



Future Networks and Services

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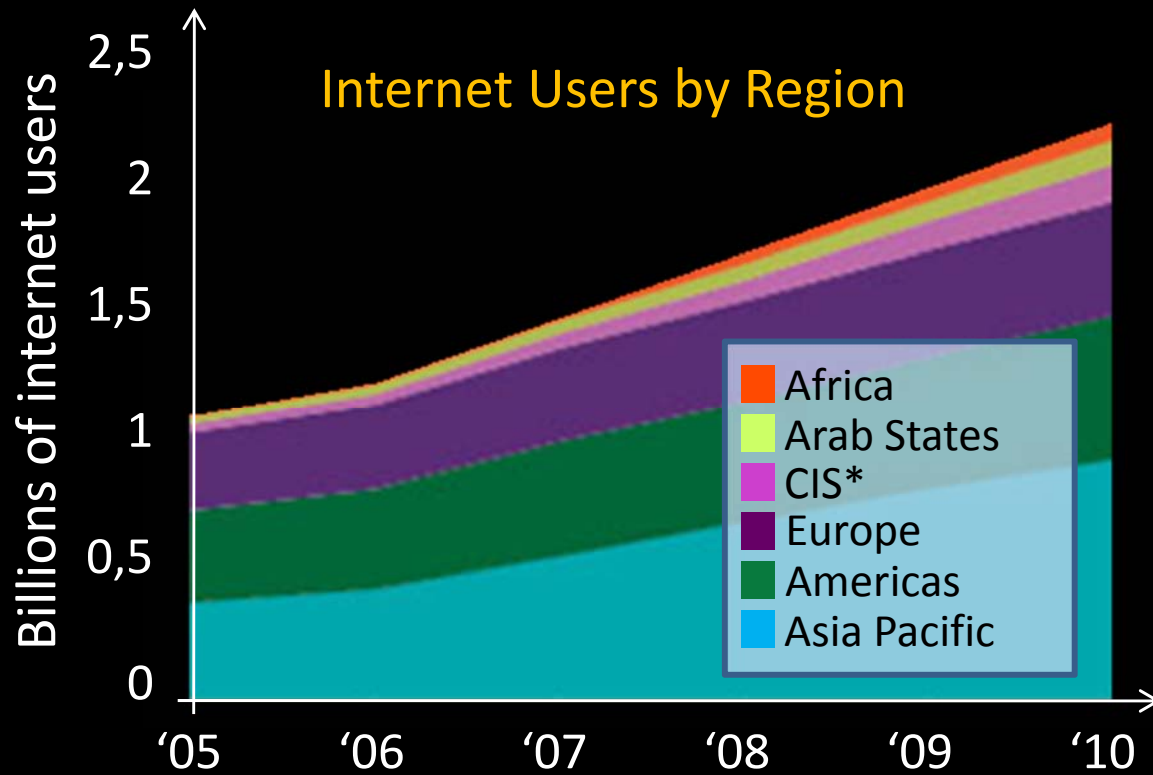


Agenda

- Internet Trends & Future
- Internet (Web) of Things
- Green & Cloud Computing
- Future (Converged) Networks
- Future (Mobile) Services



The World in 2010: ICT facts and figures



*CIS: Commonwealth of Independent States

The world now boasts an estimated **5.3 billion mobile subscriptions**, of which 3.8 billion are in the developing world. And **Internet users** have surpassed the **2-billion** mark.

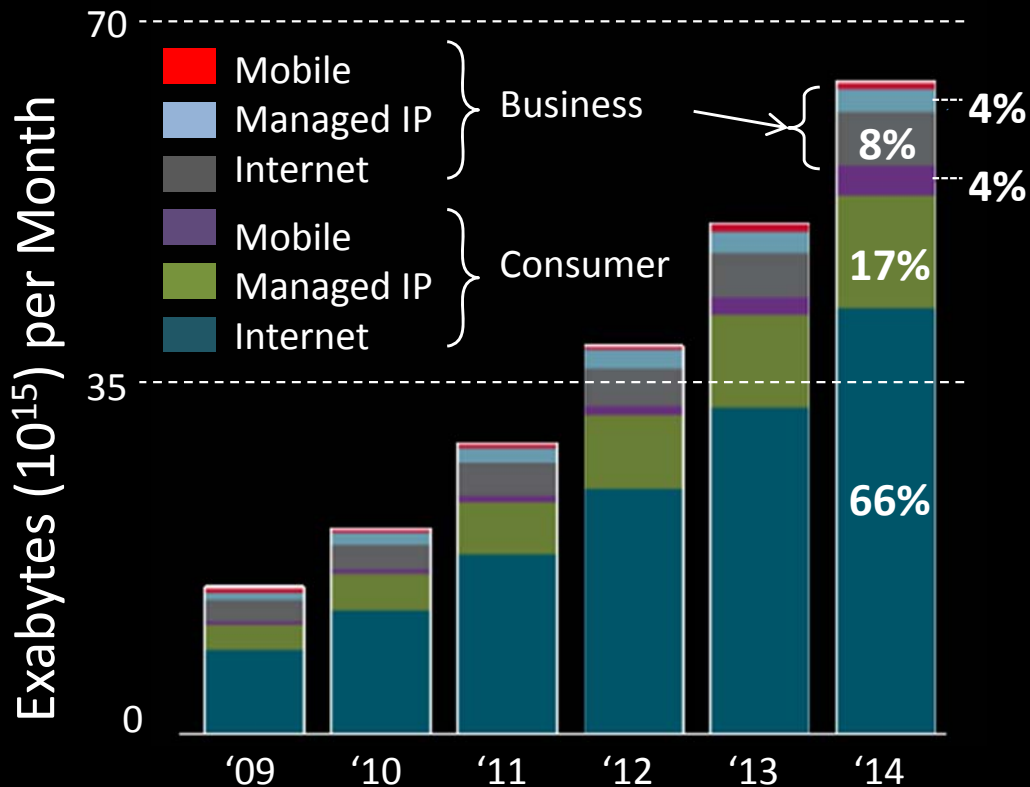




Internet Traffic Growth

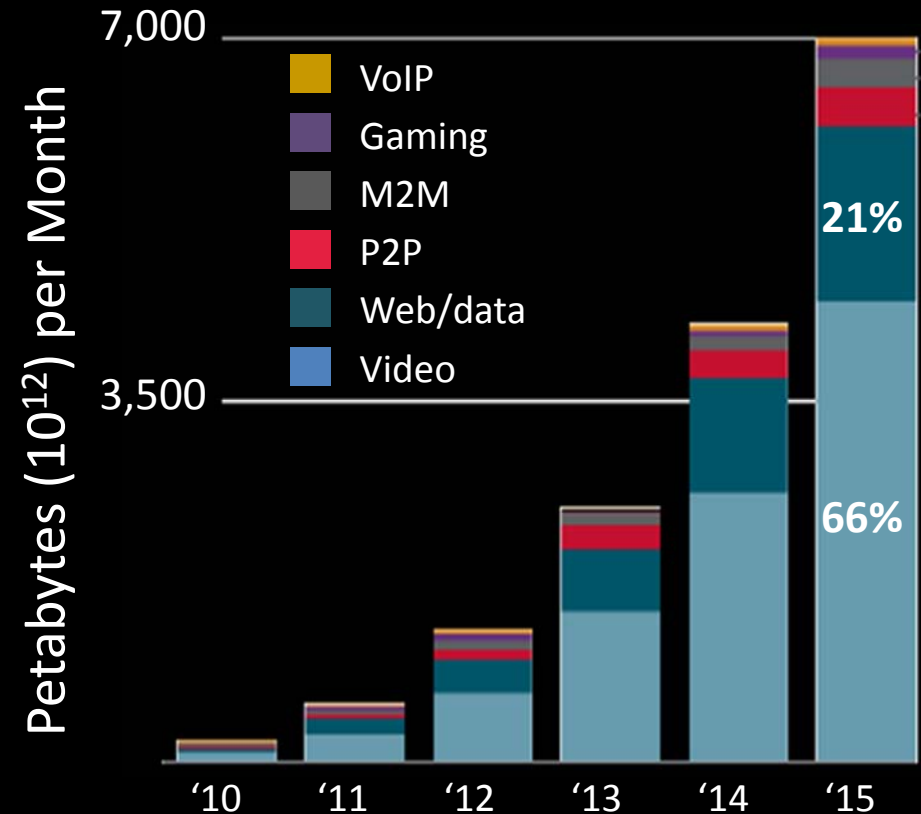
Internet traffic trend

34% CAGR 2009-2014



Mobile internet traffic

92% CAGR 2010-2015



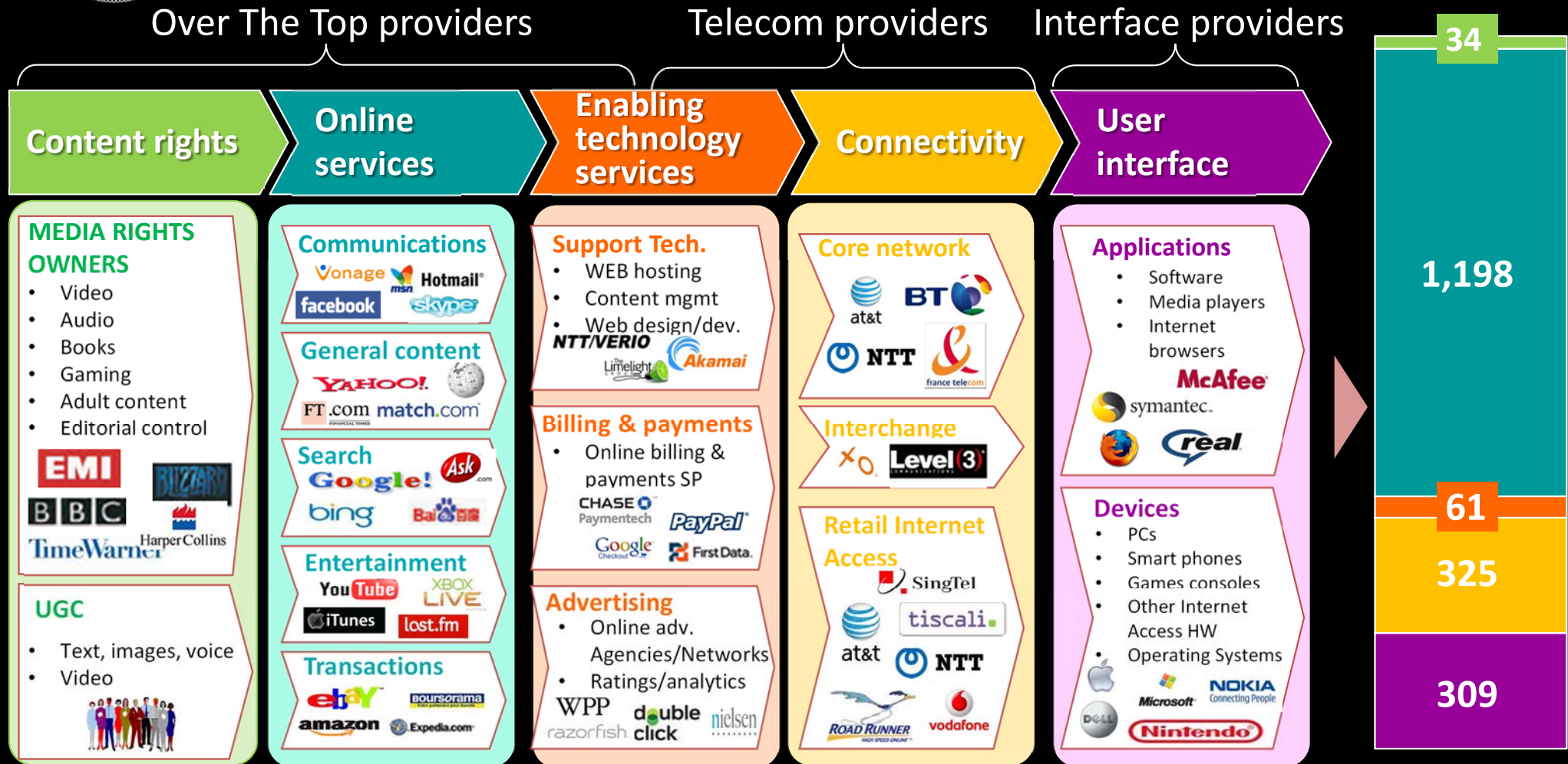
2015 VoIP traffic = 1.5% mobile traffic & 0.4% total traffic

Source: Cisco Visual Networking Index, 2010 & Mobile 2011



Internet Value Chain

1,927 US \$b



- 62% revenues from online services, 17% from connectivity
- 62% revenues from business users, 38% from consumers
- 80% business revenues from online services

2008 Revenues

Source: AT Kearney, 2010. (Year 2008 data)



IEEE Technology Time Machine

Symposium on Technologies Beyond 2020



- Cloud Computing
- Internet of Things
- Smart Grid
- e-Health
- Intelligent Transportation Systems

- Future Directions in Wireless
- Future Mobile Services

- Future of Silicon based Microelectronics
- Carbon Nanostructures and conducting Polymers in Electronics
- Energy Harvesting and Storage
- Advances in Biomedical Engineering
- Displays and Touch screens
- Natural User Interfaces and Augmented Reality



The Internet of the Future



Social Networks
Semantic Web
Internet of Things
Web Services

Increasing Knowledge Networking

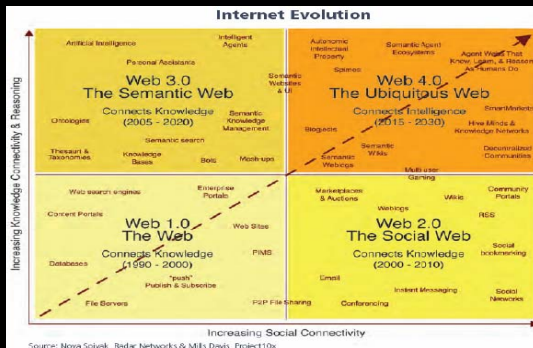
The Semantic Web
(knowledge)

The Ubiquitous Web
(people & objects)

The Web
(information)

The Social Web
(people)

Increasing Social Networking



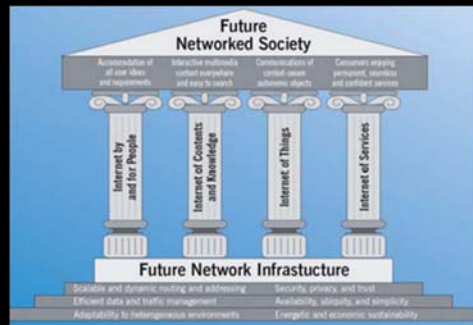
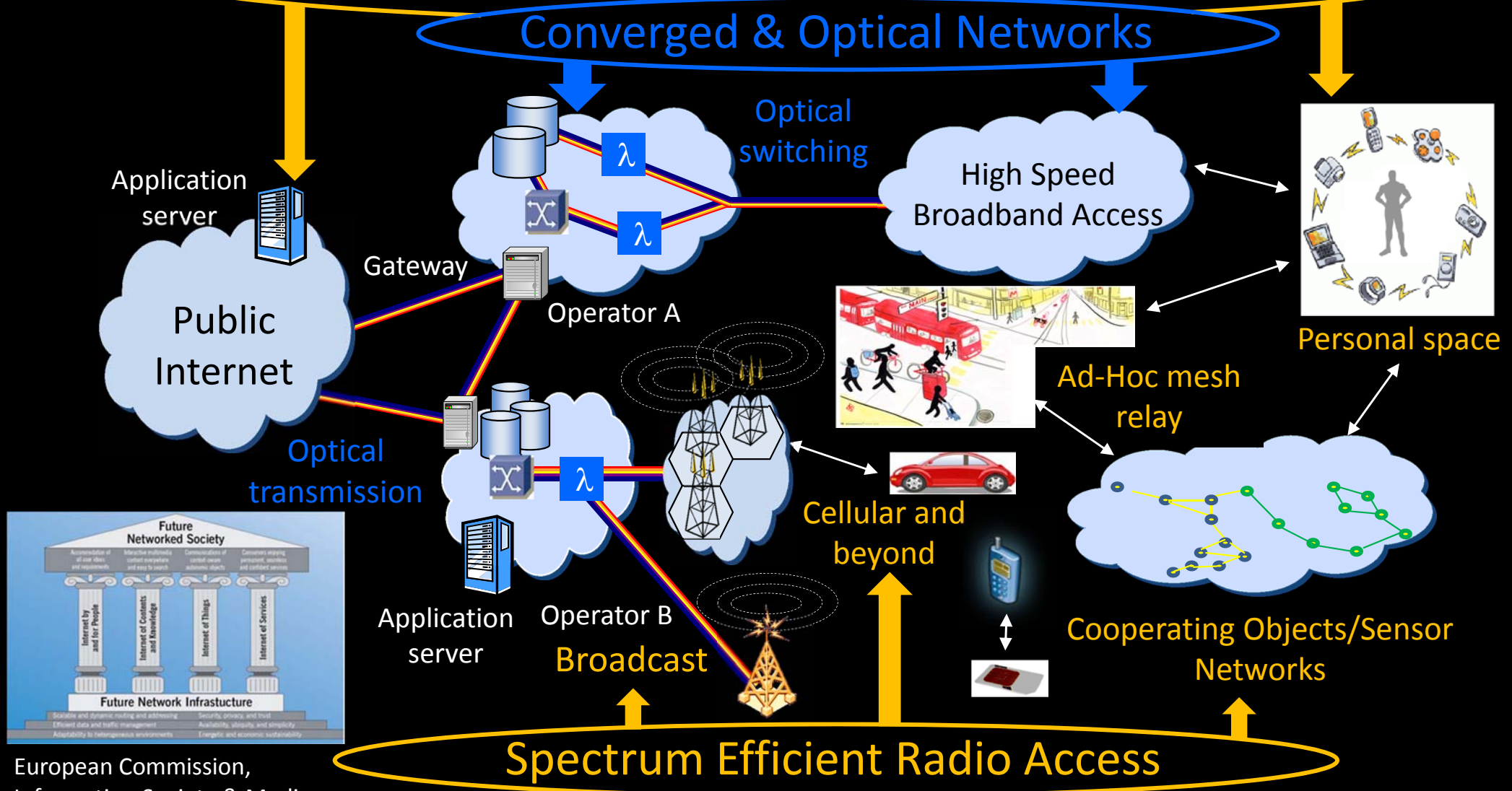
After Nova Spivak, Radar Networks & Mills Davis, Project 10x



The Network of the Future

Internet Architecture & Network Technologies

Converged & Optical Networks



European Commission, Information Society & Media



Agenda

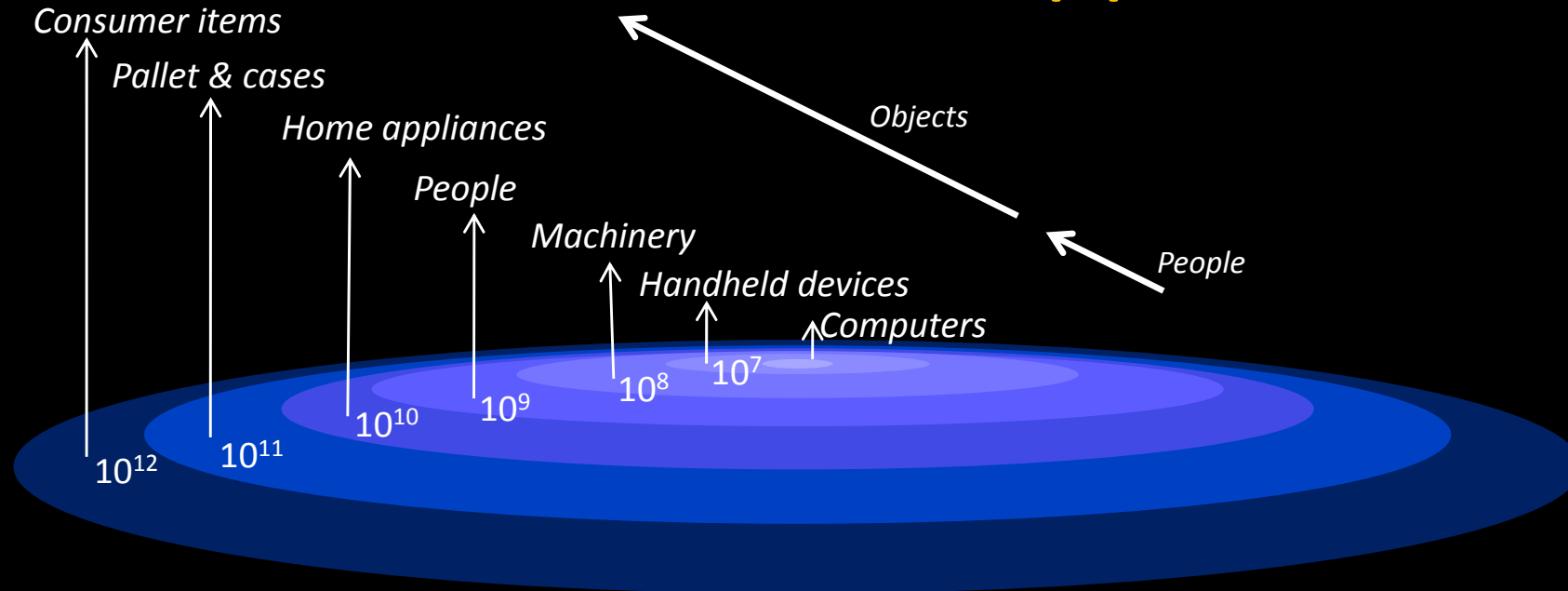
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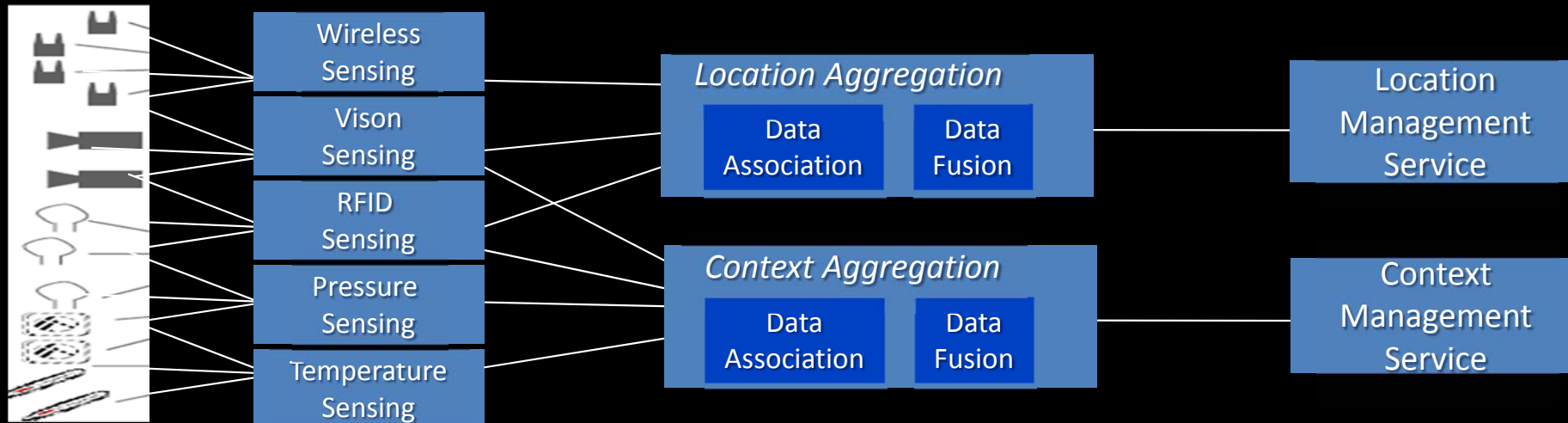
Athena/Minerva
Goddess of Wisdom



Internet of Things & Context-Aware Applications

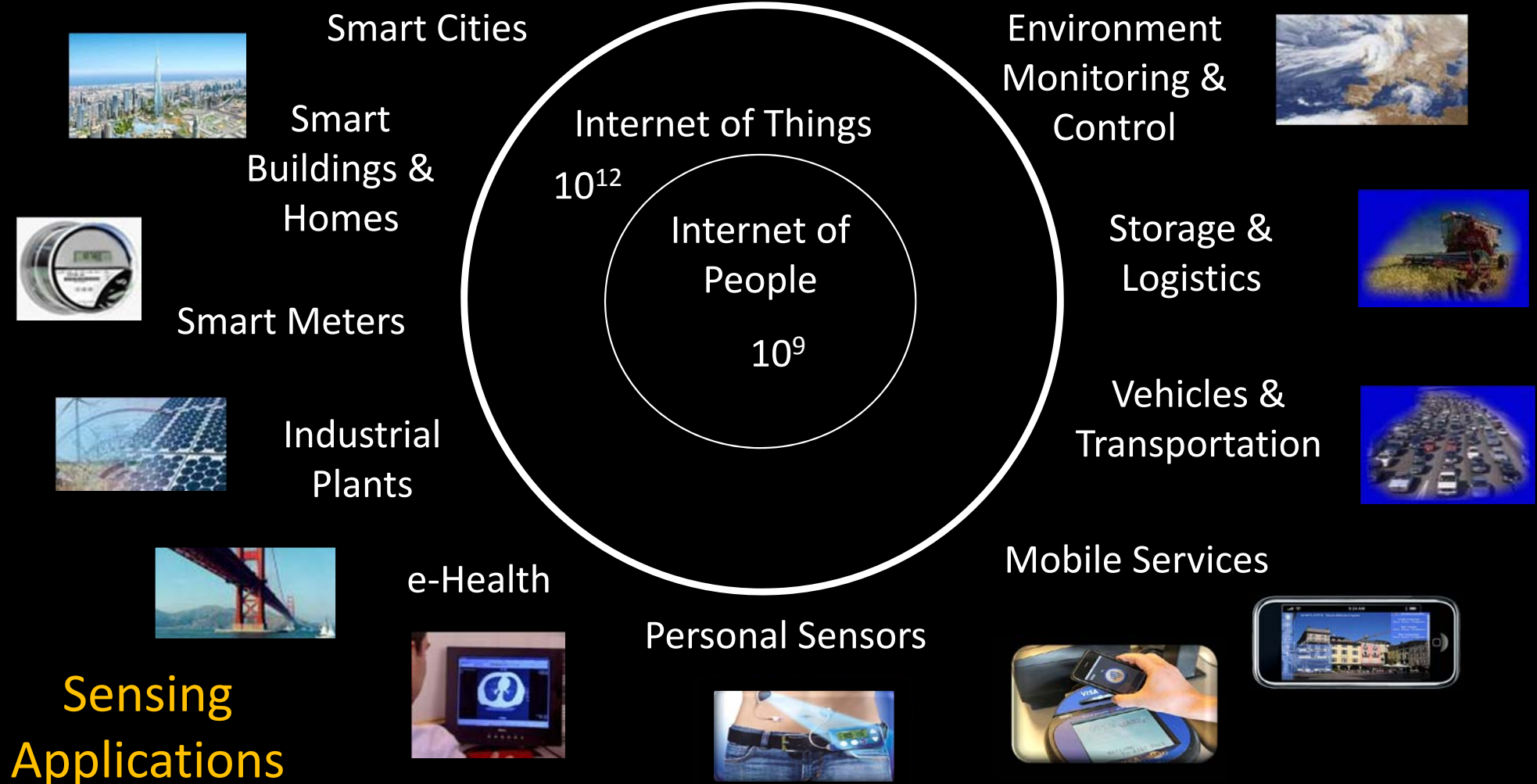


Source: Forrester Research, Ind. April 2006





Internet with Things



Internet + Internet of Things = Wisdom of the Earth



Internet of Things Technologies

Enabling Technologies

- M2M interfaces & protocols
- microcontrollers
- wireless communications
- RFID technology
- energy harvesting technologies
- sensors
- actuators
- location technology
- software

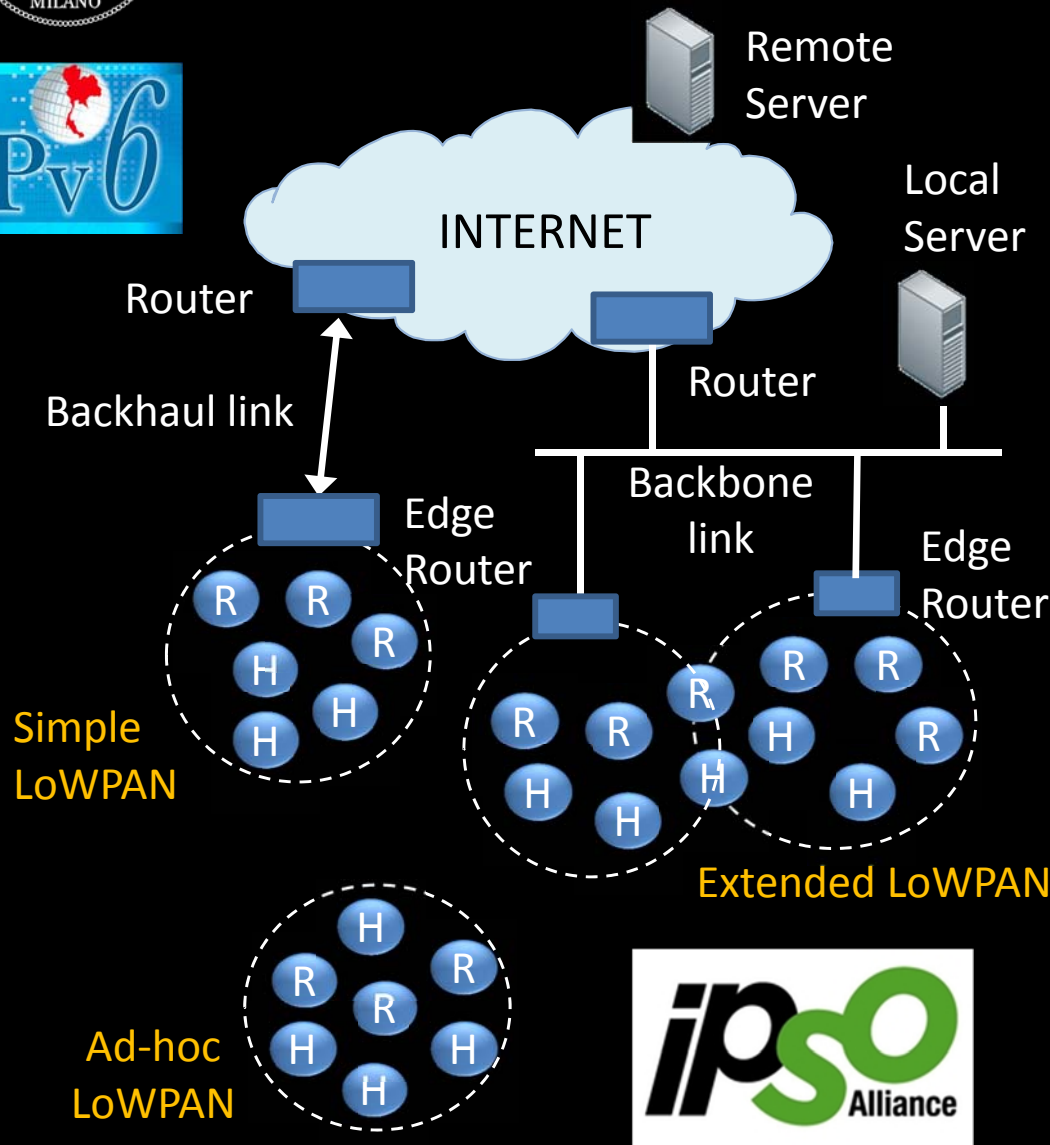
Synergistic Technologies

- geo-tagging/geo-caching
- biometrics
- machine vision
- robotics
- augmented reality
- mirror worlds
- tele-presence & adjustable autonomy
- life recorders and personal black-boxes
- tangible user interfaces
- clean technologies

Source: SRI Consulting Business Intelligence, 2010



WSN 6LoWPAN & ROLL



IPv6	
Ethernet MAC	LoWPAN Adaptation
	IEEE 802.15.4 MAC
Ethernet PHY	IEEE 802.15.4 PHY

IPv6-LoWPAN Router Stack

Routing Over Low power and Lossy networks (ROLL)

Standard routing algorithm for embedded apps

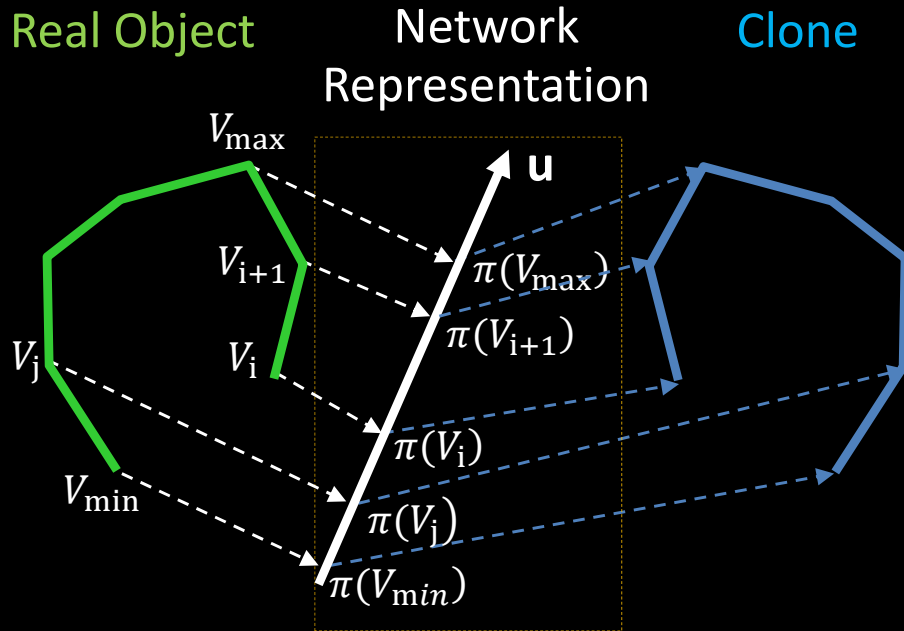
Application specific requirements

- Home automation
- Commercial building automation
- Industrial automation
- Urban environment

Sources: 6LoWPAN, The Wireless Embedded Internet, Shelby & Bormann, 2009



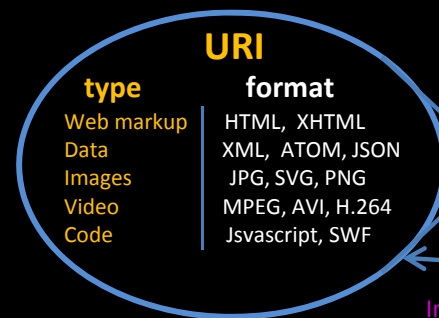
Representing & Identifying Things



Source: Roberto Saracco, 2010

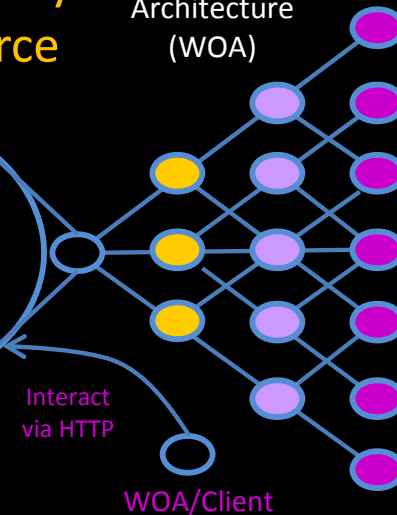
- For each Real Object there is a representation in the cloud for duplications, synchronization, recreation of the object, etc.
- Actions and events on the Real Object act on network images and clones, and vice versa

An Individual, Uniquely Addressable Resource



- Non exhaustive list of possible representations
- Links (URIs) to globally unique resources, in lieu of copies

Web- Oriented Architecture (WOA)



Resource Examples:

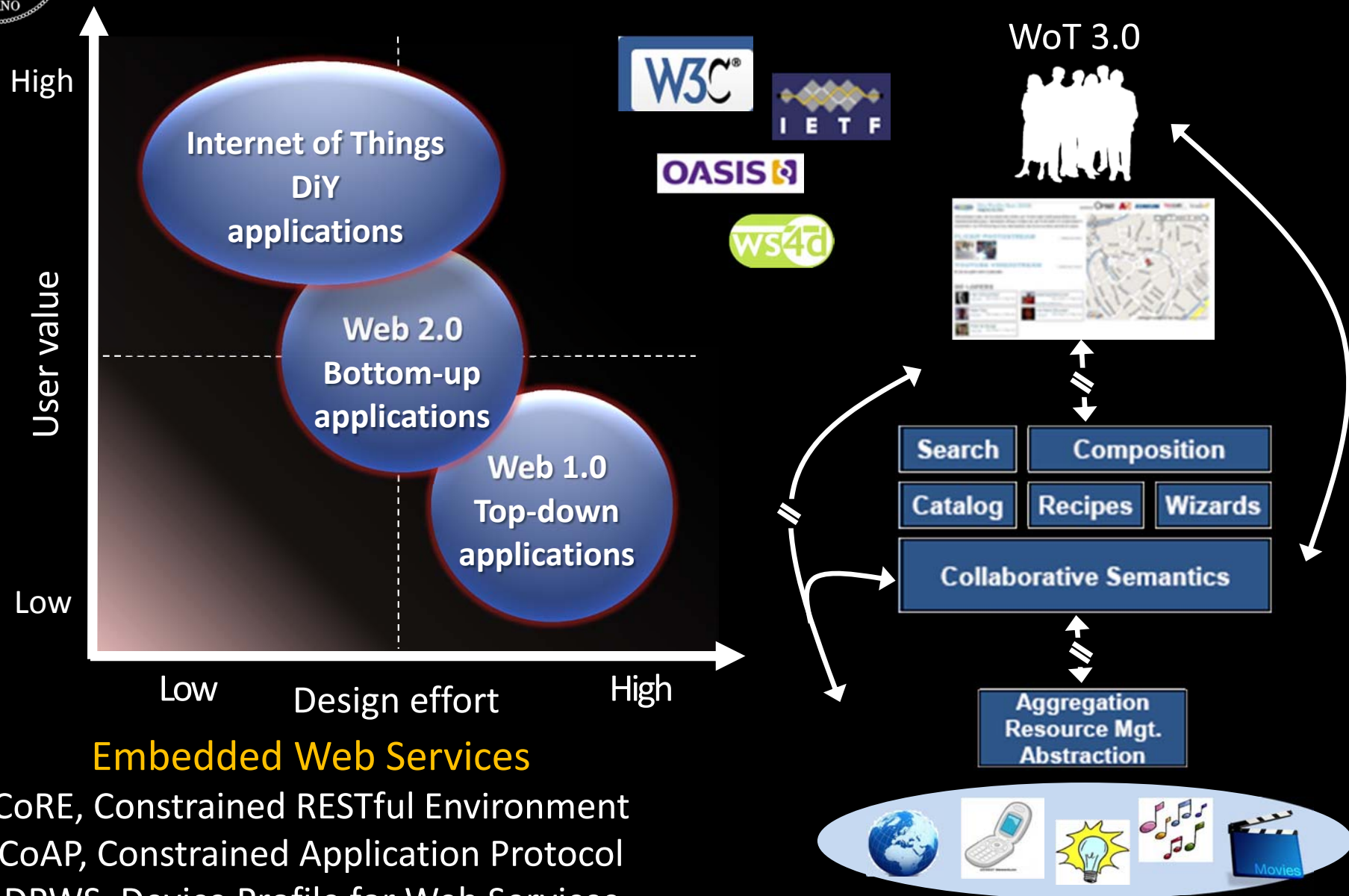
- Web page
- Customer Orders
- Products
- Blog posts
- Stock quotes
- Geolocations
- Map tiles
- Headshots
- Call records
- Podcasts
- Ajax components
- Web widgets
- Advertisements
- OpenOffice docs

Source: Dion Hinchcliffe, 2008

- Any Virtual Object is addressable
- Every Virtual Object can be dynamically associated to a User Identity
- Every user can have control over a specific virtualized object or aggregation of objects



Programming the Web of Things



Embedded Web Services

CoRE, Constrained RESTful Environment
 CoAP, Constrained Application Protocol
 DPWS, Device Profile for Web Services

Source: Lieven Trappeniers, 2009



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ICT-enabled Emission Reduction

Total ICT-enabled Reduction : 7.8 GtCO₂e

35% of Global 21.7 GtCO₂e Reduction

The Climate Group, SMART2020

Transport 28%

- Smart logistics
- Private transport optim.
- Dematerialization (telecom)
- Efficient vehicles
- Traffic control

Buildings 31%

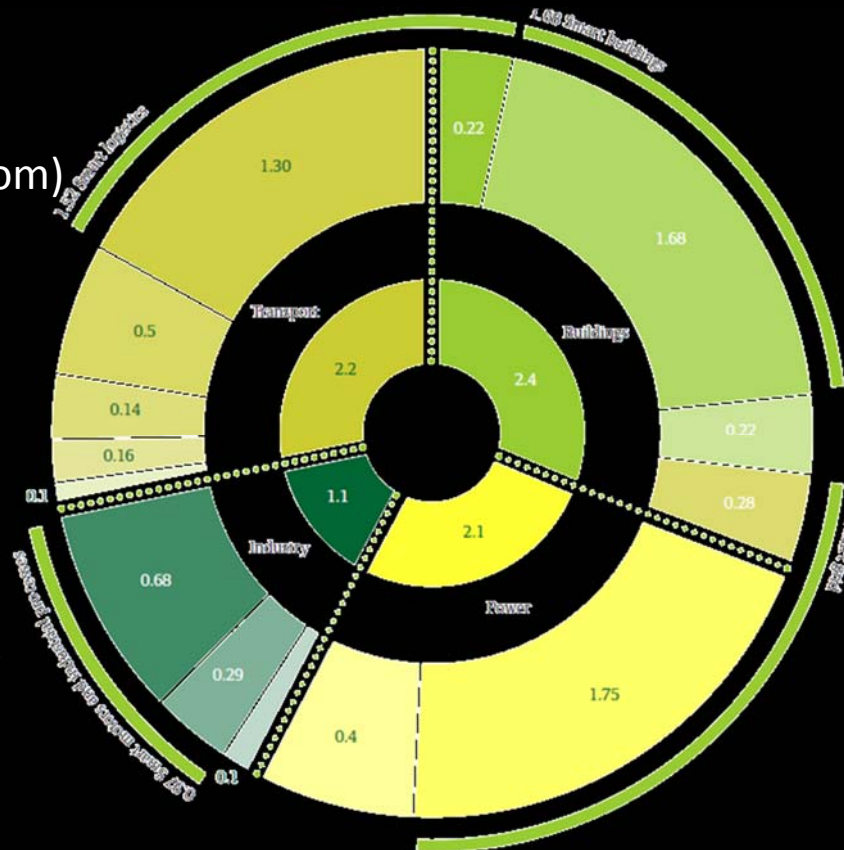
- Smart logistics
- Smart buildings
- Dematerialization (telecom)
- Smart grid

Industry 14%

- Smart motors
- Industrial process autom.
- Dematerialization (less waste production)

Energy 27%

- Smart grid
- Efficient generation of power, combined heat and power (CHP)





Cloud Computing for Consumers

MUSIC



VIDEOS



APPS/DOCS



PHOTOS



VOICE



last.fm

facebook

Spotify

Rhapsody

amazon MP3

PANDORA internet radio

jango

NETFLIX



facebook

Joost

hulu

YouTube Broadcast Yourself

Babelgum

amazon.com

BBC iPlayer

slingbox

Scribd



Salesforce

Google

OVI NOKIA



facebook

WAC

facebook

Picasa

flickr

photobucket

shutterfly

skype

Vonage

PROJECT Gizmo

wengoPHONE

Google voice

Jajah

fring

RETEL

Who is driving Consumer world?

facebook

“UNIFIED DIGITAL LOCKER”(*)

Fixed-mobile cloud computing

(*) Morgan Stanley 2010

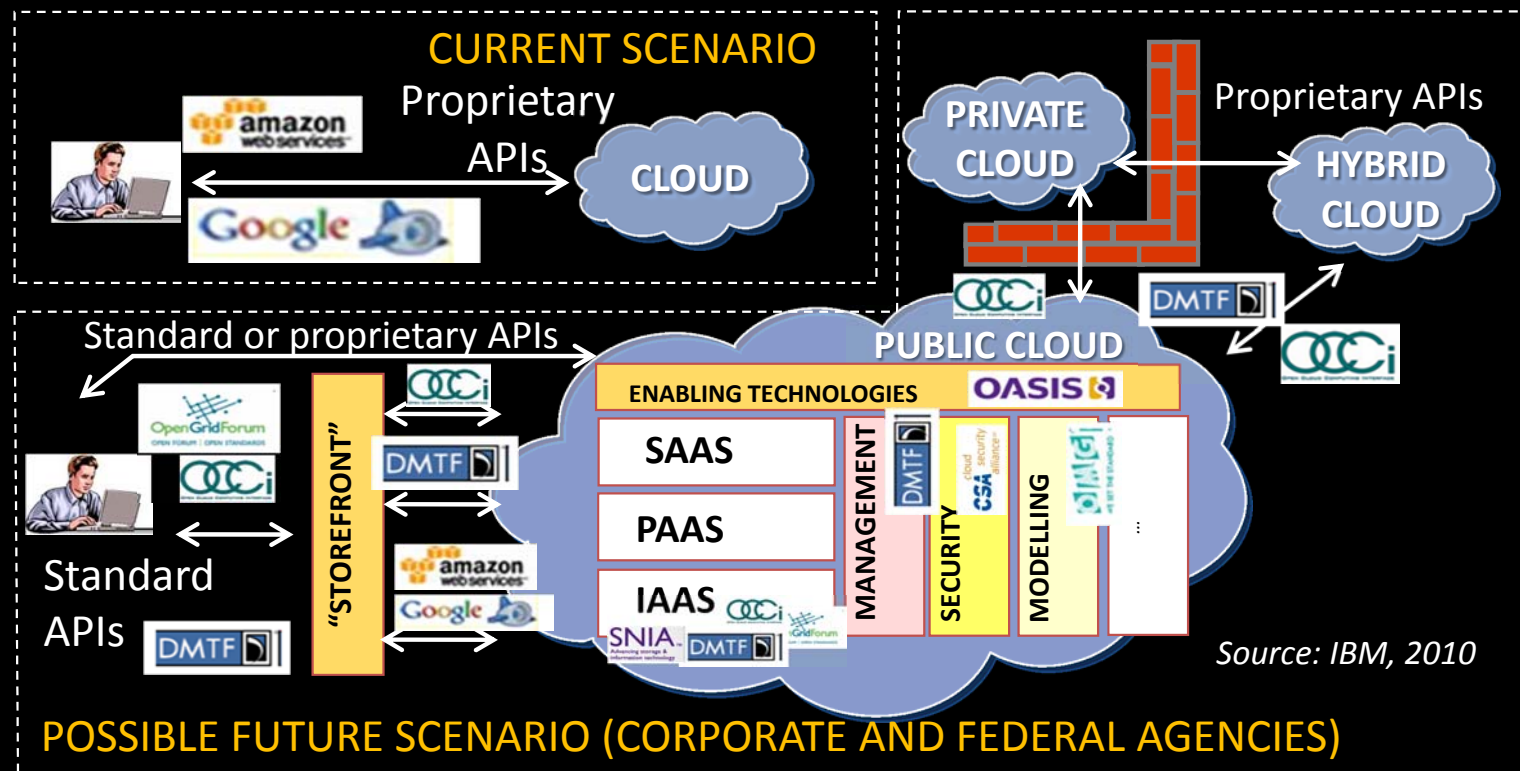
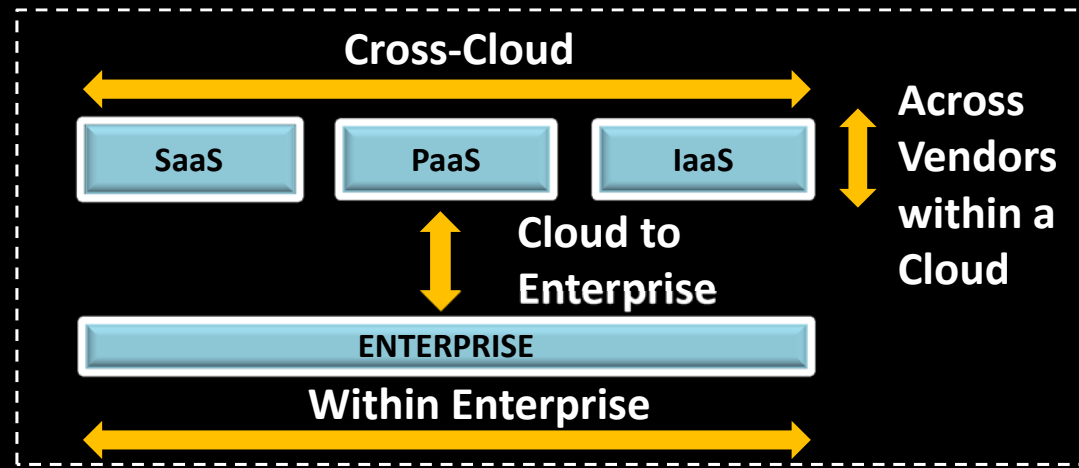
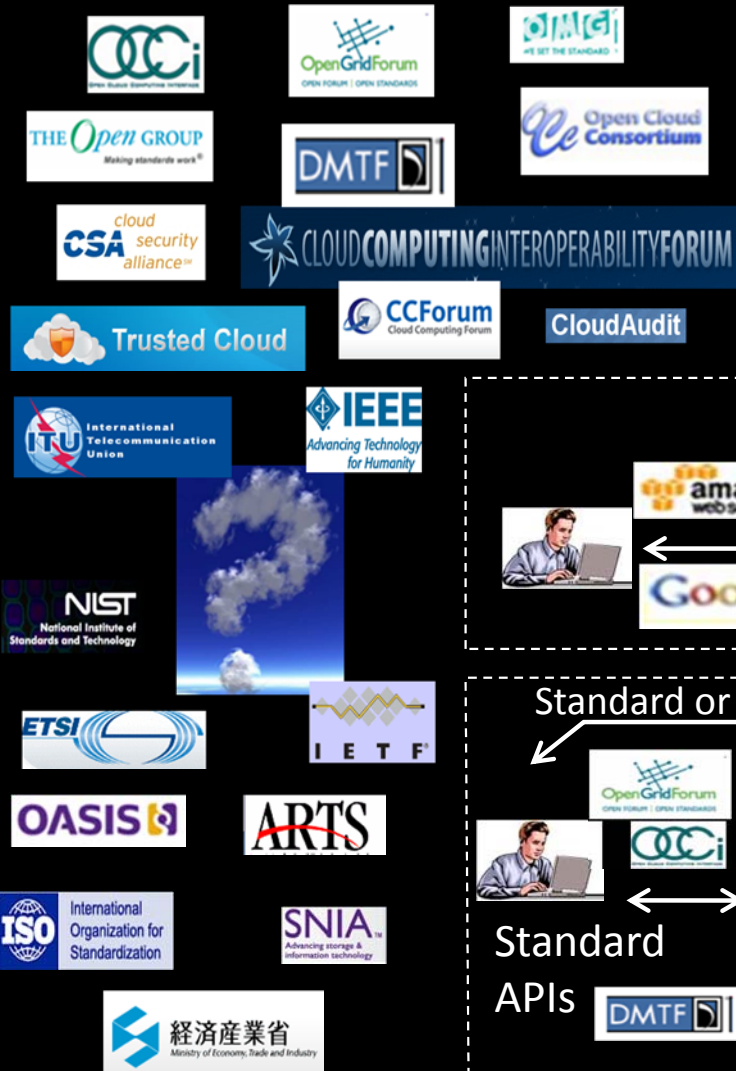
Who is driving Business world?

?



Cloud Computing Standards

A crowded scene





Agenda

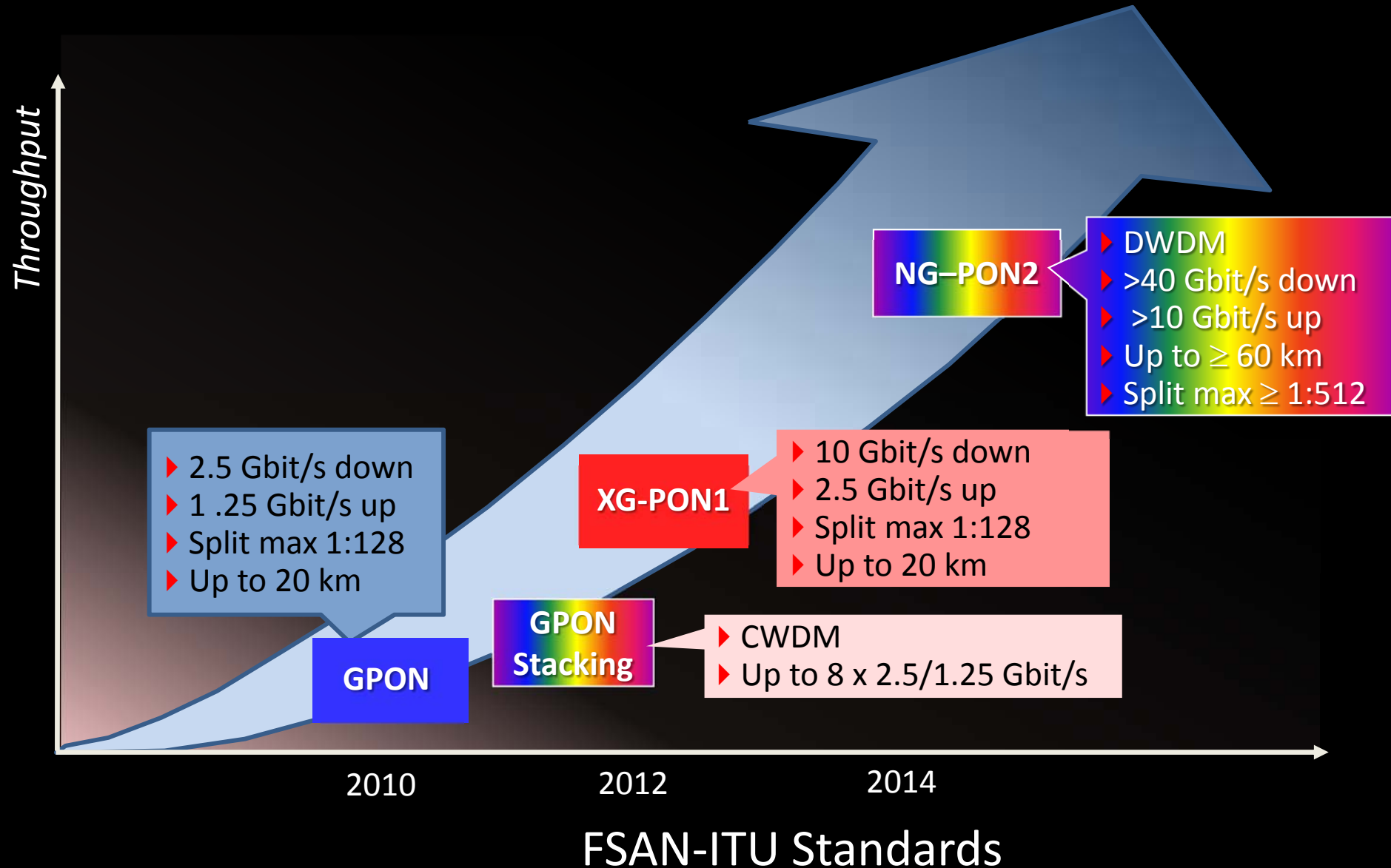
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Hermes/Mercury
Messenger of the Gods
God of Commerce

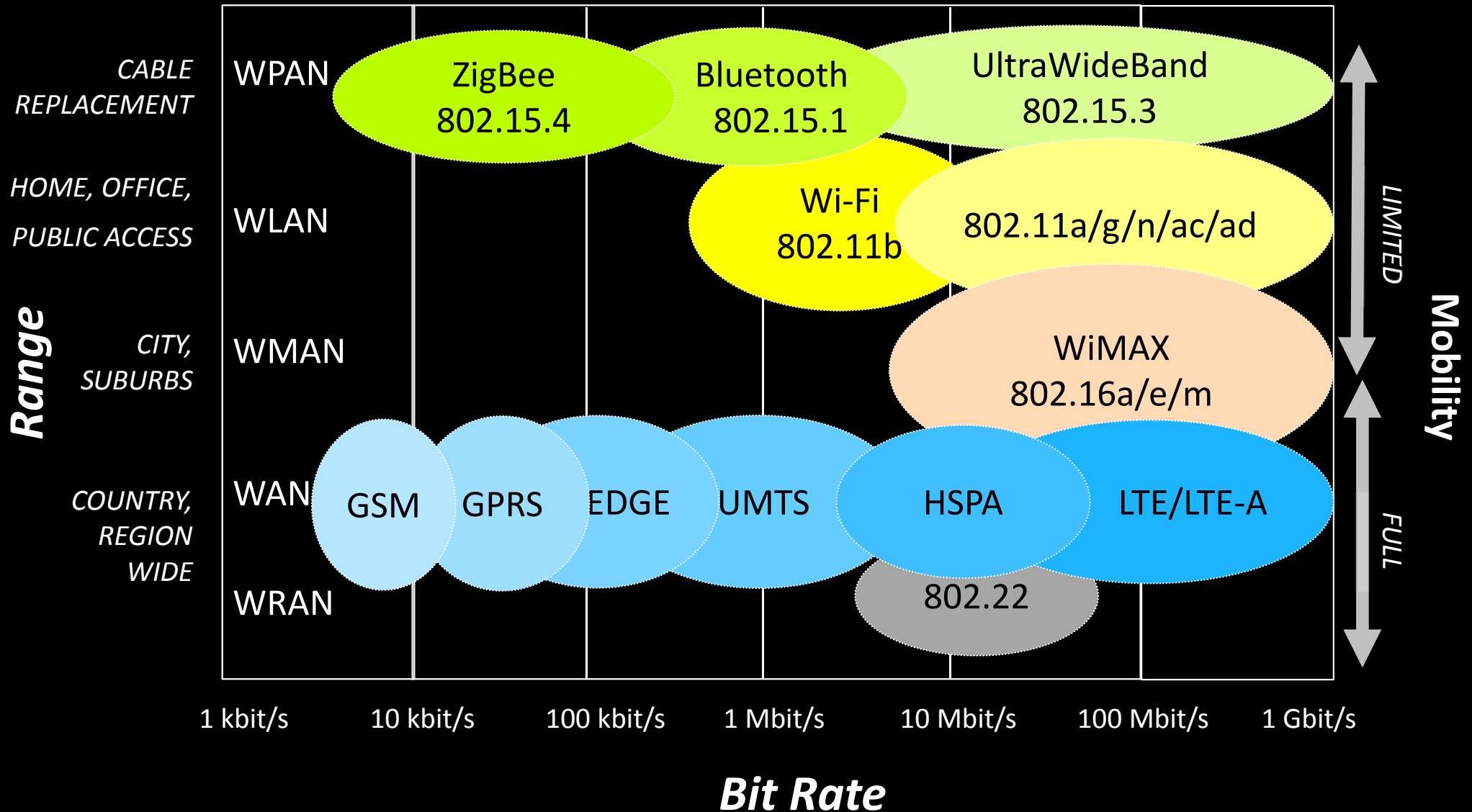


Next Generation Optical Access Towards the Terabit/s



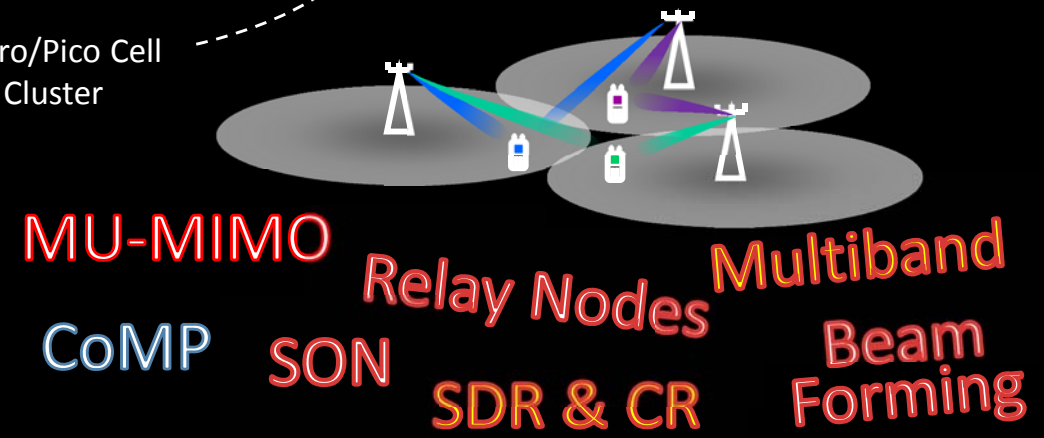
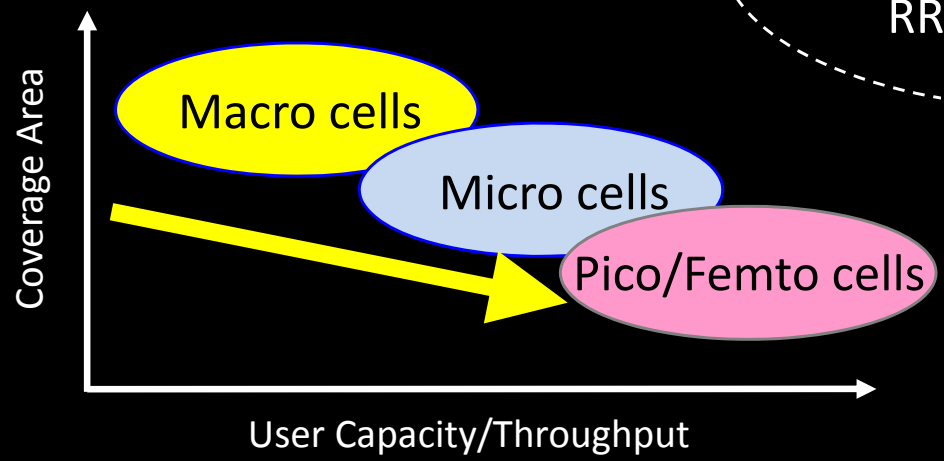
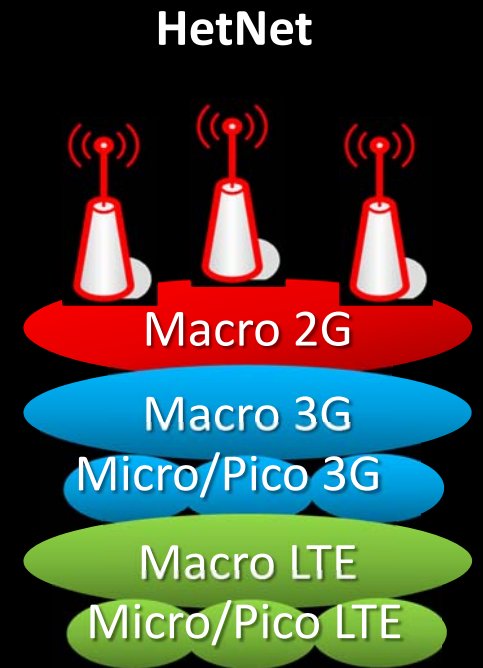
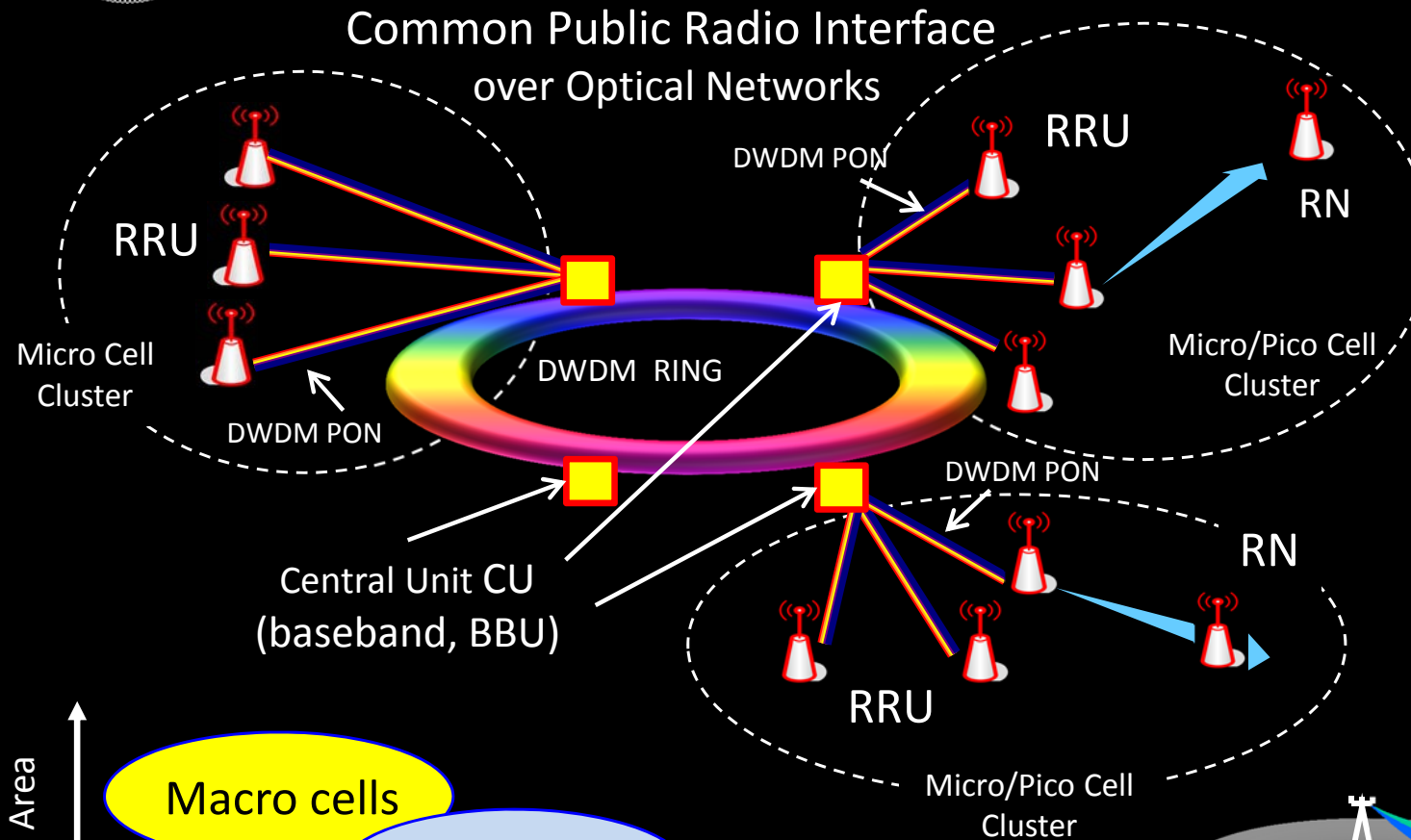


Wireless Access Towards the Gbit/s



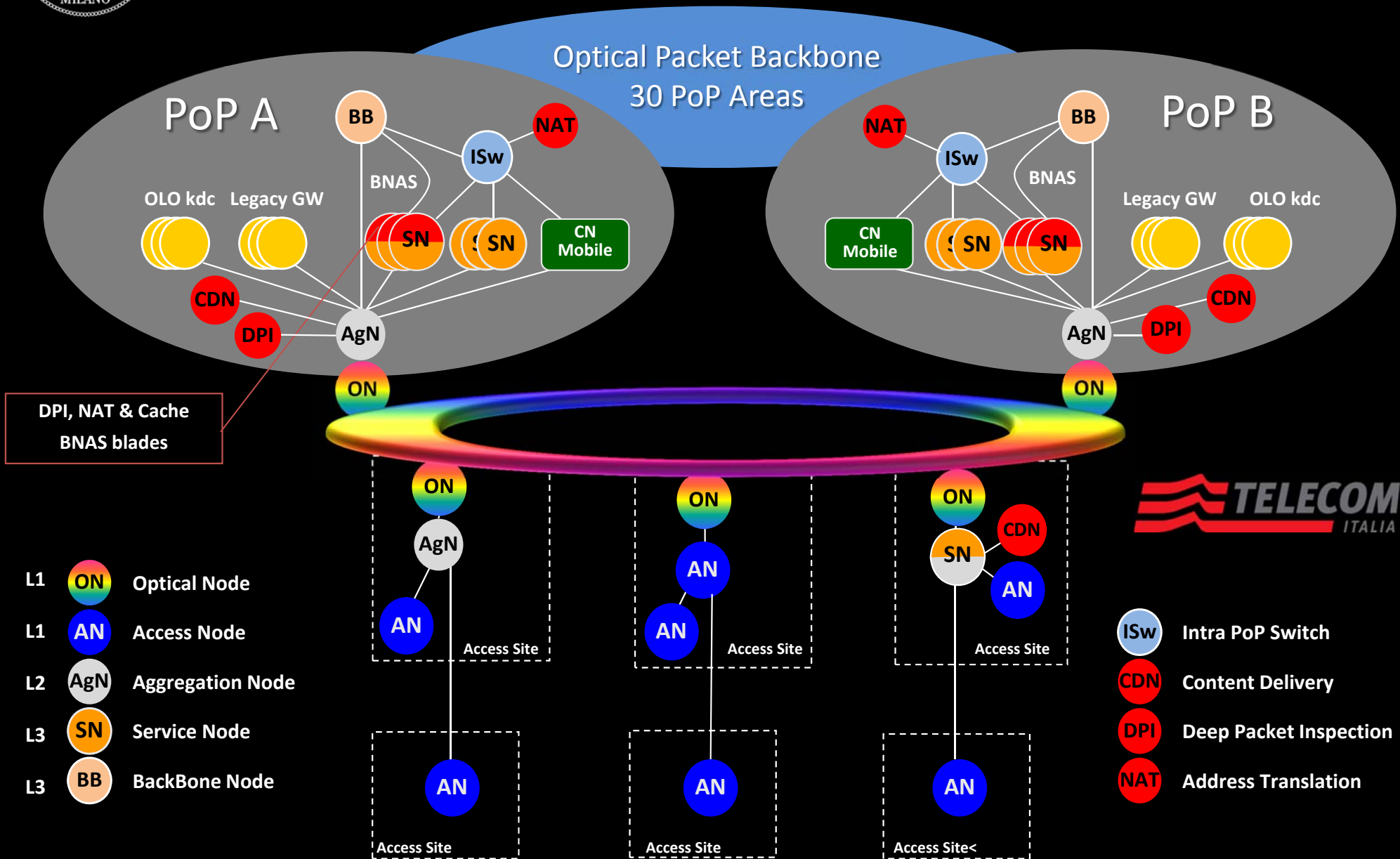


Cloud Radio Access Network, CRAN





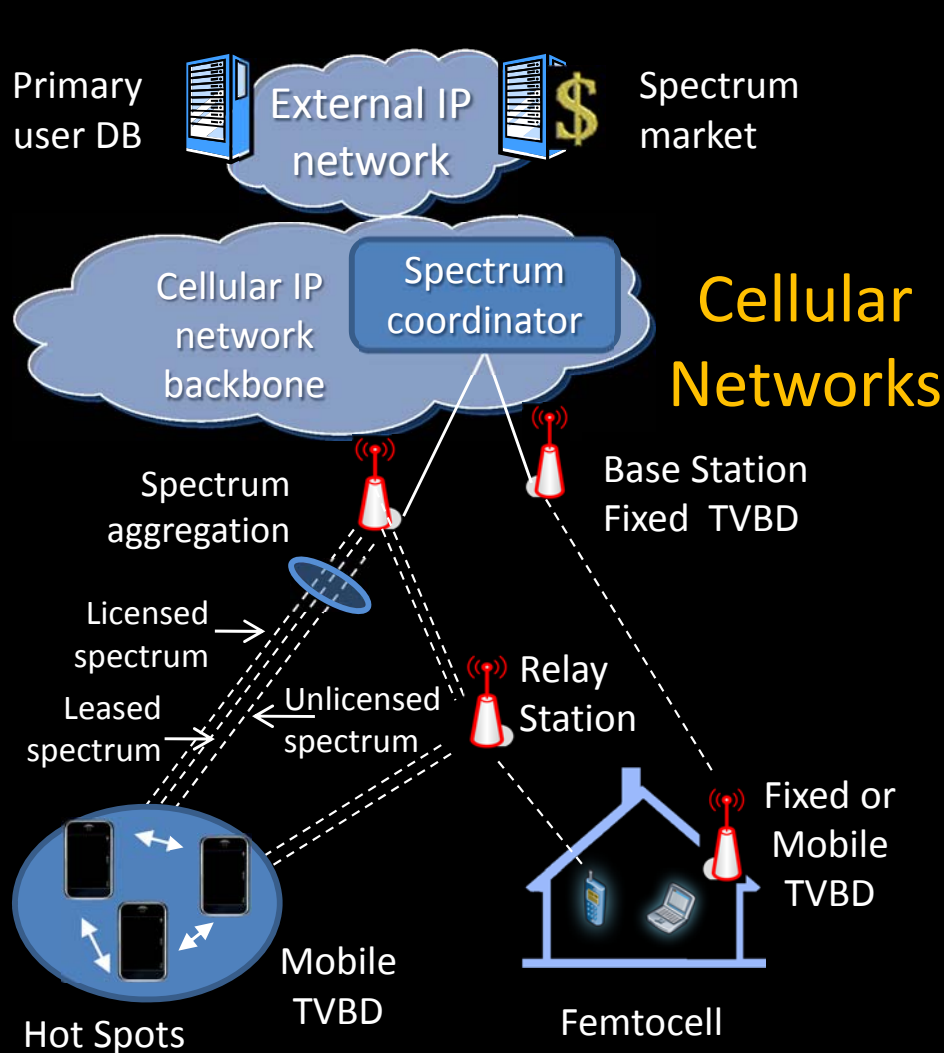
Converged Access and Aggregation



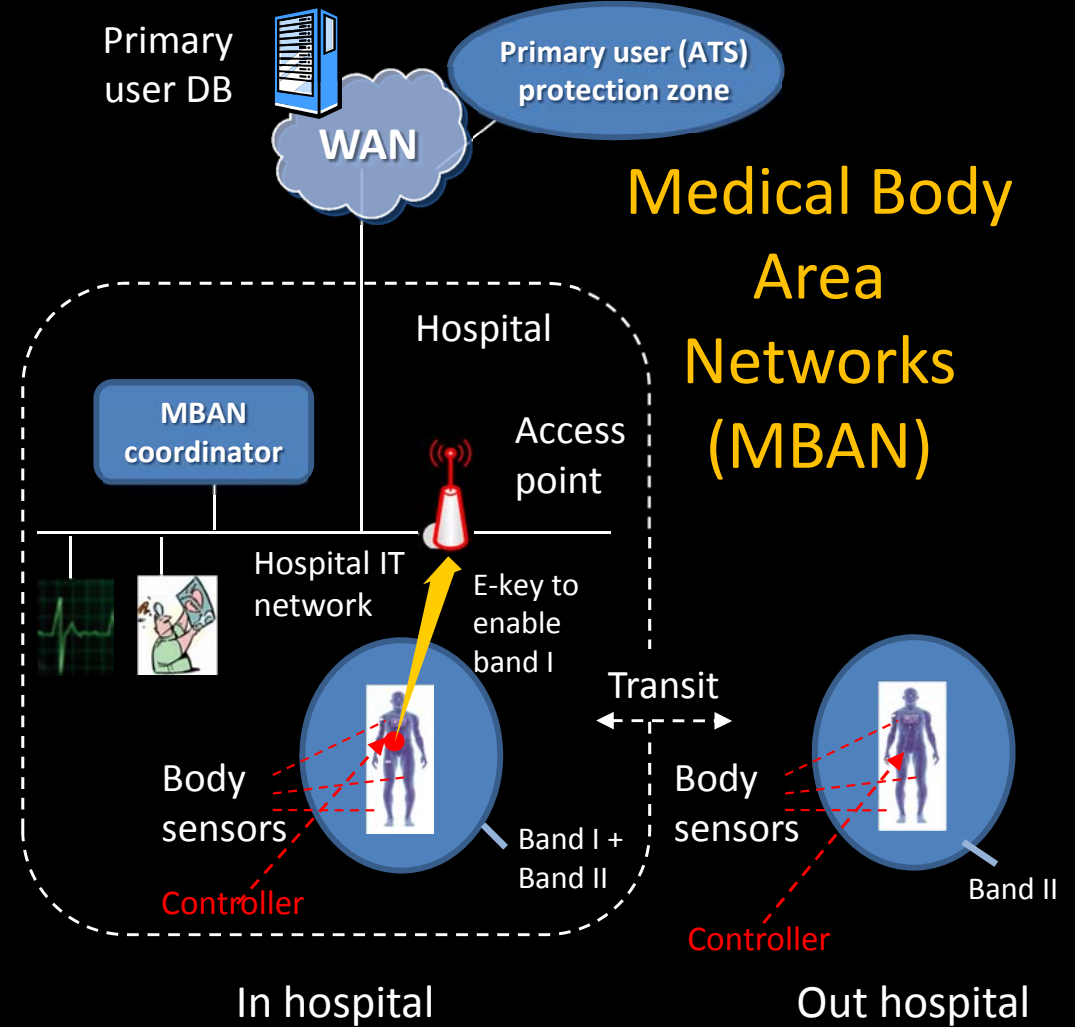


Cognitive Radio Applications

TV White Spaces – IEEE 802.22



2.36-2.40 GHz AMT Band Secondary Use



Other: Smart Grid, Public Safety Networks

Source: Wang, Ghosh and Challapali, 2011



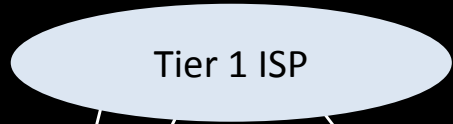
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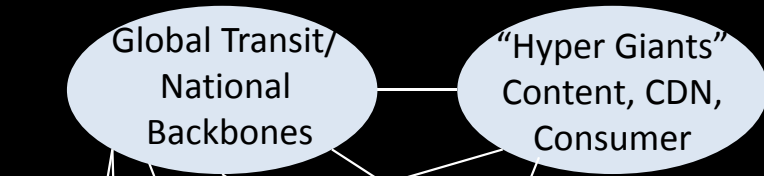


Old and New Internet Models

National Backbone Operators



Settlement free



Global Internet Core

Tier 1 ISP

Global Transit/
National
Backbones

"Hyper Giants"
Content, CDN,
Consumer

NAP

NAP

IXP

IXP

Regional Access Providers

Pay for transit BW

ISP1

ISP2

Regional/
Tier2
Providers

Local Access Providers

Pay for access BW



Customer Networks

Customer Networks

Consumer and business customers

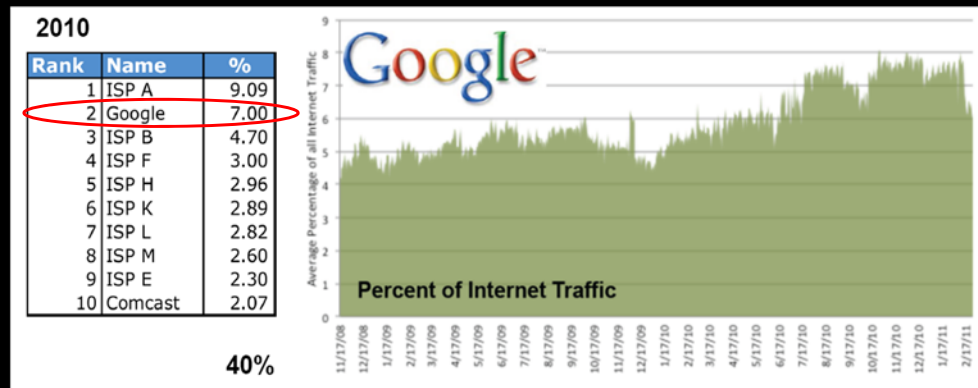
Consumer and business customers

Flatter and much more densely interconnected Internet
Disintermediation between content and eyeball networks
New commercial models between content, consumer and transit

NAP: Neutral Access Point

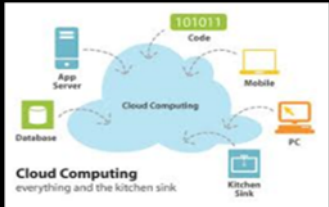
IXP: Internet Exchange Point

Source: Craig Labowitz, Arbor Networks, April, 2011



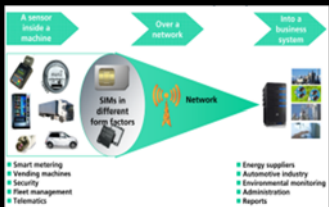


Managed Internet Services (QoS)



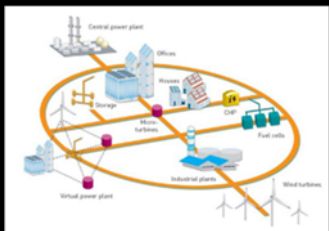
Cloud Computing

The evolution to on-demand service models, enabled by virtualization and communication networks, offers the opportunity to further advanced scenarios of "utility computing "



Internet of Things

The spread of cheap and pervasive computing capacity and sensors opens the way for automation applications and mass market Web applications involving personal and public smart objects



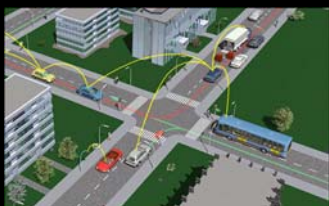
Smart Grid

The transformation of the energy sector (especially electricity) is based on a substantial supply of ICT infrastructure components able to "activate" the energy transport network



e-Health

The emerging need for health and social care (also associated with the growth of population life expectancy) finds in ICT a chance to increase effectiveness and efficiency



Intelligent Vehicle Transportation

ICT offers opportunities to support the growing need of security, safety and efficiency in the transportation sector, in particular for vehicles traffic automation and control



Mobile NFC Applications



Card Emulation Mode

Transaction:

Mobile payments, Ticketing, Access control, Transit, Top-ups, Toll gate

Peer to peer Communications

Connectivity:

Data transfer: fast, easy & convenient device association, setup & configuration

Reader Mode

Service Discovery:

Content distribution, Information access, Smart advertising

Source: NFC Forum, 2008



Tata Docomo, Active Poster



Wave & Pay



m-Health

Alcatel-Lucent Wallet Phone



Future Mobile Device

SENSING

Local content & service discovery

SEEING

Augmented reality UI
Map, 3D, in building navigation

INTERACTING

Connection manager



KNOWS

You and what is around you

LEARNS

What you like

DISCOVERS

Things relevant to you

FILTERS

Out the irrelevant

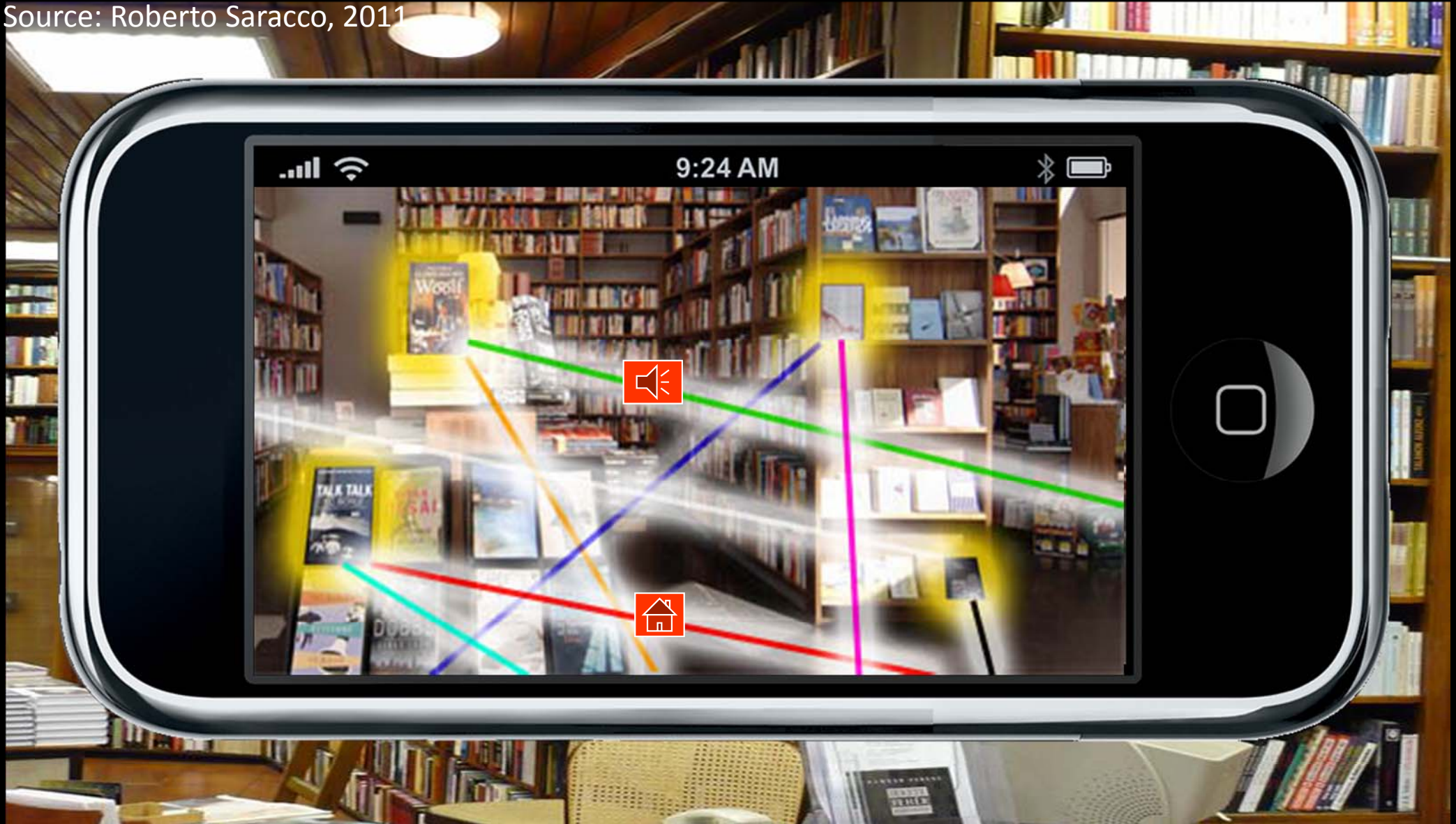
Massive scale computations (billions of simultaneous transactions) needed to mash up personal data, preferences, real world data, and device capability

Sources: from Qualcomm, USI, 2010



The Internet with Things

Source: Roberto Saracco, 2011





Grazie!

Le tre Grazie

The Three Graces
Antonio Canova

