Politecnico
di Milano

Evolving Information and Communication Technologies

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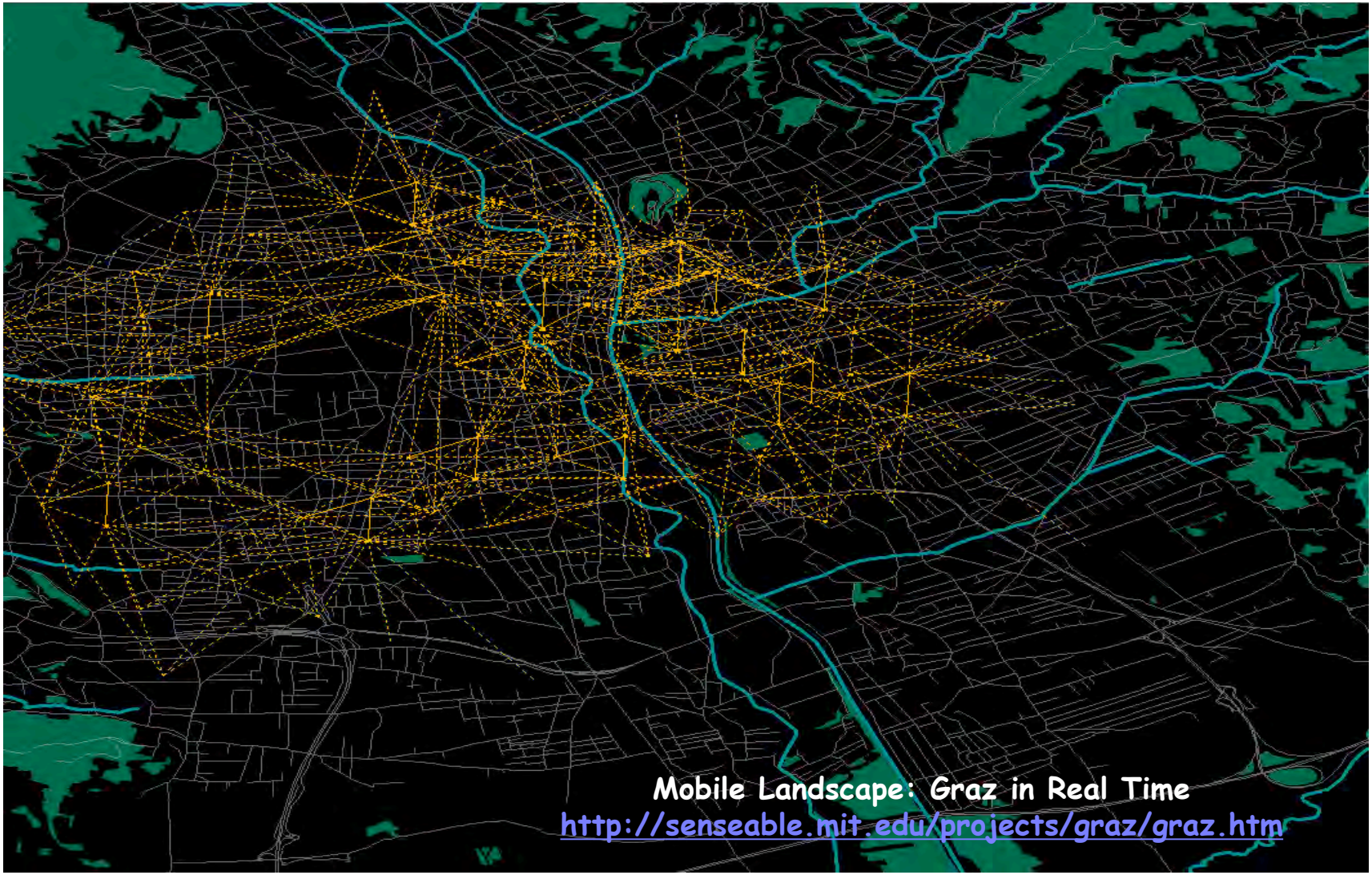
Fondazione ASPHI onlus

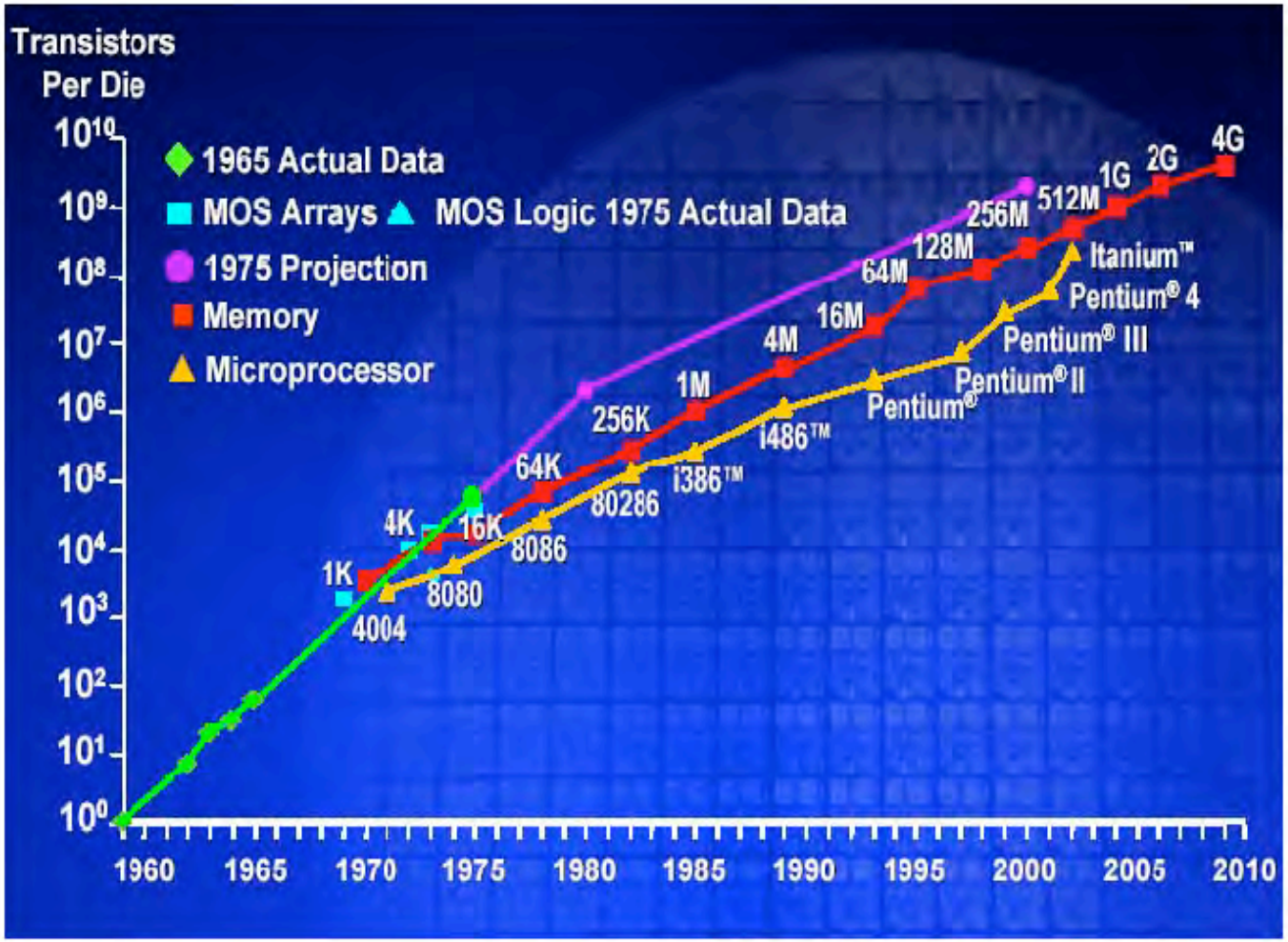
ASPHI

HANDImatica 2006
ACCESSIBILITA' MISURA DI CIVILTA'
Bologna, 1 Dicembre 2006

The Power of Exponential Growth



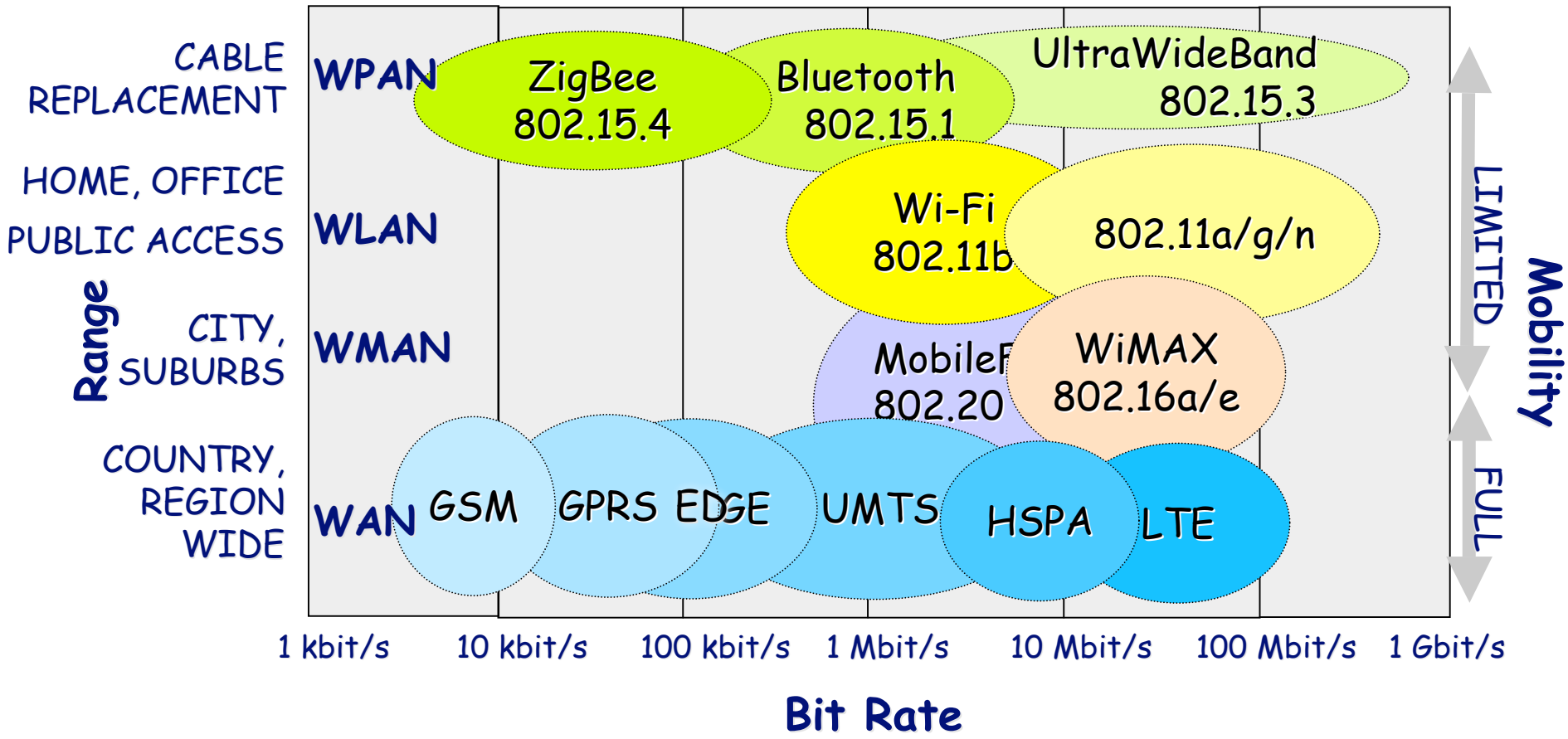
The Moore's Law



(Source: Intel)

Mobile ICT Terminals

Wireless Communications

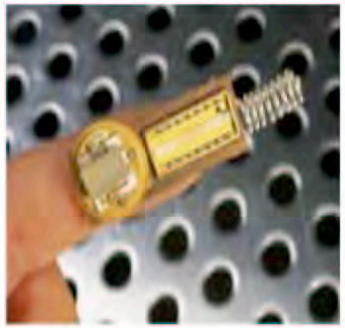


Pervasive and Ubiquitous Computing

- Small, lightweight, cheap, mobile processors
  - in almost all everyday objects („embedded computing")
  - on human body („wearable computing")
  - embedded in the environment („ambient intelligence")
- A world of "smart objects"
- Smart objects
- Can remember pertinent events
  - they have memory
- Show context-sensitive behavior
  - they have sensors
- Are responsive
  - they communicate with their environment
  - they are networked with other smart objects

Sensors

- Miniaturized cameras, microphones,...
  - pattern recognition, assisted by heuristics
    speaker recognition, speech controlled devices
- Fingerprint sensor on mobile objects
- Radio sensors
  - without power supply
- Location sensors
  - e.g., based on GPS
- Dust sensors



Weareable Computing

SUBSTRATE

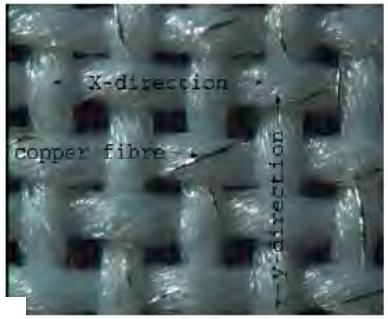


Fig. 2: Woven fabric using 230µm thick polyester (PES) yarns, twisted with a copper (Cu) filament both in x- and y-direction. The 40µm diameter copper filaments are insulated with a polyesterimide coating

LOCAL NETWORK

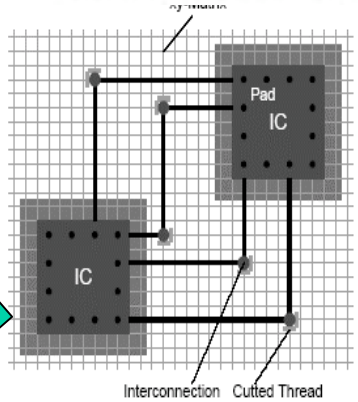


Fig. 5: xy-matrix of isolated conductive yarns, configured for IC interconnect

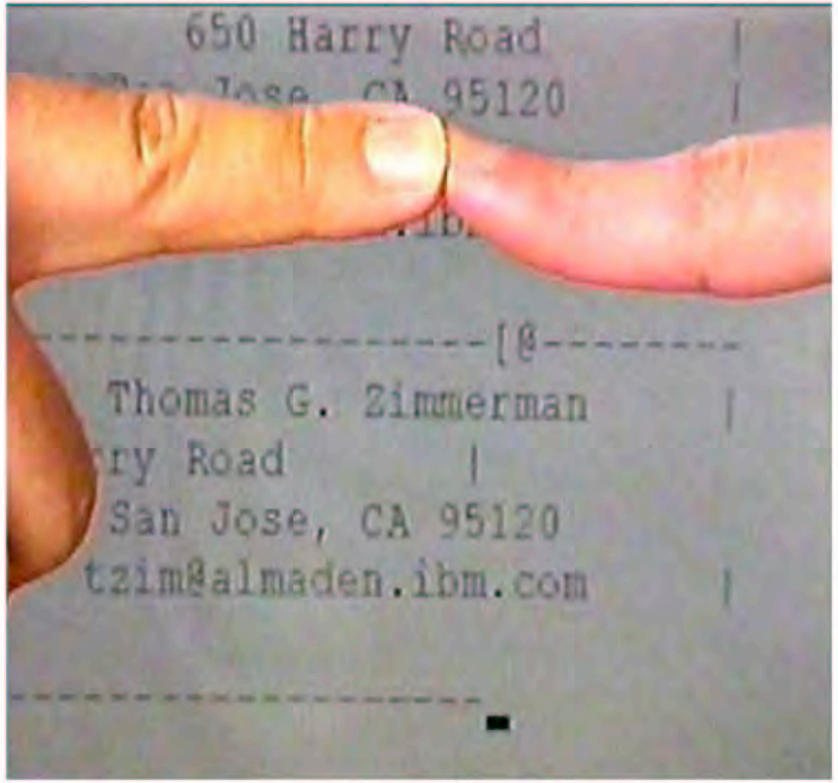
INTERCONNECTIONS

Tröster et al., 2003

Body Area Network

- Very low current (some nA), some kb/s through the human body

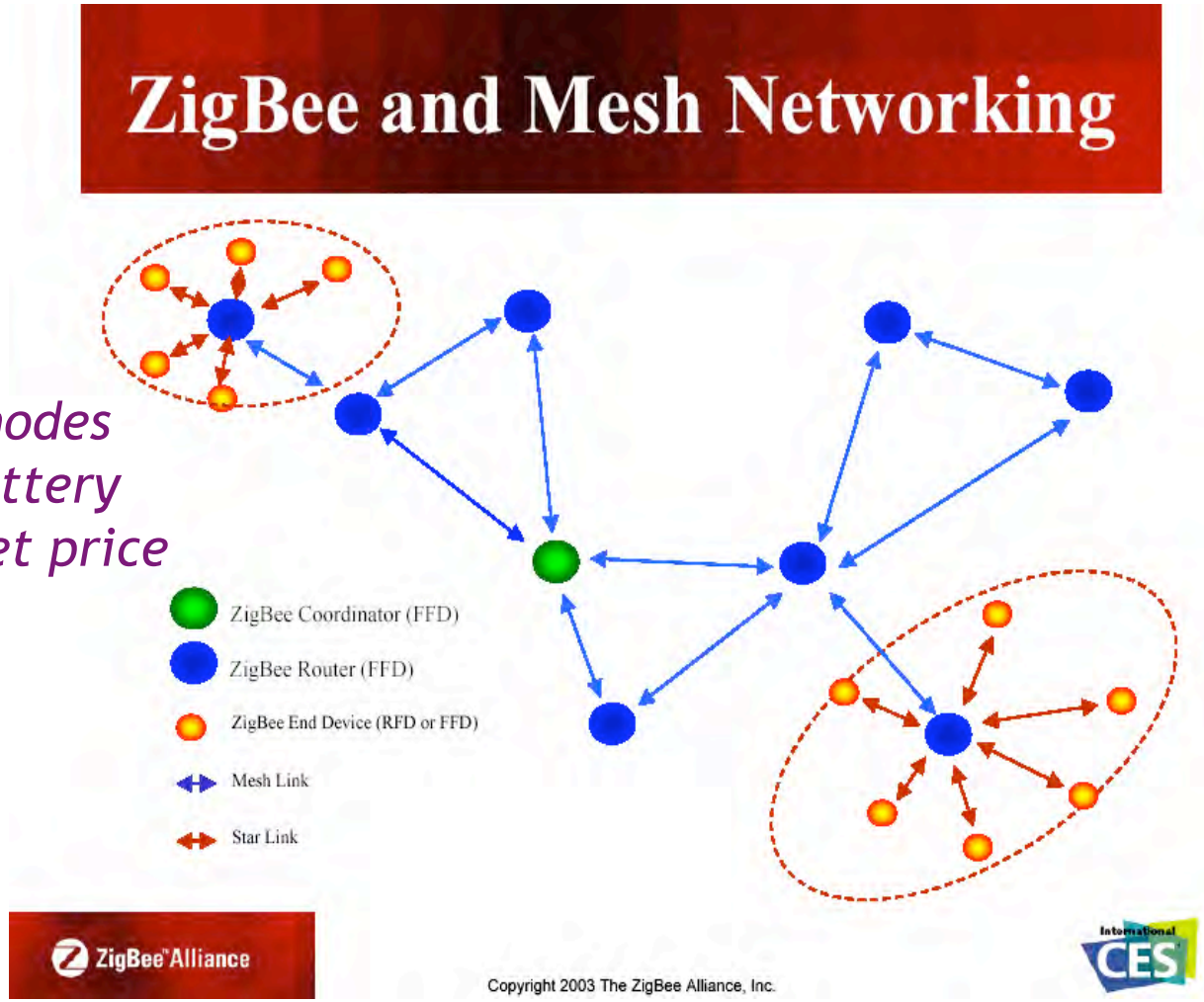
- Possible applications:
  - car recognizes driver
  - phone configures itself when it is touched
  - micro payment: pay when touching the door of the bus
  - toaster and TV identify user



business card exchange

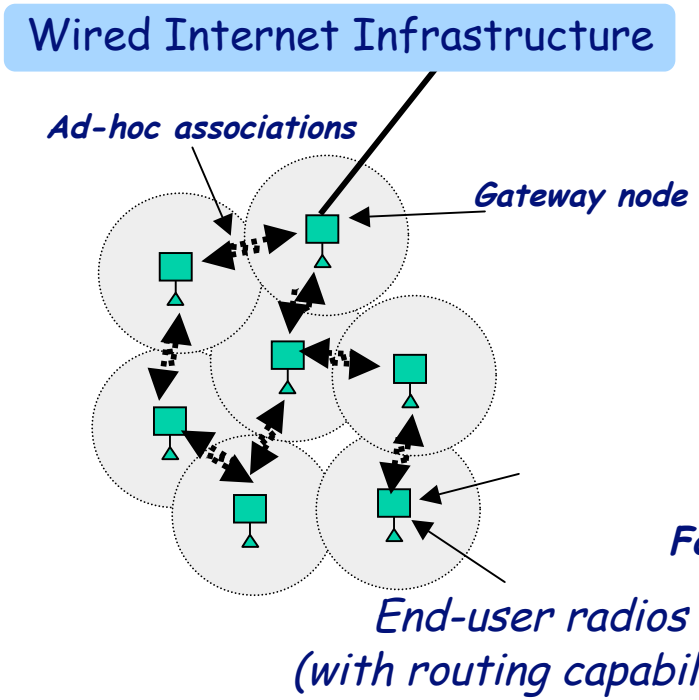
Source: Friedemann Mattern, 2001

ZigBee Ad Hoc Networking

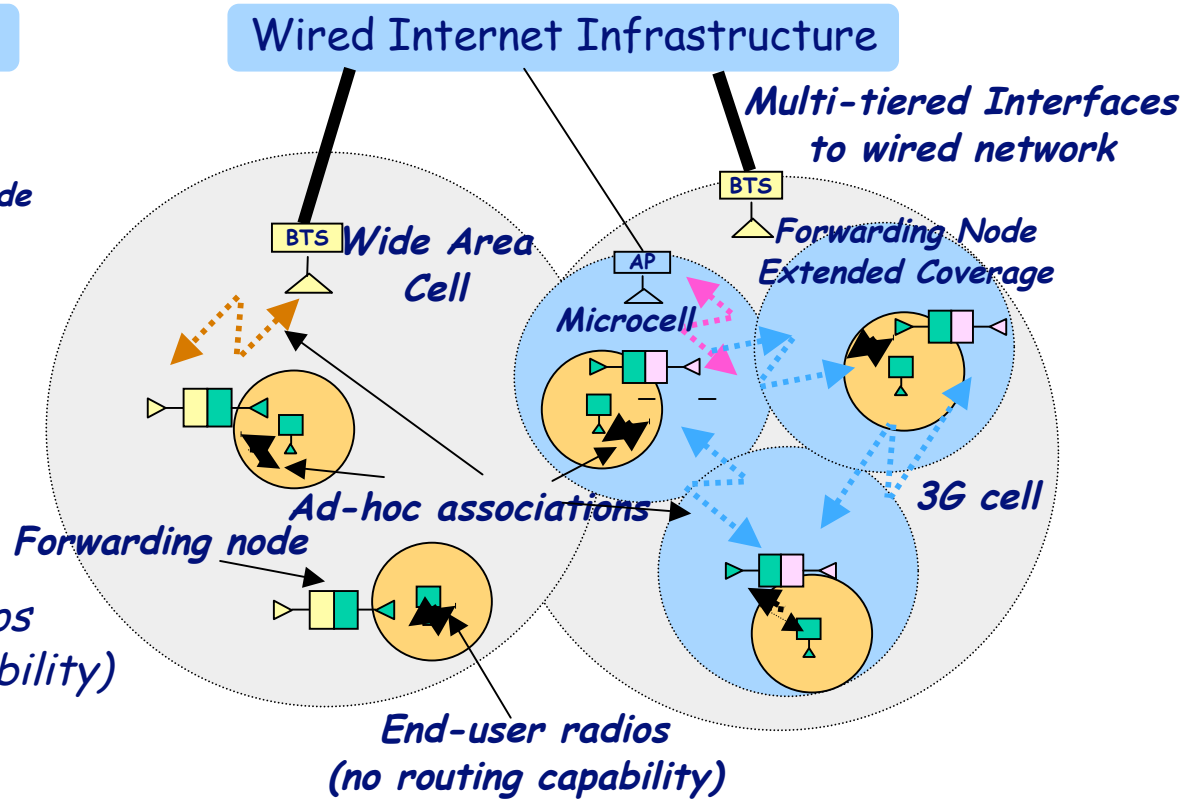


- *Tousands of nodes*
- *2-year life battery*
- *1-2 US $ target price*

Wireless Ad-Hoc Networks Architectures



"Flat" mesh network
with ad-hoc routing



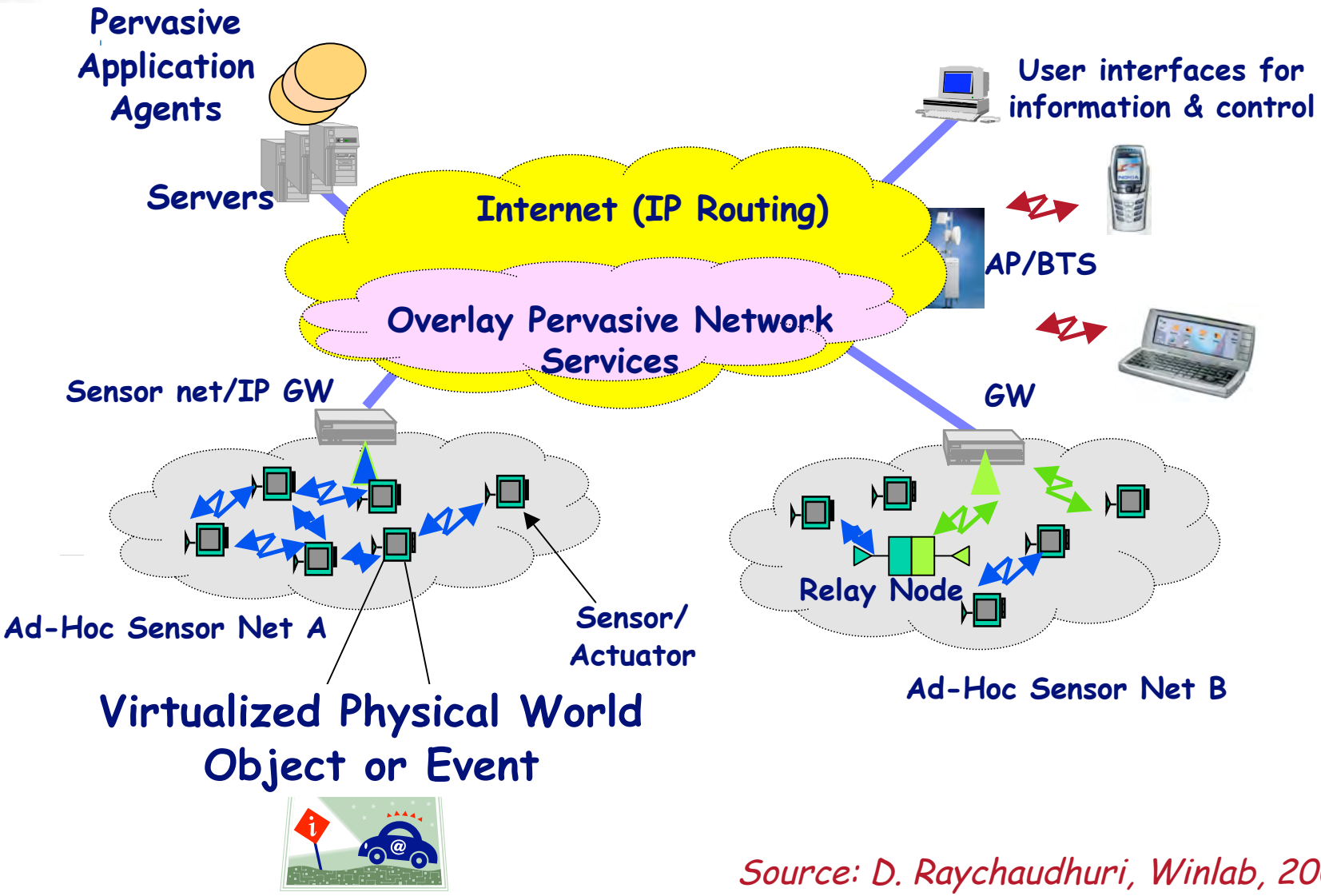
Hierarchical architecture
with radio forwarding nodes and AP's/BS's

Cognitive Radio

According to Institute of Electrical and Electronic Engineers (IEEE)

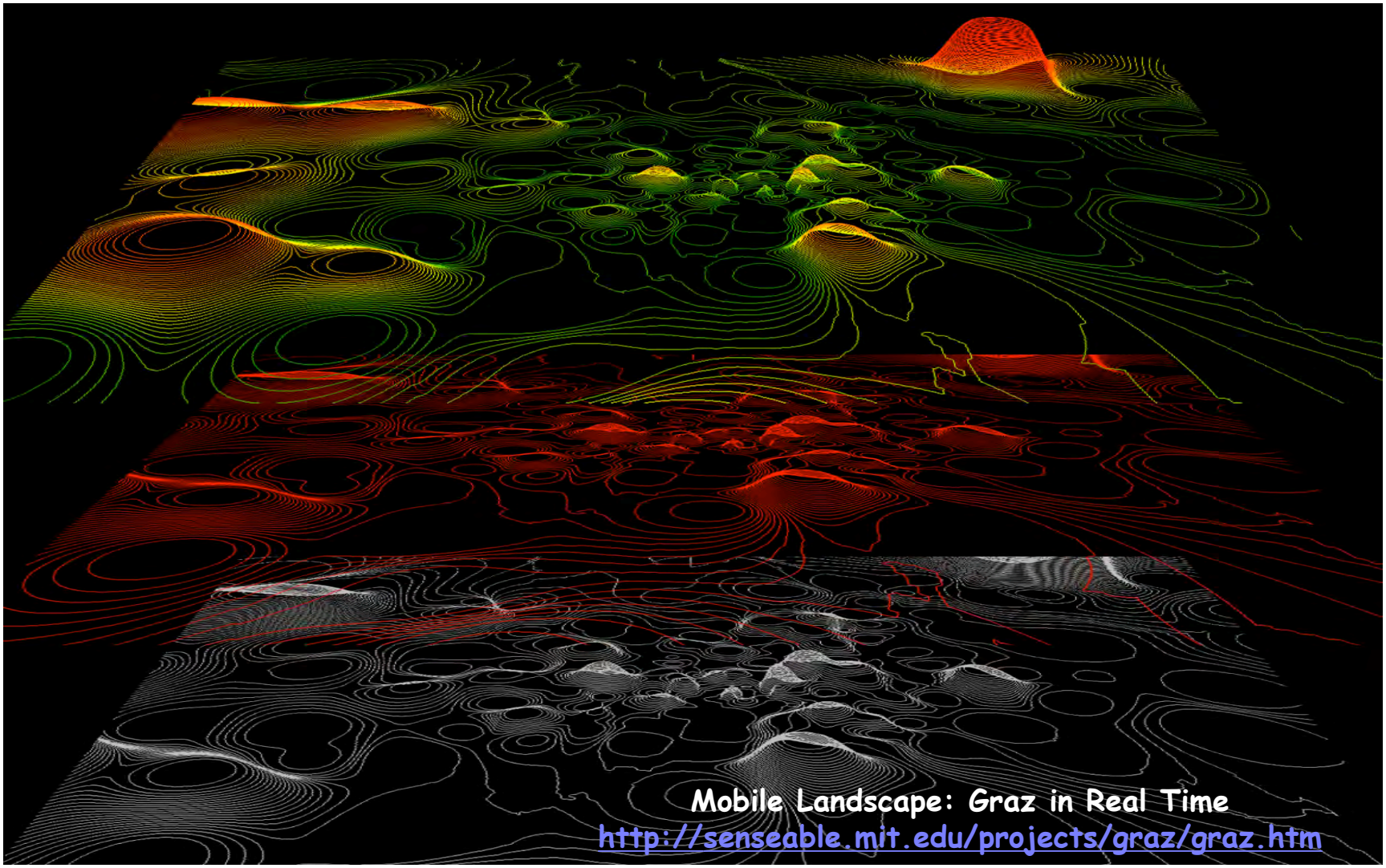
- the cognitive radio is a radio transmitter/receiver that is designed to intelligently detect whether a particular segment of the radio spectrum is currently in use, and to jump into (or out of) the temporarily-unused spectrum very rapidly, without interfering with the transmissions of other users

Wireless Sensor Network Architecture

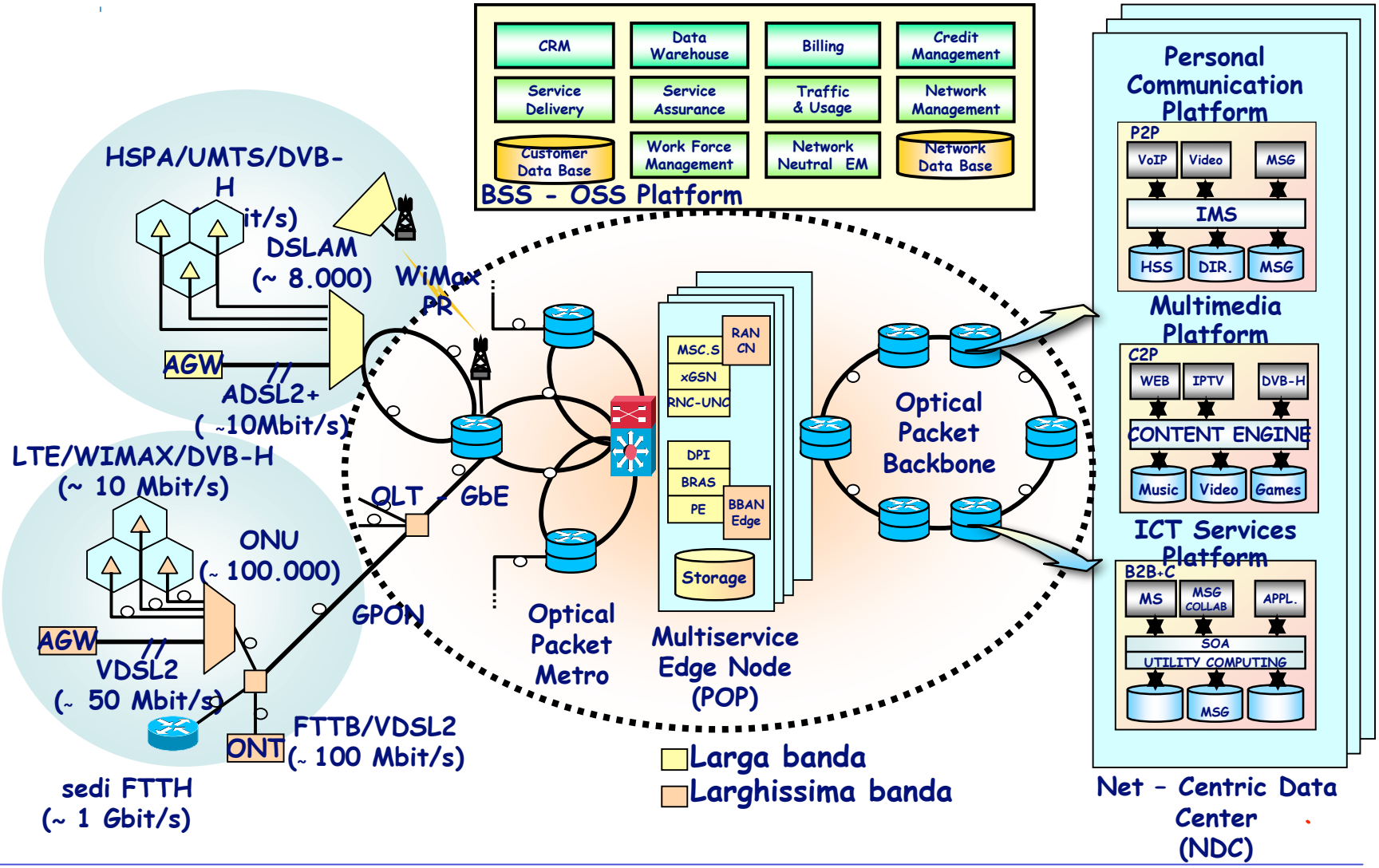


Source: D. Raychaudhuri, Winlab, 2005

Networking at Multiple Layers

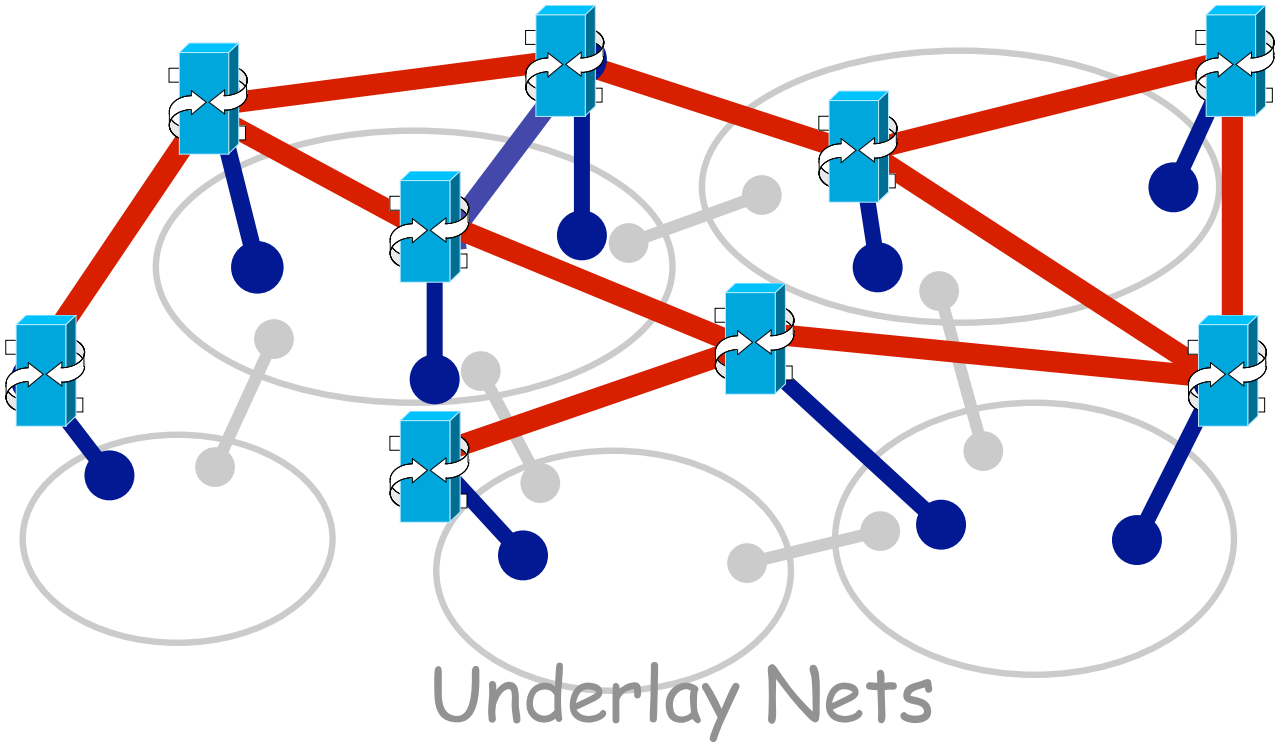


Telecom Italia Next Generation Network



Overlay Networks

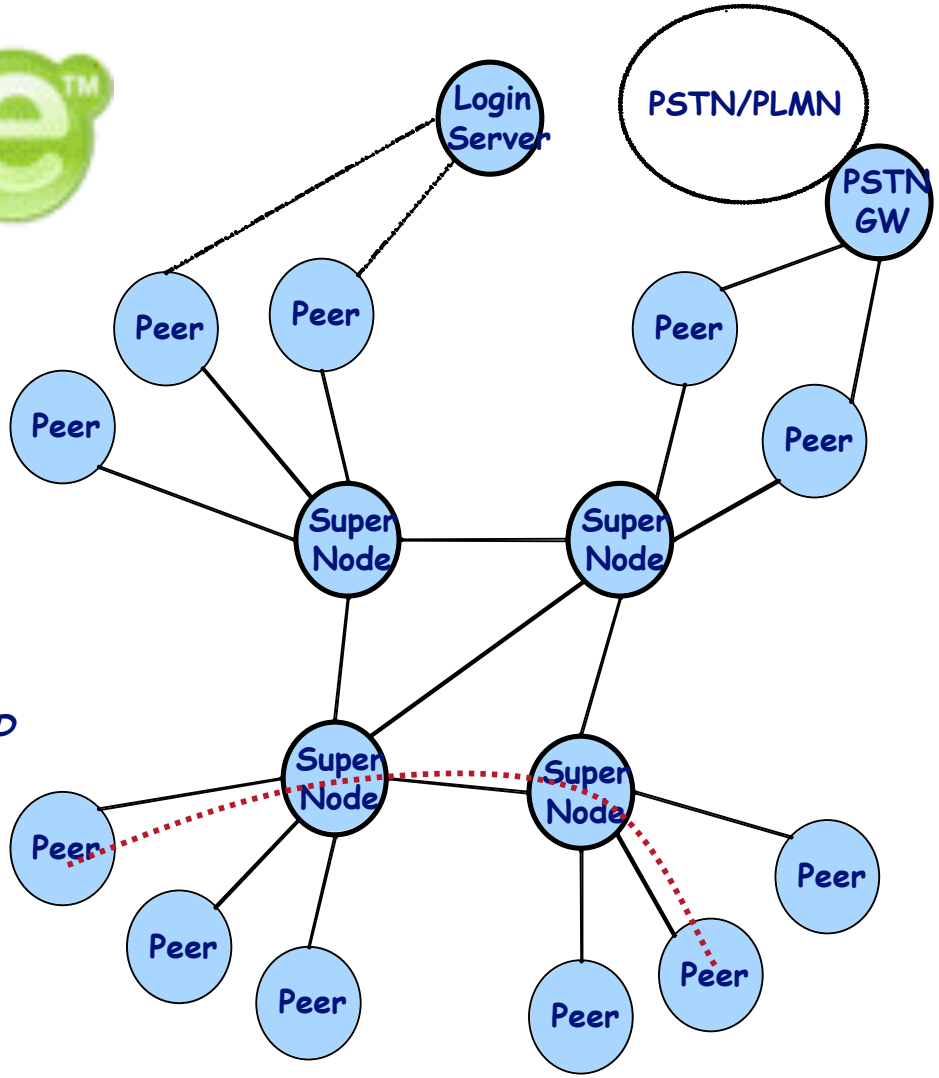
Grid Networks
Content Delivery Networks
Peer-to-Peer Networks
Active Networks: XML Routing



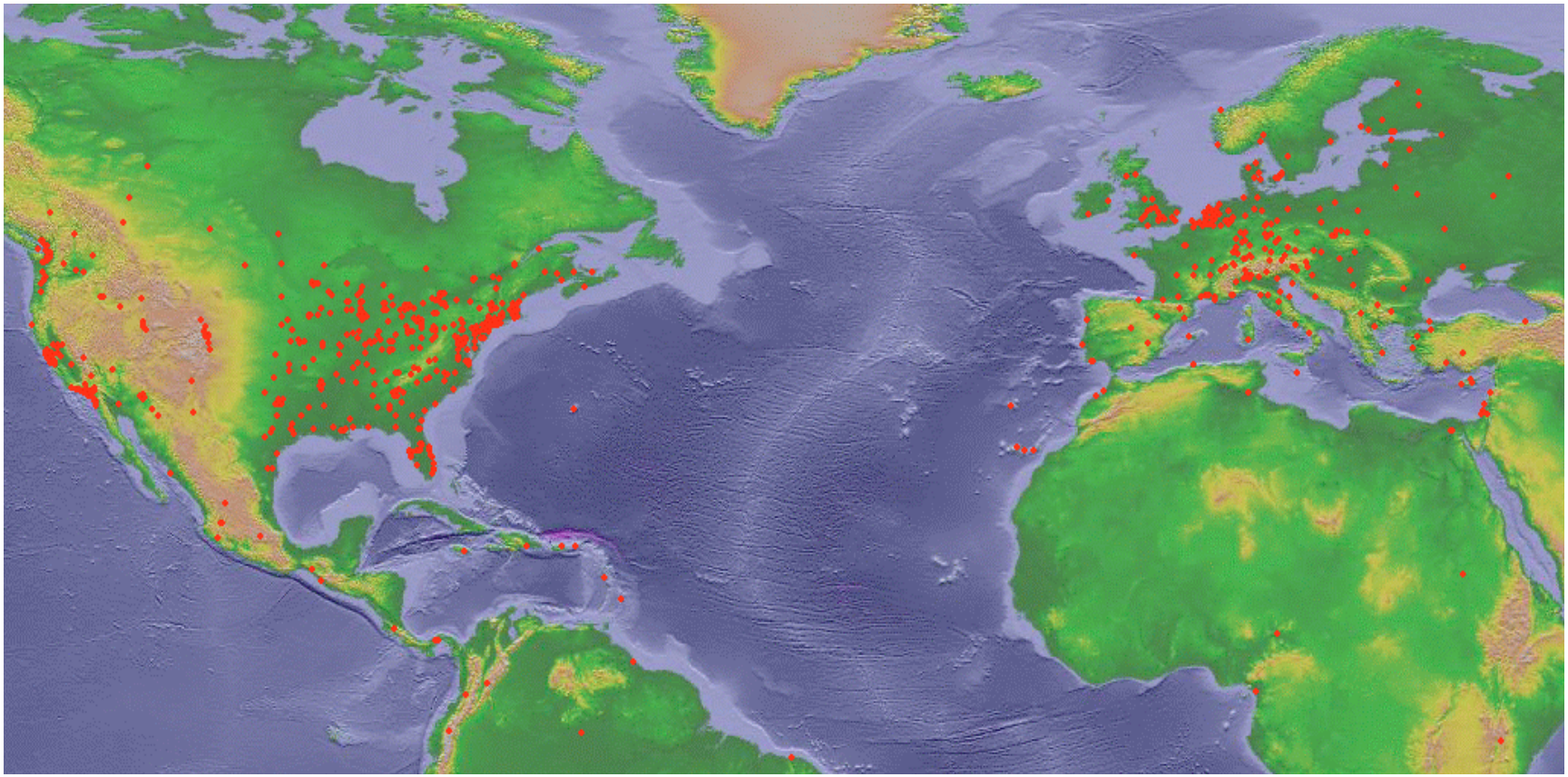
Skype Networking Architecture

Super Nodes

- *They are established after acceptance test by Skype*
- *They have public IP address*
- *They offer storage, processing & bandwidth*
- *Each Serves 100s Peer Nodes*
- *They route encrypted calls*
- *They execute "NAT" of private IP addresses*
- *They exploit p2p protocol*

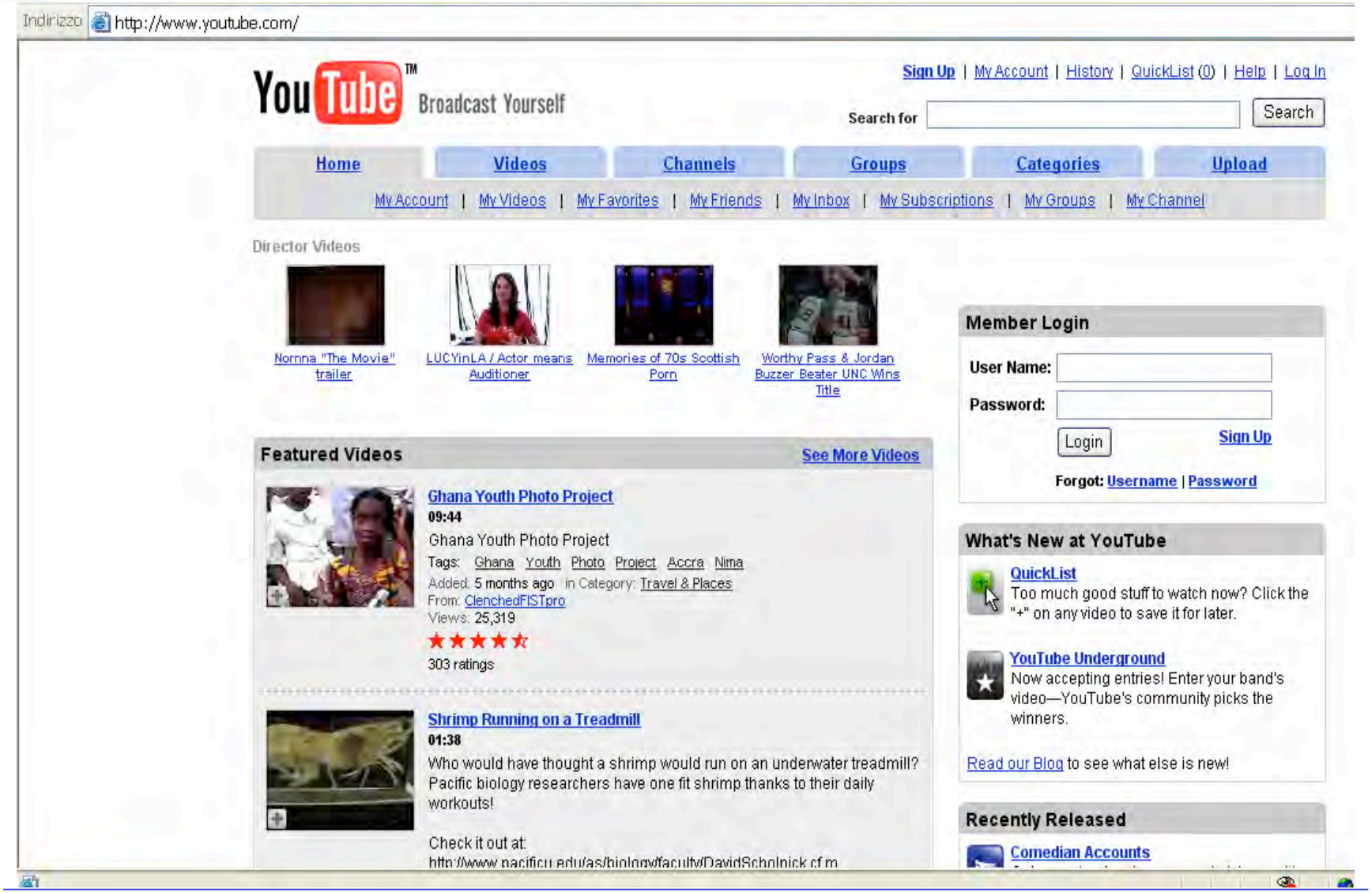


SkypeNet Supernode Map
The Power of a 2-level Hierarchy



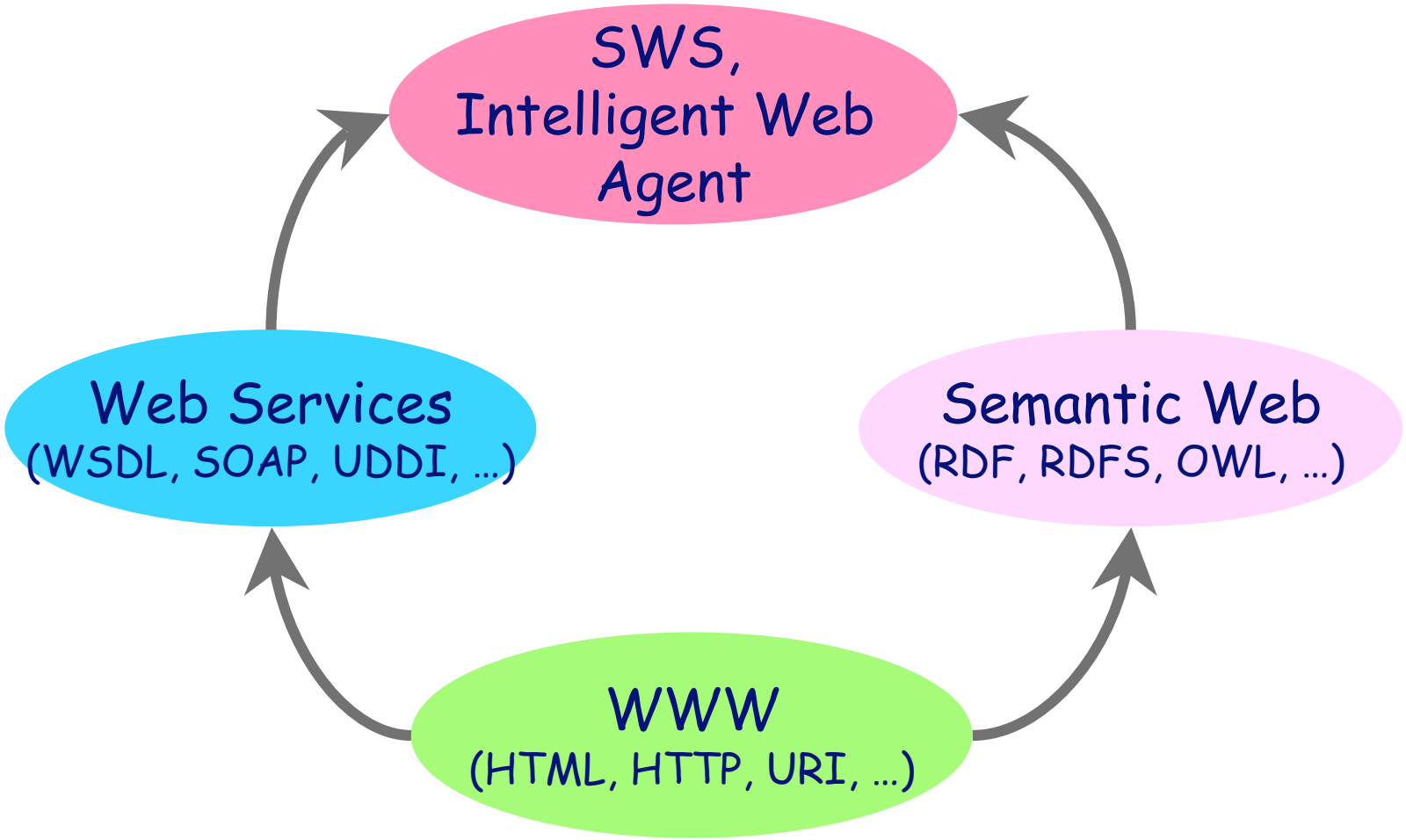
Source: Coobol, December 2005

YouTube – Broadcast Yourself



The Service Interoperability Gap

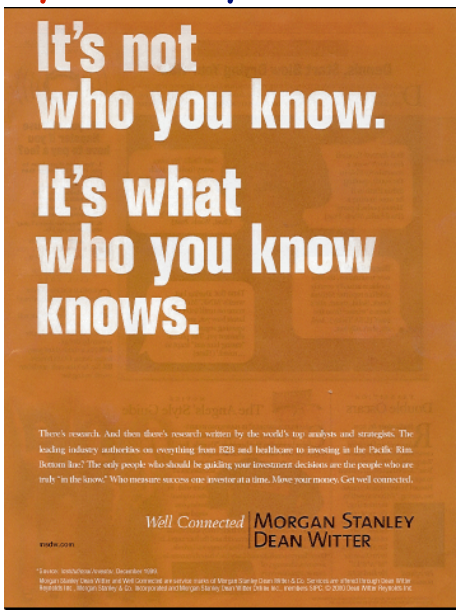
Semantic Web Services (SWS) & Intelligent Web Agents



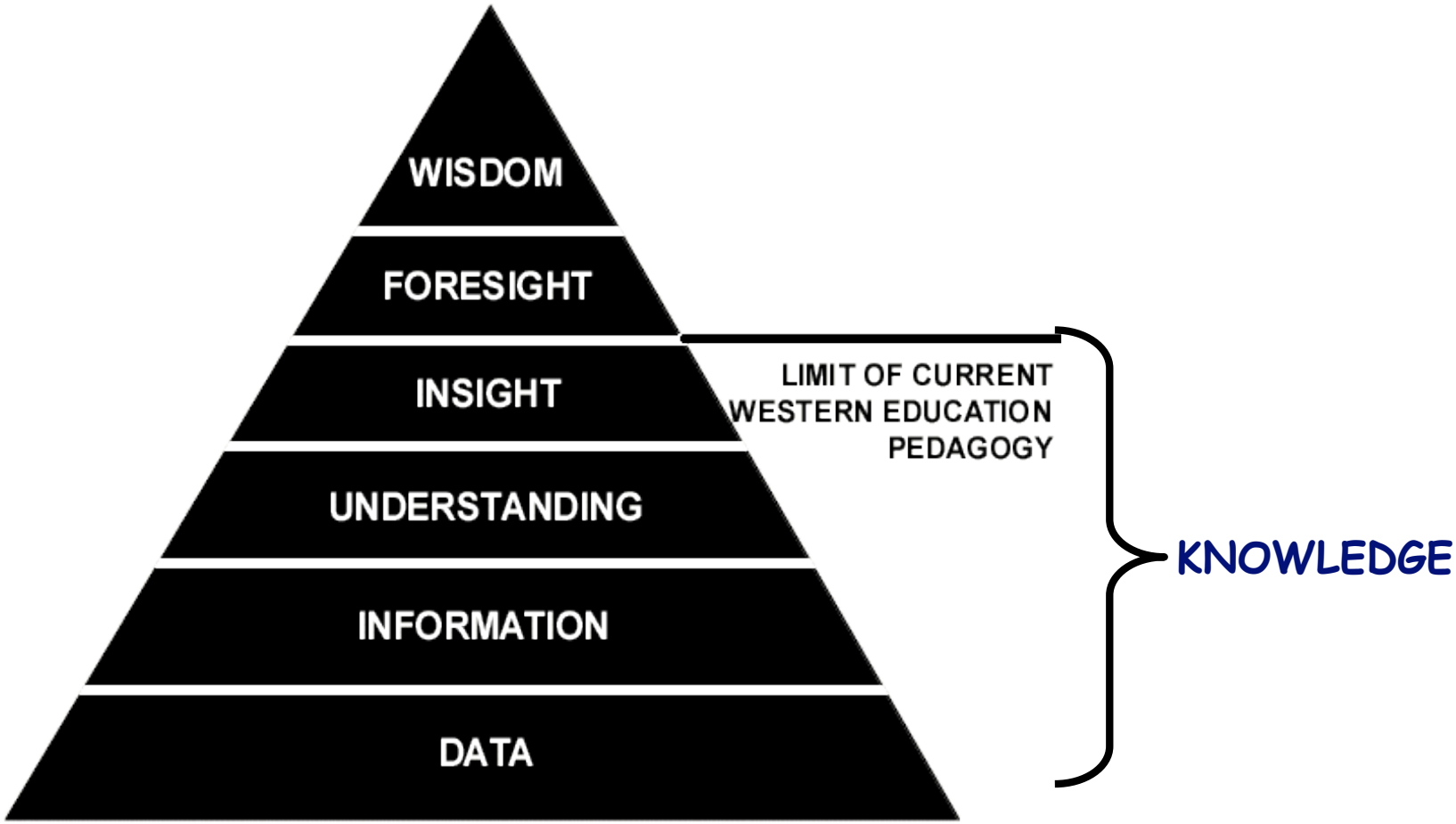
Social, Cognitive and Knowledge Networks

- Social Networks
  - Its not what you know, its who you know
- Cognitive Social Networks
  - Its not who you know, its who they think you know
- Knowledge Networks
  - Its not who you know, its what they think you know

Cognitive Knowledge Networks



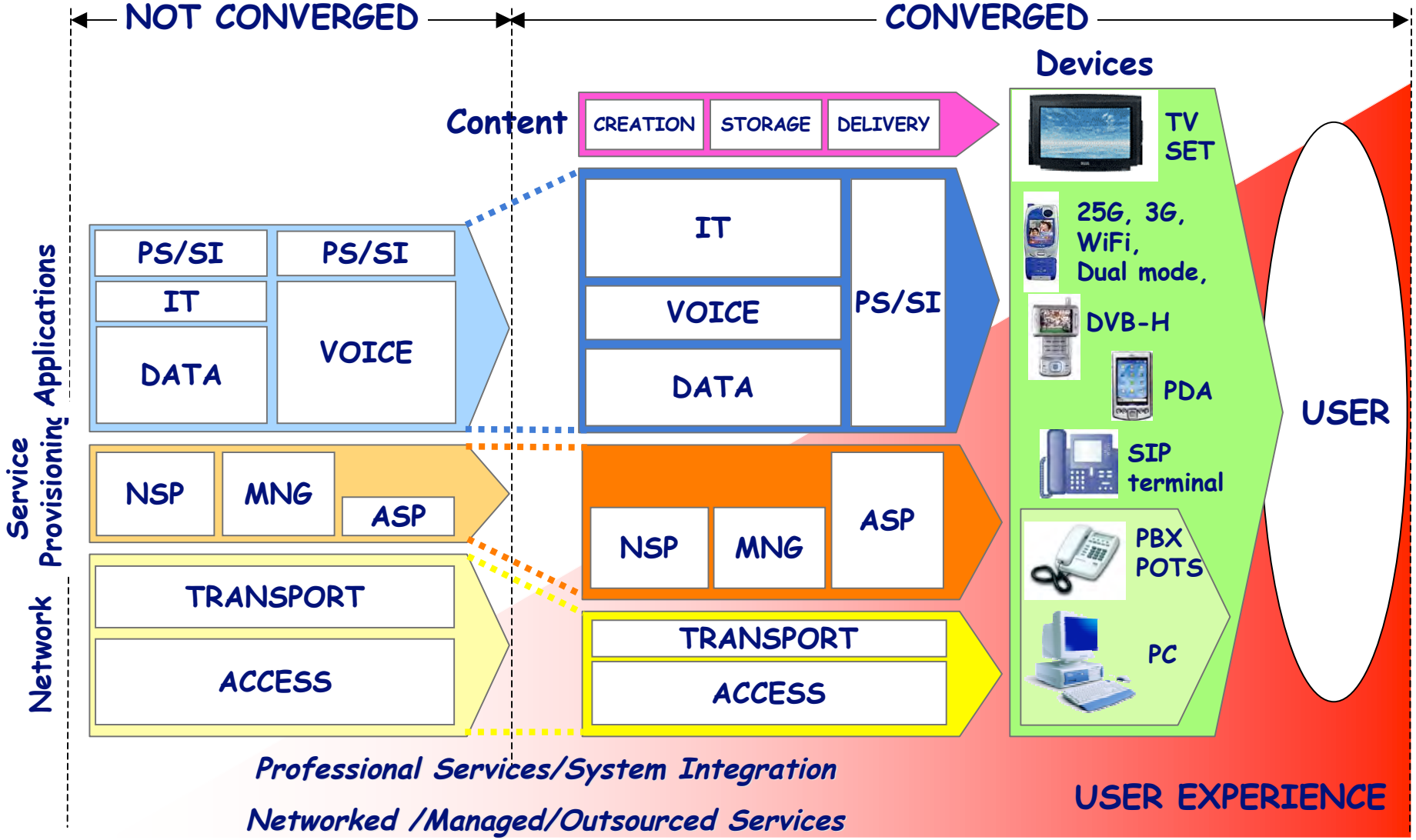
Learning in the Age of Information



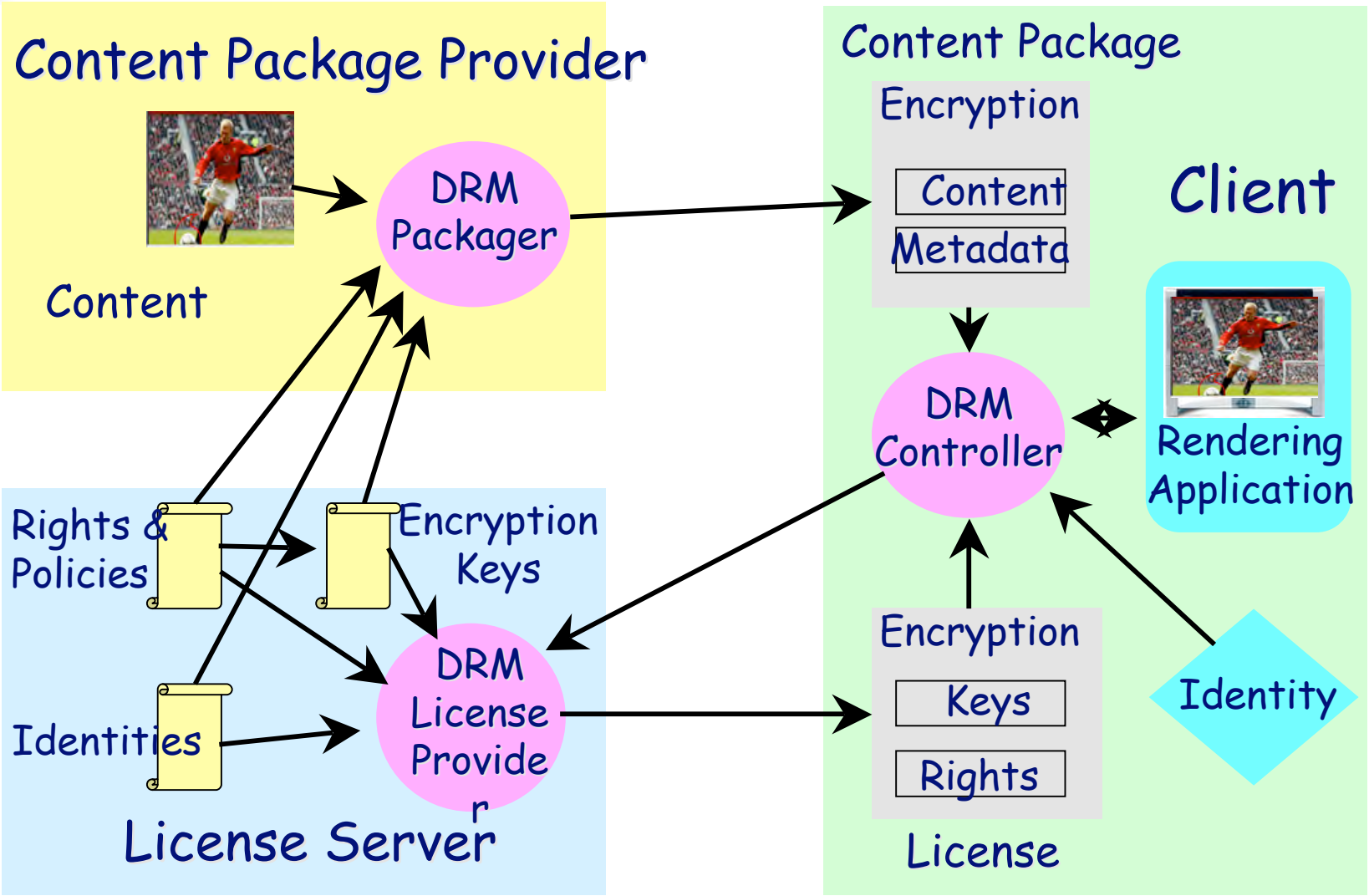
Knowledge is Power, but Wisdom doesn't need Power

ICT Service Convergence

Converged ICT Business Framework



Digital Rights Management Scenario

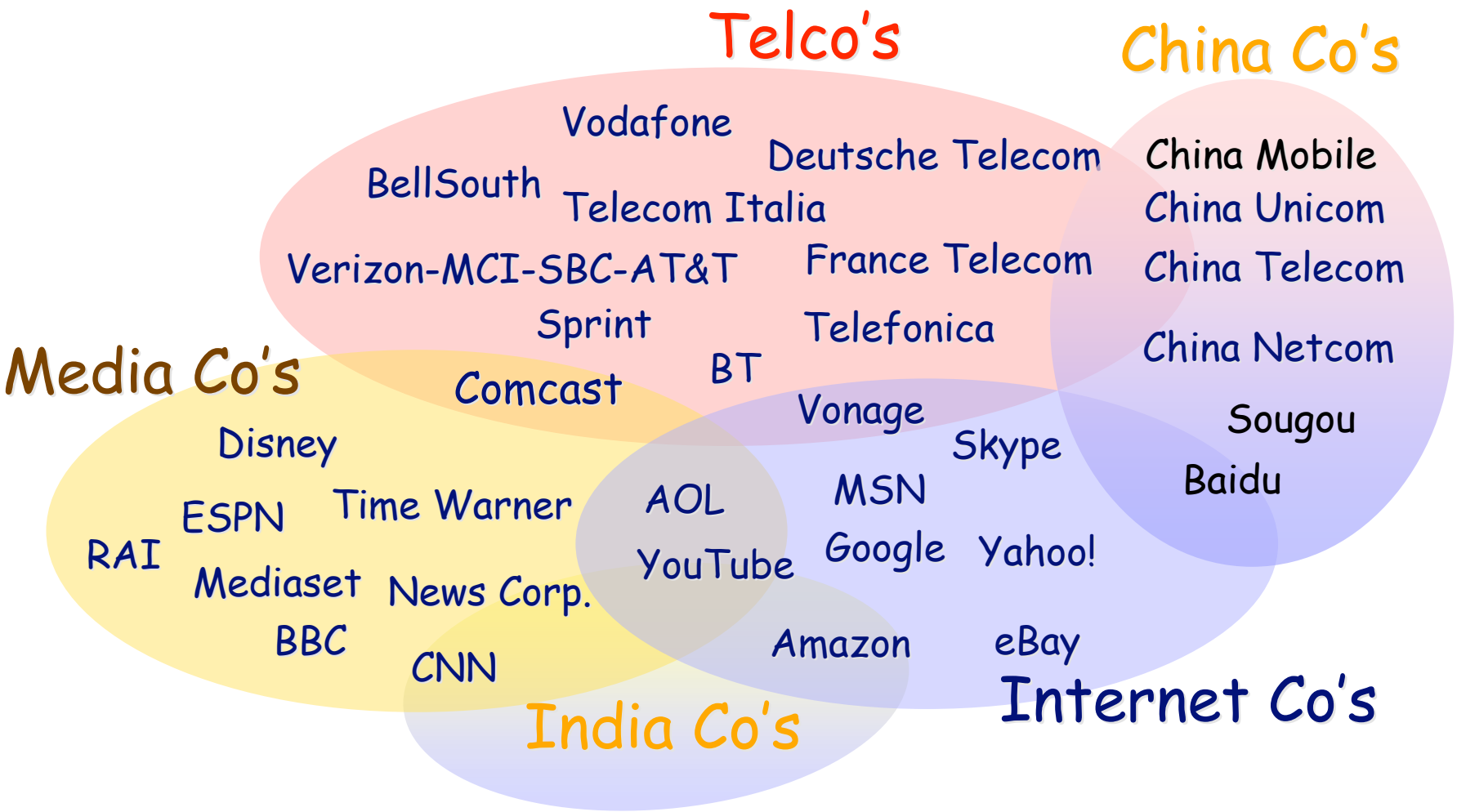


Hard and Soft Biometrics for Authentication and Profiling

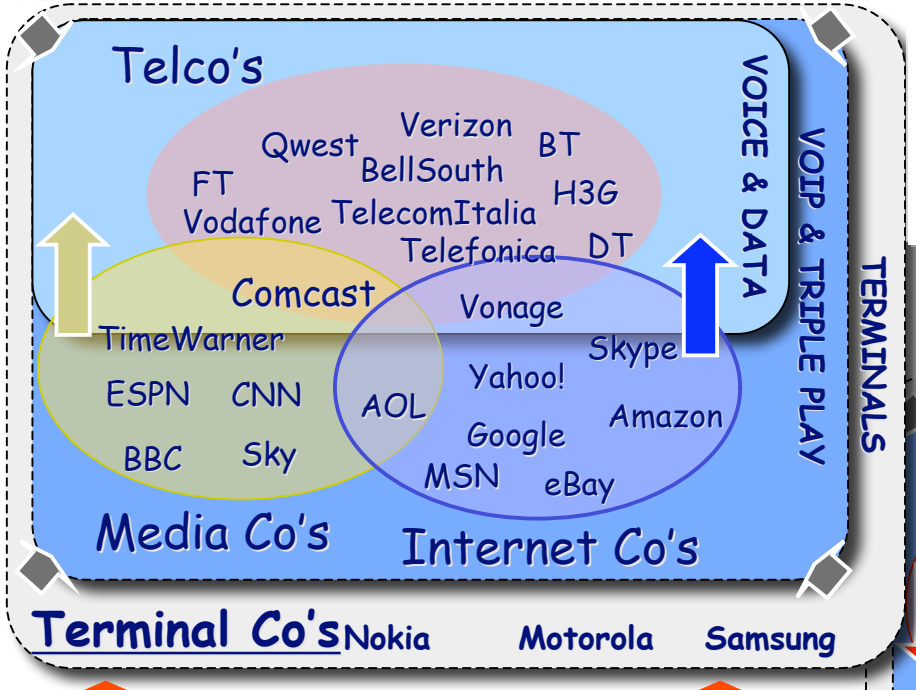
Source: Jain, Nandakumar, Lu, & Park, Michigan State University, 2004

- Client Profiling
  - Age, Age Slot
  - Sex
  - Gender
    - Ethnicity
    - Skin Color
    - Hair Color
  - Eye Color
  - Humor (happy, surprised, angry, ...)
  - Height
  - Weight
  - Hair Lenght
  - Beard
  - Glasses
  - ...

ICMT & World/Chindia Business Convergence

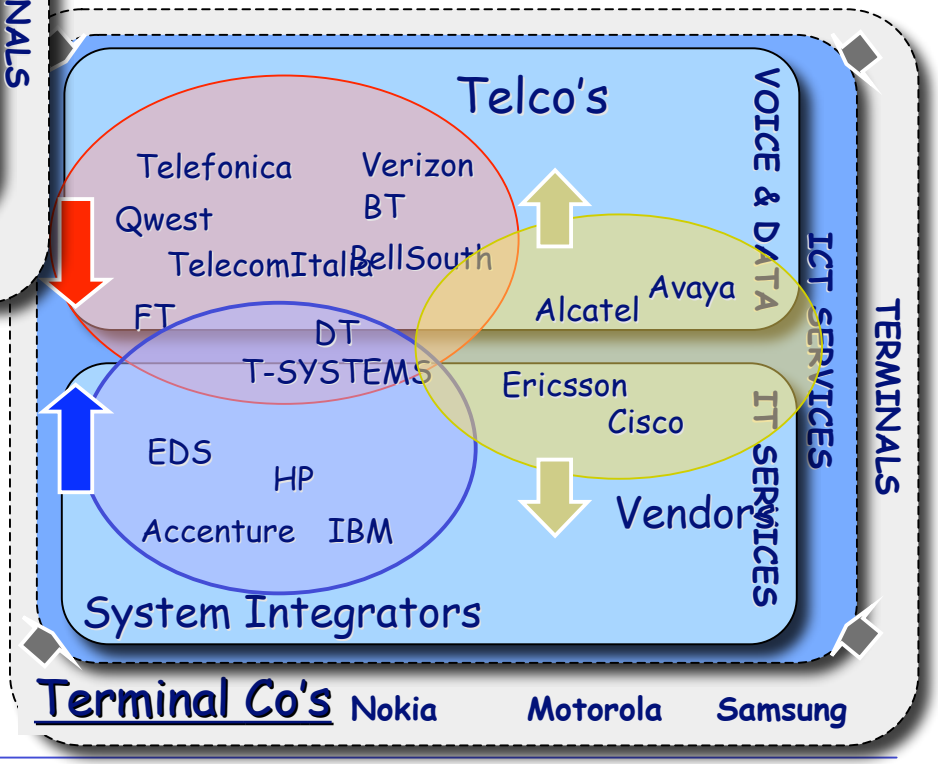


Competition for ICT Services



Telco providers and vendors trying to enter the IT market, leveraging the ever-growing enterprise communications needs while adding value through convergence

BUSINESS



CONSUMER

Players seeking new revenues through bundled quad-play services to get hold of customer profile and provide personalized ads.