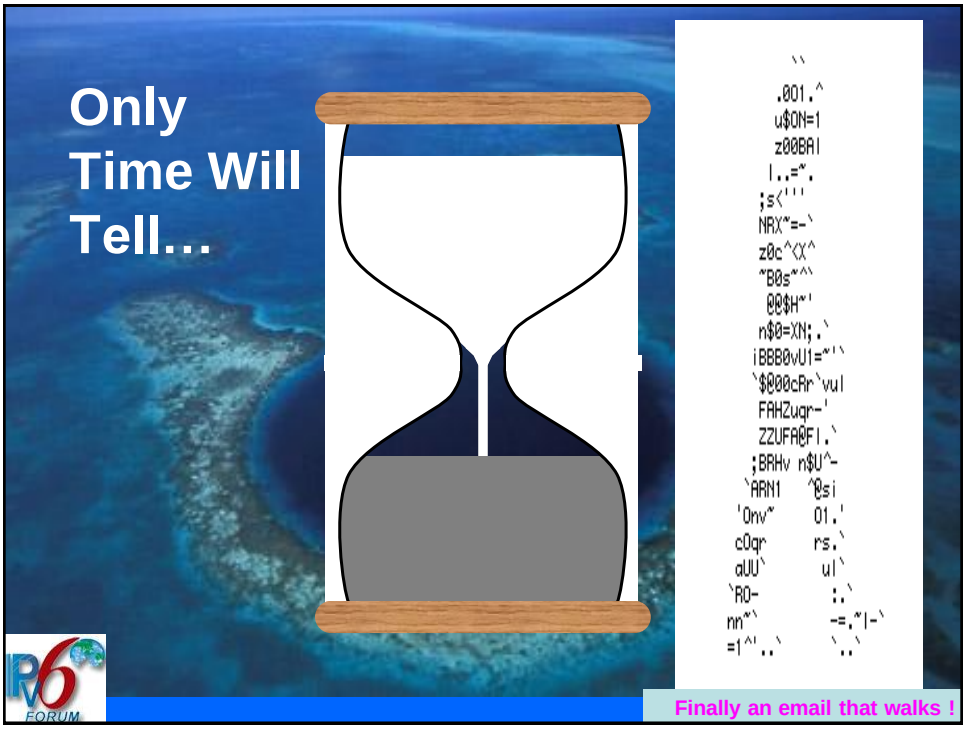
IPv6?

- The Chairman/CEO of ARIN has advised NIST:
  - There are not enough IPv4 addresses left to address a major new application
- The Chair of the IETF has advised NIST:
  - Re-use of the IPv4 address space in air-gap networks is regularly tried and regularly causes problems in networks
  - The IETF strongly recommends IPv6 deployment

NIST asked the IETF Draft-baker-ietf-core

- The reader is warned:
  - IPv4 is running out of address space, and
  - IPv6 has positive reasons that one might choose it apart from the IPv6 space, such as the address autoconfiguration facility and its ability to support an arbitrarily large number of hosts in a subnet.
- As such, the IETF recommends that one always choose IPv6 support, and additionally choose IPv4 support in the near term.




Only
Time Will
Tell…
Finally an email that walks !