Performance Evaluation in Wireless Networks and Technologies from 2.5 G, 3G, LTE to 4G and Beyond

ICIW 2008, AICT 2008

Athens, June , 2008

Dr. Reda

Innovation Communication Technologies

Munich / Vienna

ABOUT CONVERGENCE

Convergence…..

- **Convergence :**

  IT & Communications   ICT
  Data & Voice Networks
  Fixed Networks & IP
  Fixed Networks & CATV
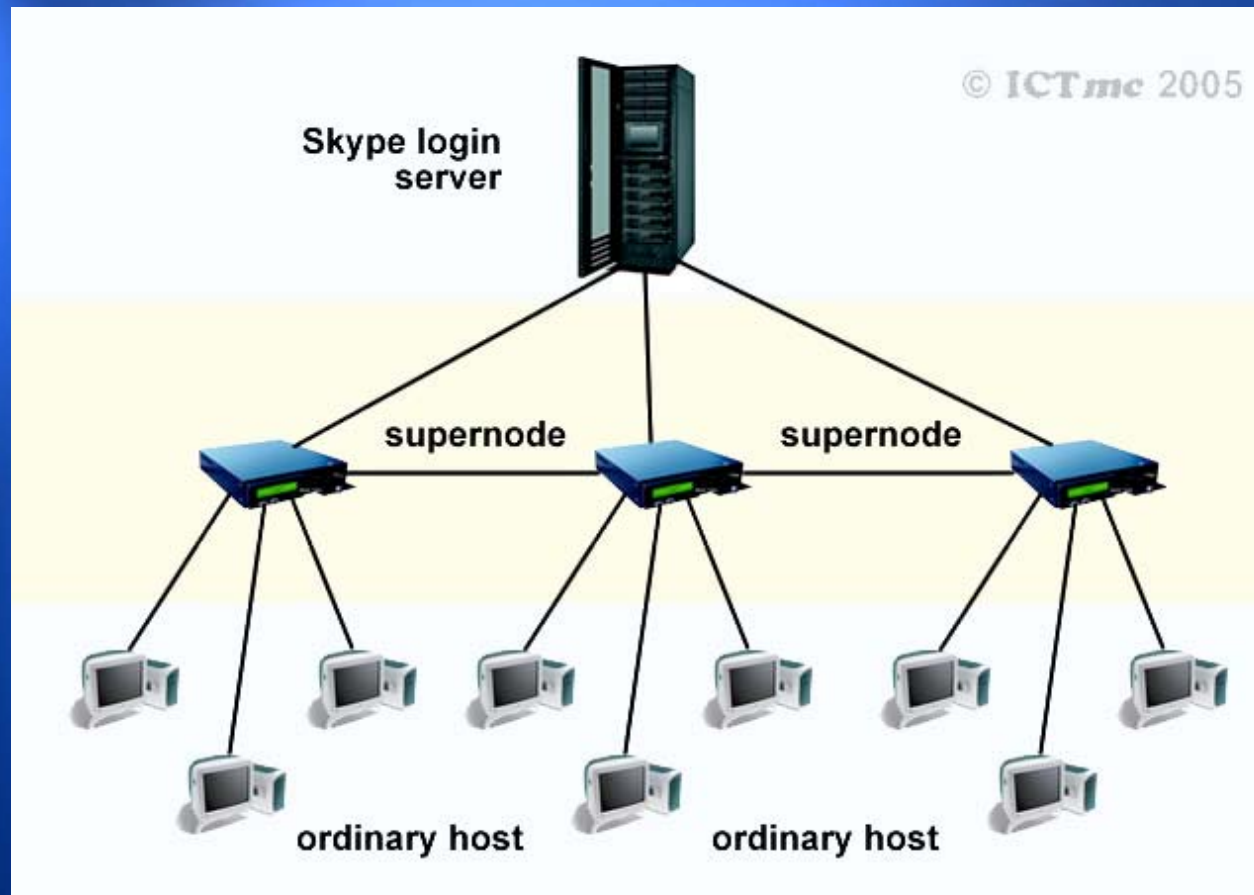 **All IP**
  Mobile Networks & Fixed Networks
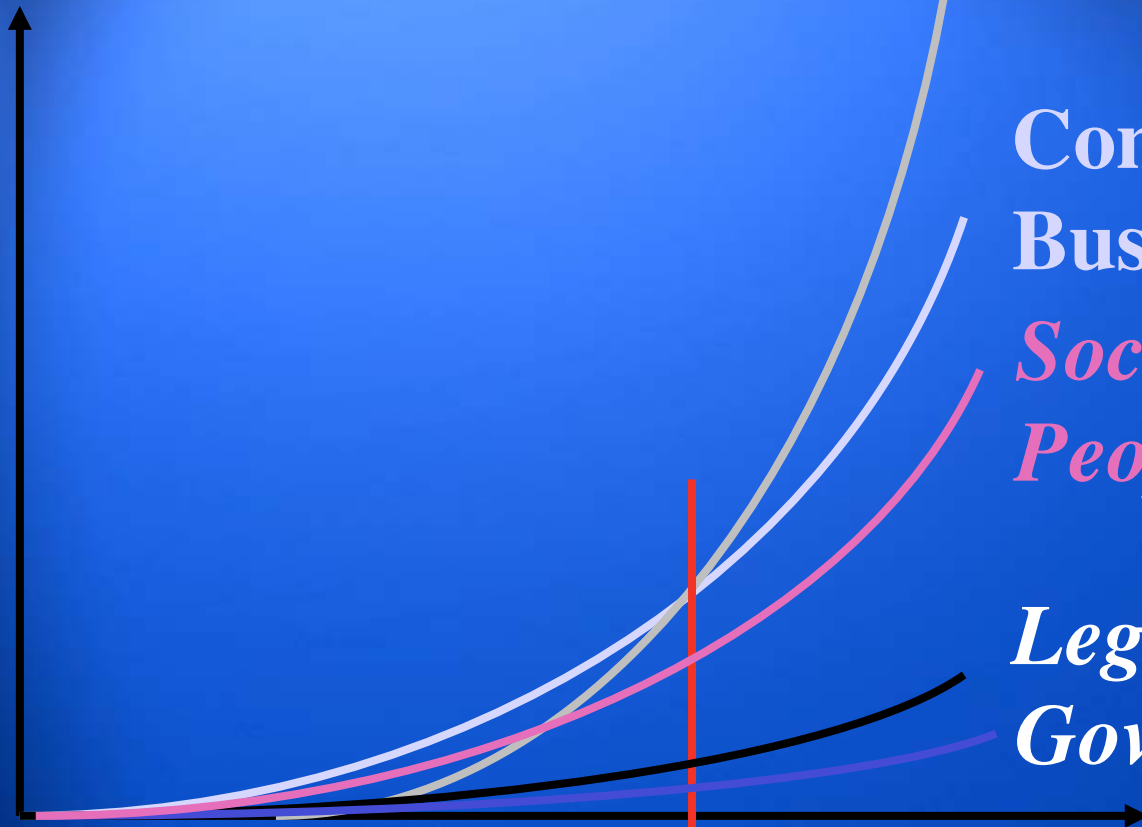 **Mobile Networks & BB**
  Triple Play
  Q. Play

Peer-to-Peer Network including Supernodes, Ordinary Nodes, and the login Server.

It's not about time - It is about $

Rate of change
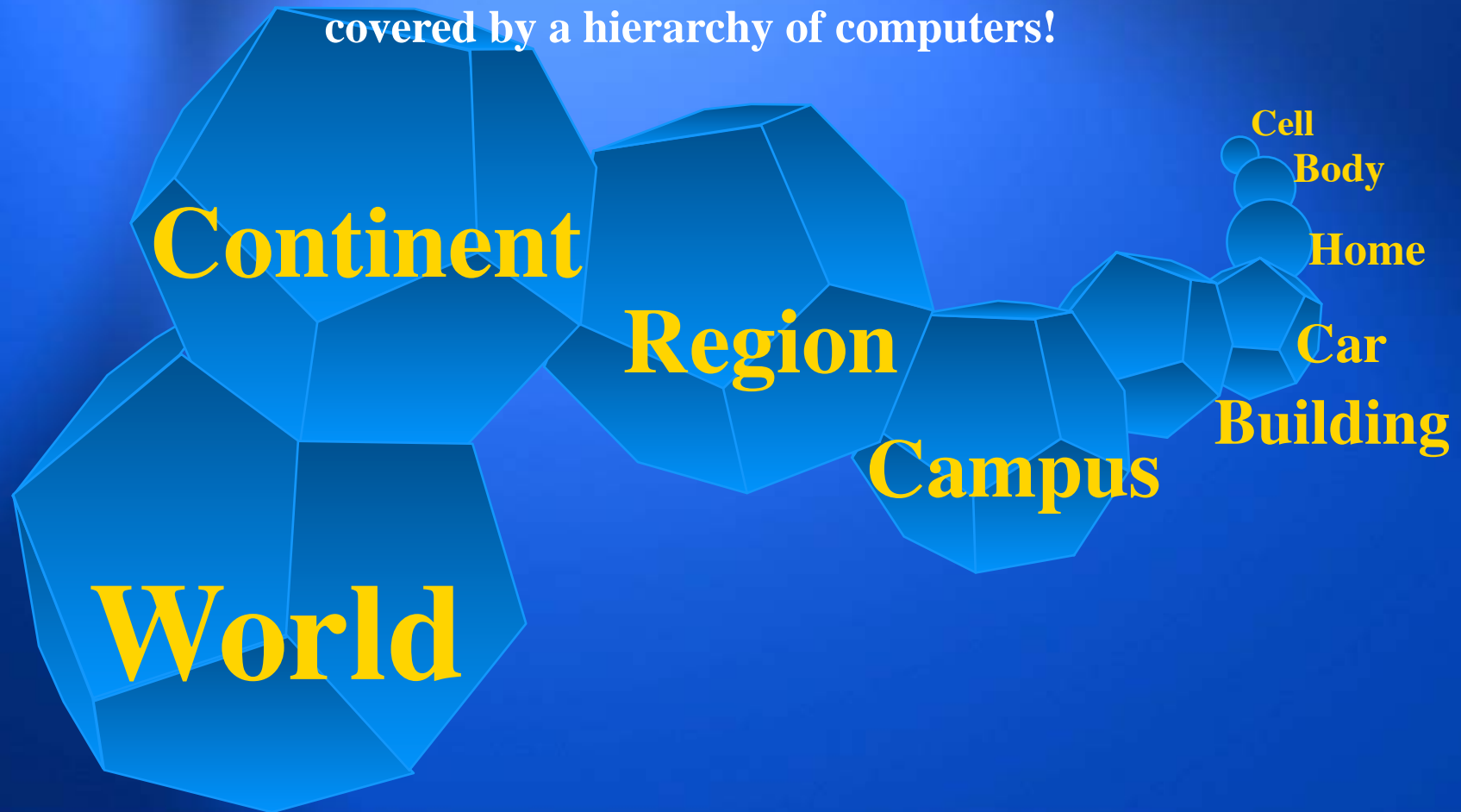
Technology

Companies
Business
*Society
People*

*Legal Systems
Governments*
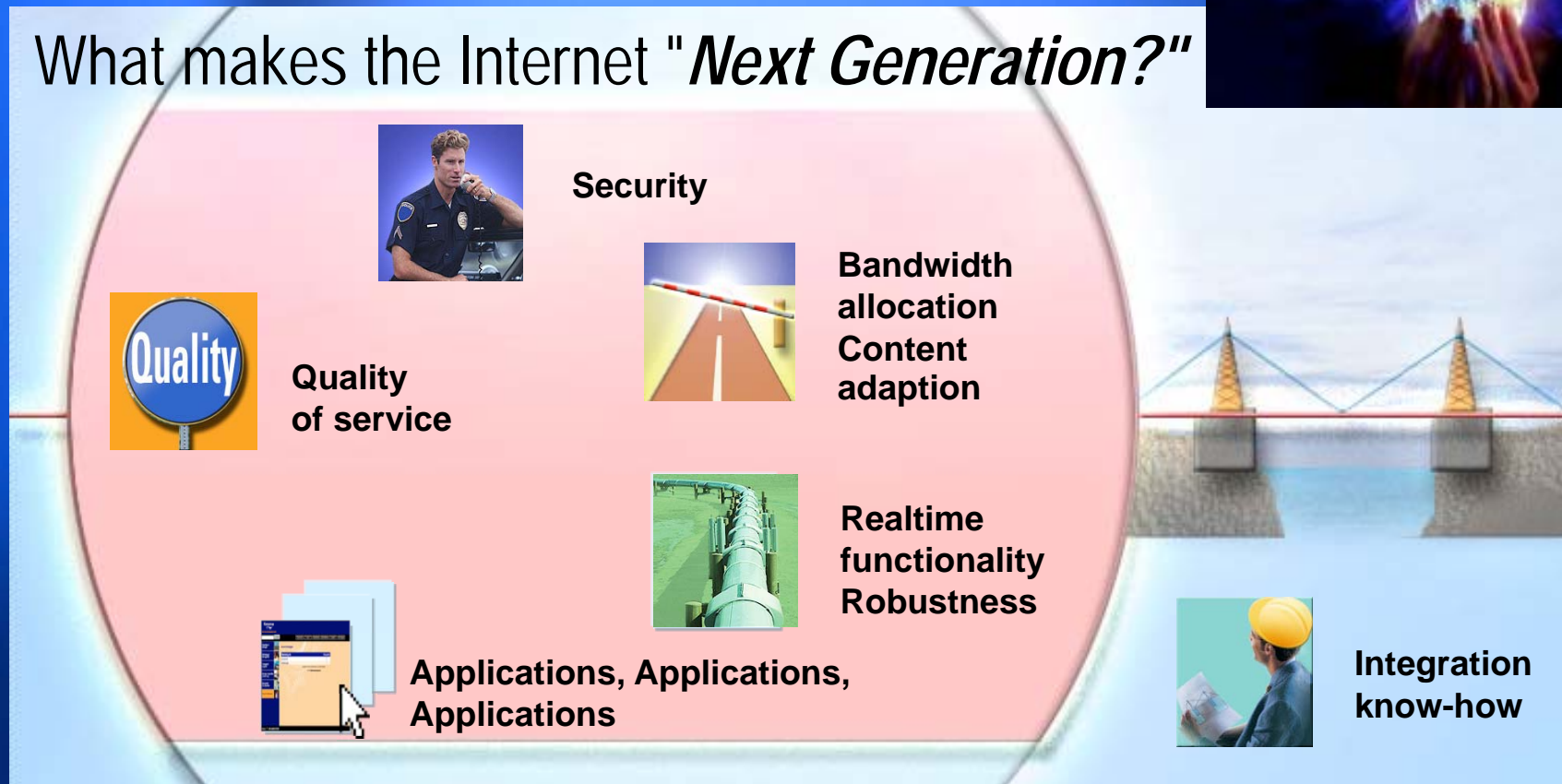
Today

Time

Everything is integrated in Cyberspace

covered by a hierarchy of computers!

Continent

World

Region

Campus

Building

Car

Home

Body

Cell

NGN ??

What makes the Internet "*Next Generation?*"

Security

Quality of service

Bandwidth allocation Content adaption

Realtime functionality Robustness

Applications, Applications, Applications

Integration know-how

Emerging services

- **Triple-play services :**
  - **Telephony**
  - **High-speed Internet**
  - **Broadcast TV and PPV**

Game Console

DVD Player/Recorder

Set-top /PVR

Communication

entertainment

information Control

Telecom Industry Trends

Convergence of Technologies (Broadband Access , 3G, WLAN)
Open Regulatory Environment : e.g. Number Portability
New Opportunities for End Users and Service Providers

End-User:
a) New Services Bundles & Devices
b) Access a Wider Array of Service
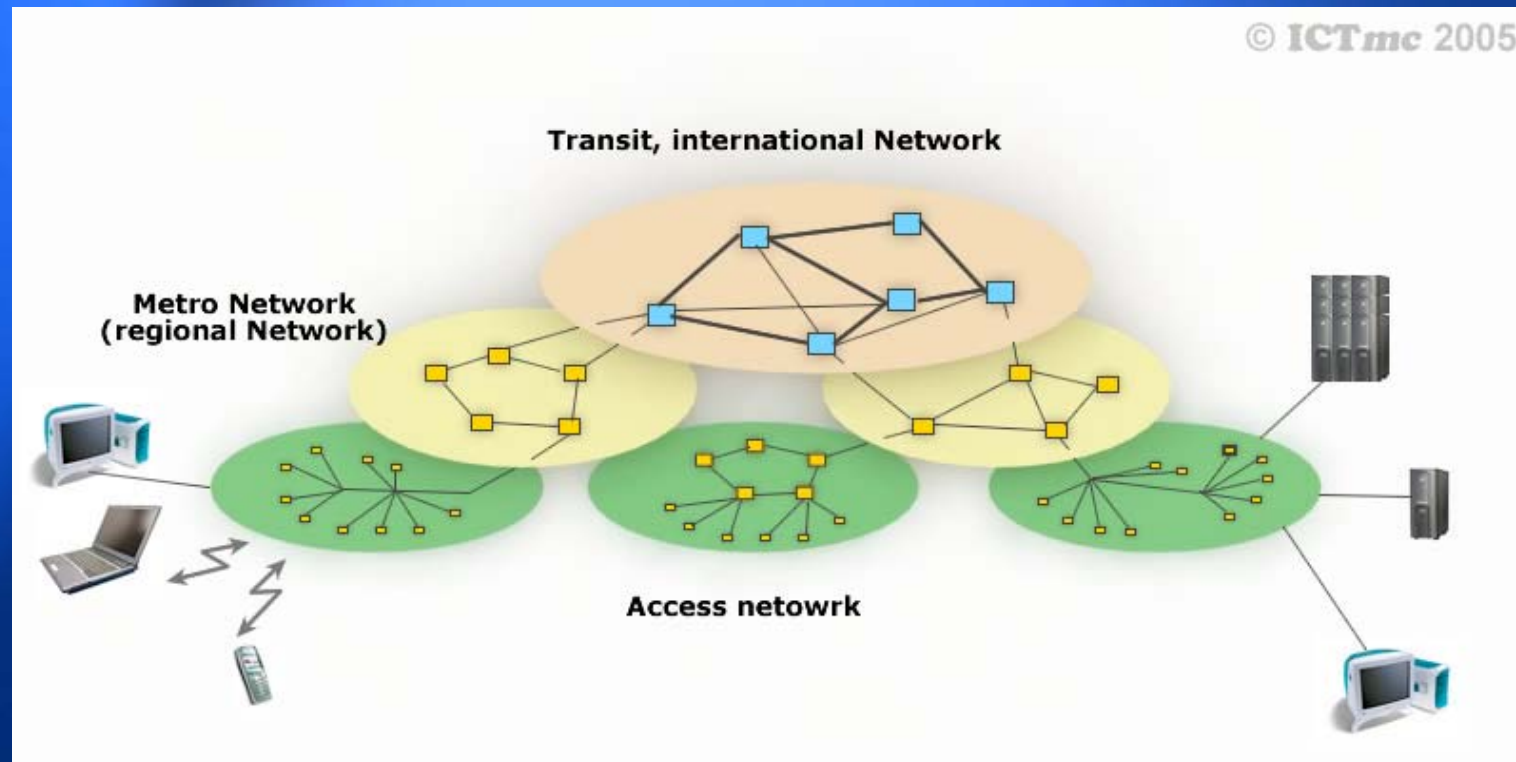c) Greater Ease of Use
d) Evolving to Lifestyle Services

Service Providers Need to Provide:
a) Service Bundles
b) Increase ARPU
c) Reduce churn

NGN – Operators Efforts
a) Broadband Service: FTTX, xDSL, WiFi
b) VoIP, Video Telephony, VoD/MoD
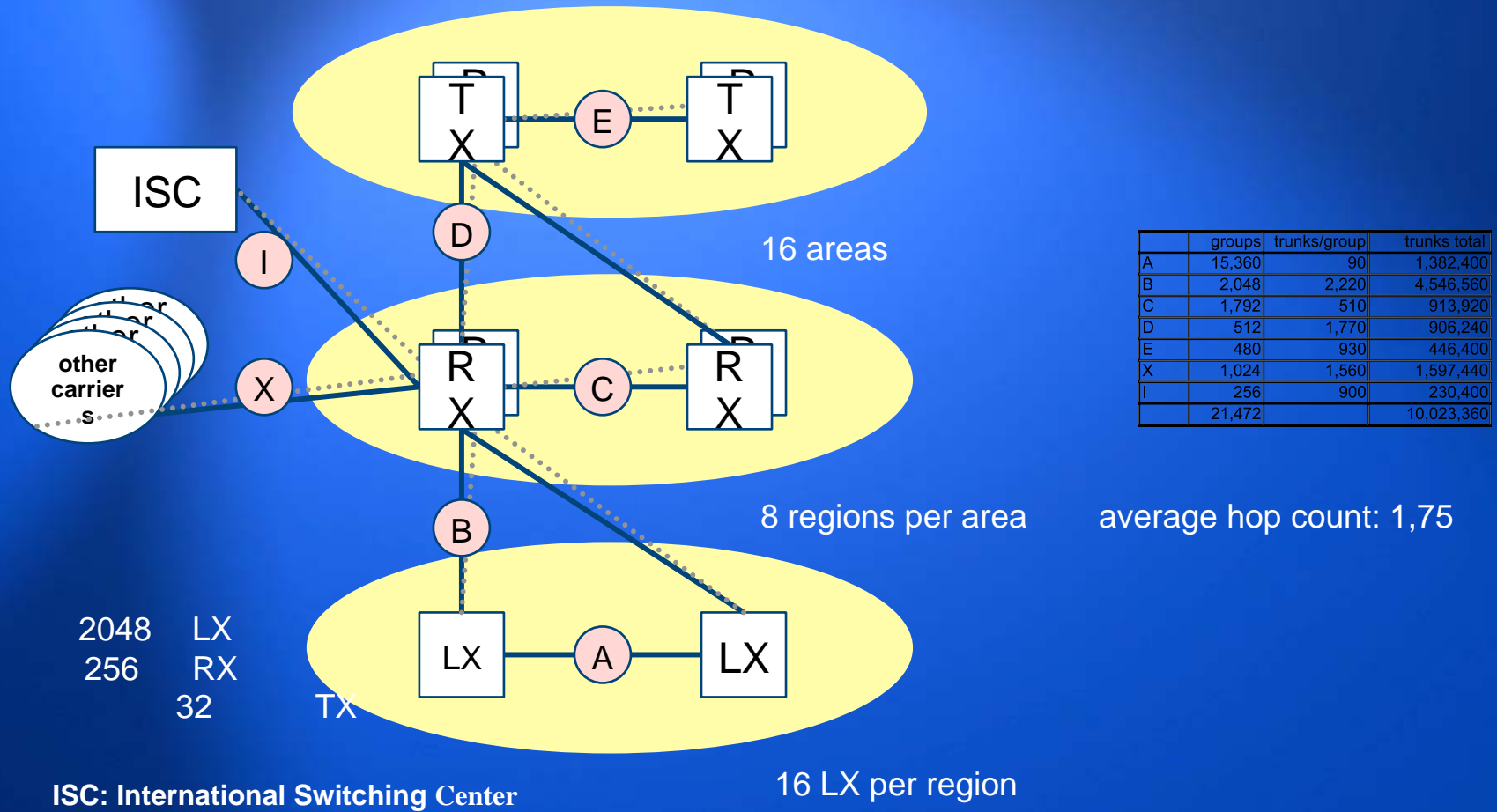c) Content & Gaming
d) Convergence Service
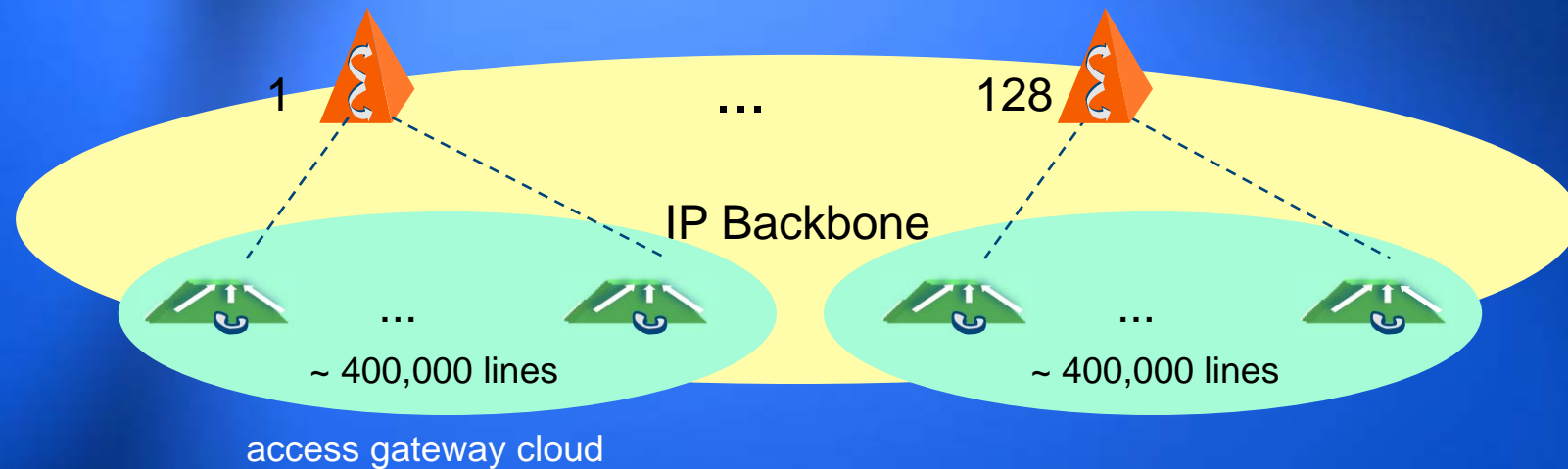
Network Architecture "old"

A Voice TDM Model network

- ~ 50.000.000 phone lines
- 2048 LE with 25.000 lines each, 6000 RCU
- per LE:
    - 1:6 line to trunk concentration
    - 15 % internal traffic
- average BH load per trunk: 0.8 Erl
- from the trunking traffic
    - intra regional traffic is 38%,
    - intra area traffic is 25%
    - interconnection traffic is 22%
    - international traffic is 3%
    - long distance traffic is 12%

16 areas

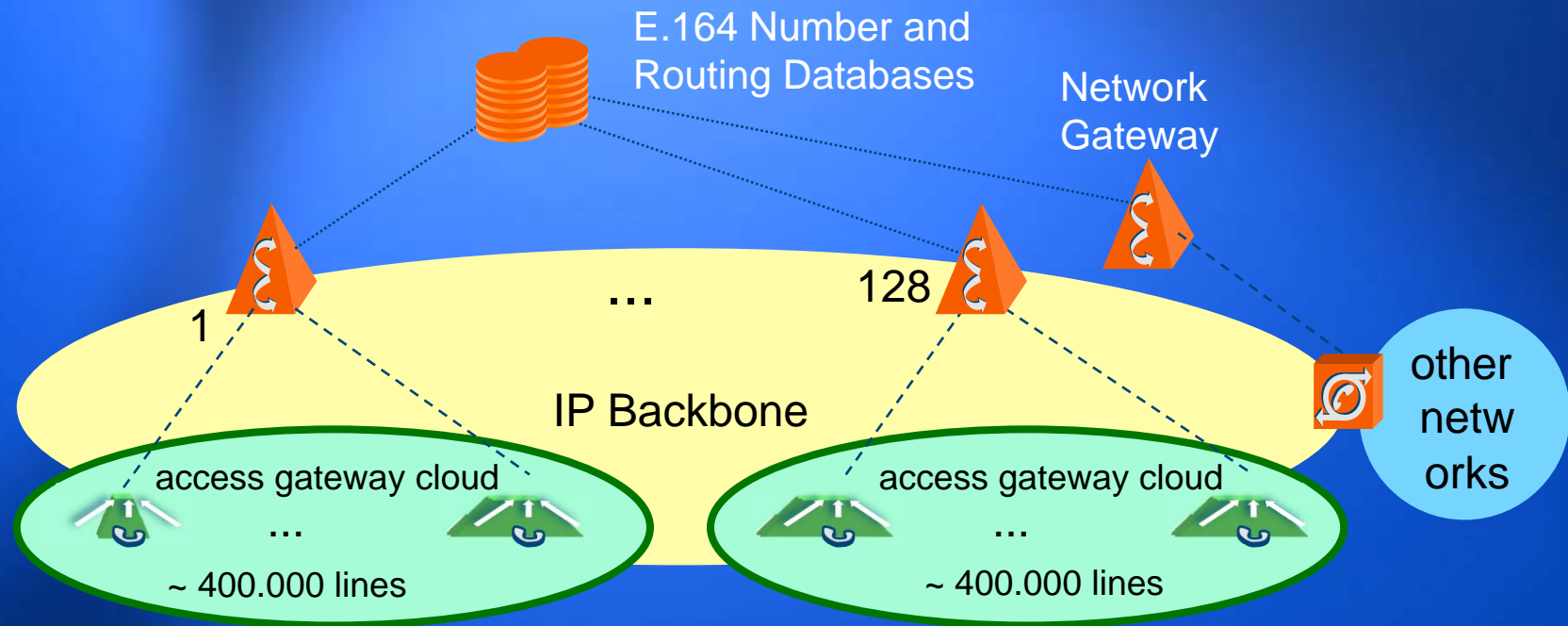|	groups	trunks/group	trunks total
A	15,360	90	1,382,400
B	2,048	2,220	4,546,560
C	1,792	510	913,920
D	512	1,770	906,240
E	480	930	446,400
X	1,024	1,560	1,597,440
I	256	900	230,400
	21,472		10,023,360

8 regions per area   average hop count: 1,75

2048   LX
256   RX
32   TX

ISC: International Switching Center

16 LX per region

NGN: Example Voice Model Network (Large)

1 ... 128

IP Backbone

~ 400,000 lines   ~ 400,000 lines

access gateway cloud

Totally flat network with 128 class 5 softswitches, each controlling ~ 400,000 lines

NGN: Routing

E.164 Number and Routing Databases

Network Gateway

...

128

1

IP Backbone

access gateway cloud
...
~ 400.000 lines

access gateway cloud
...
~ 400.000 lines

other netw orks

Routing becomes a simple address resolution and the solution can evolve from today's number portability databases

Routing is determined by Number Resolution

Comparing CAPEX/OPEX
TDM and NGN Model Networks

Rough CAPEX – saving estimations

1. No Transit Network ~ 15' – 20' Ports
2. Reduction of 1:16 in "local offices" (128 instead of 2048)
3. no low granularity (E1/T1) transport network
4. No additional high quality Data Network

CAPEX Reduction ~ 50 – 60%

Rough OPEX – saving estimations for trunk network

1 Flat network: no trunk database, no traffic control, etc. …..

2 Dramatic decrease of managed object (~ 1:20 to 1:50):

- Instead of 21500 trunk groups, 64 links
- Instead of 2048 local offices, 128 Softswitch Centers
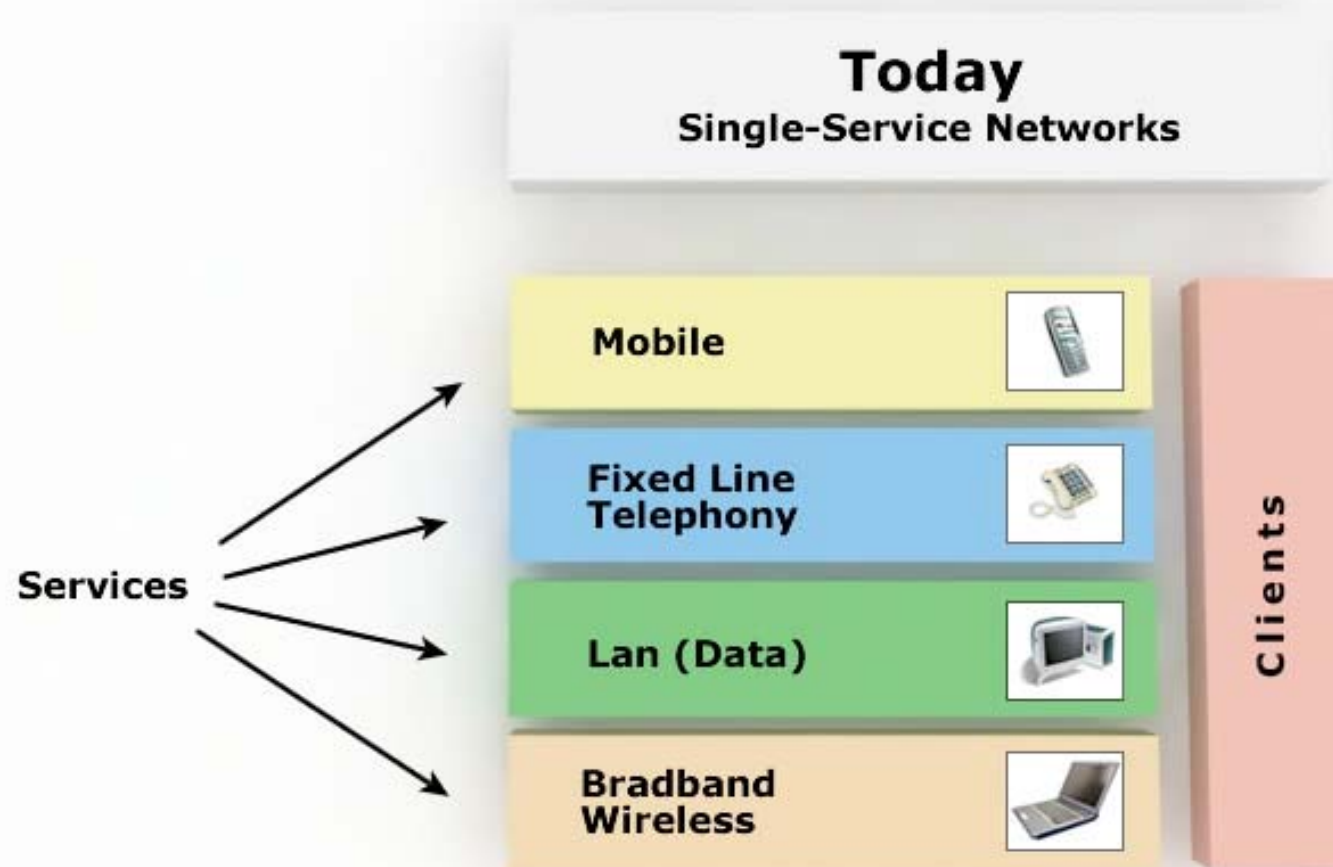
3 No additional Data Networks to be managed

OPEX Reduction: higher than 80%

ICTmc

15

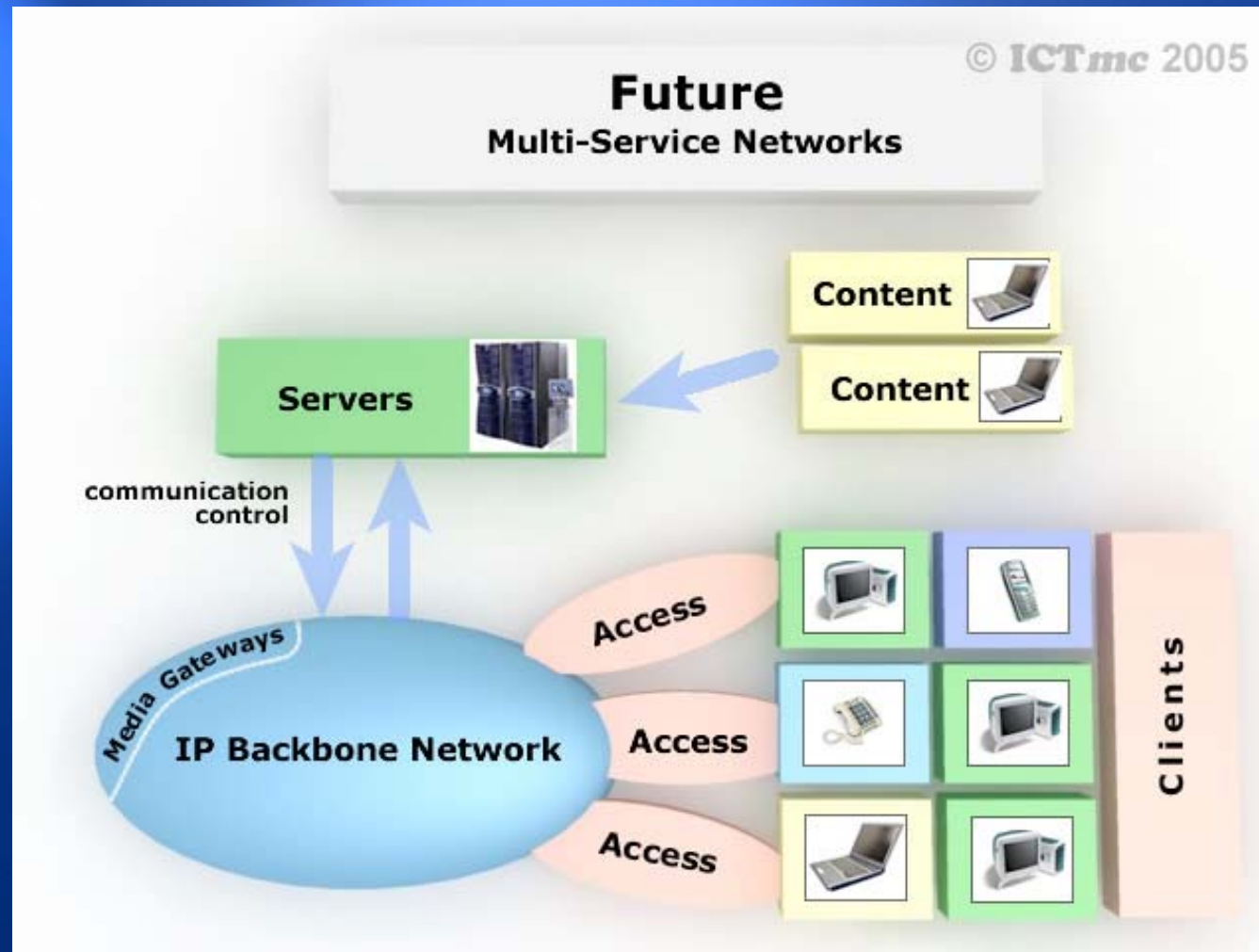# Summary: NGN is Supposed to….

- NGN allows for network consolidation, reducing the number of switching databases by more than one order of magnitude and the number of transport objects by one to two orders of magnitudes.

- Therefore with NGN the OPEX for hiA interconnection is expected to be one to two orders of magnitude lower than with TDM for LE interconnection

- Price for mediation determines the CAPEX for NGN: with current prices CAPEX for NGN backbone is not higher than that for a cost optimized TDM trunking network. Additional savings by reduced number of network nodes and synergy with a common high quality data network.

- Prerequisite is a cost efficient traffic aggregation, e.g. through optical Ethernet, resilient packet rings.

- QoS is provided by an engineered IP backbone.

IMS Architecture

Enterprise
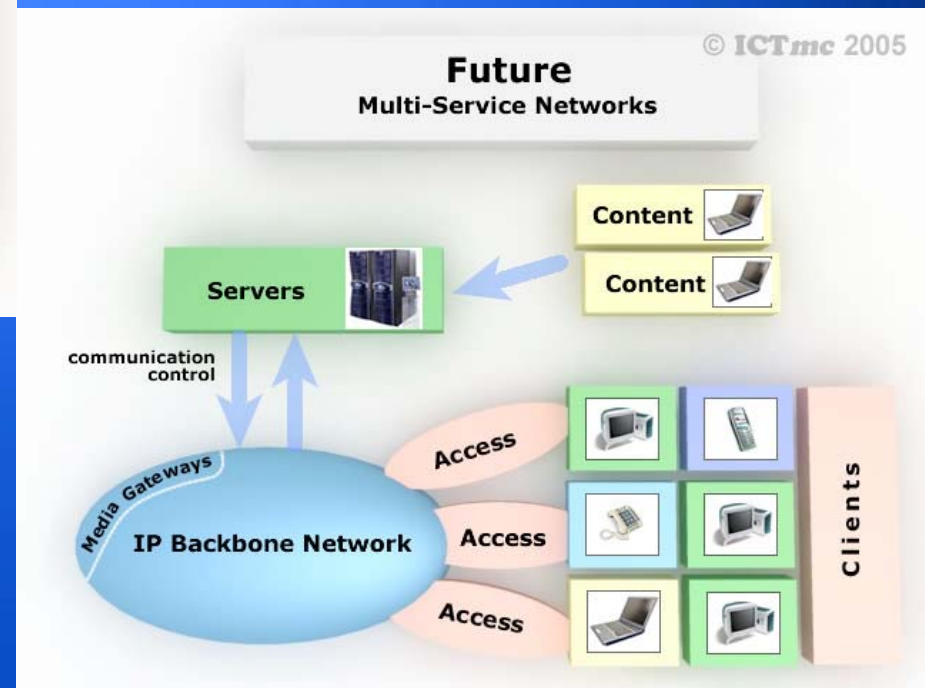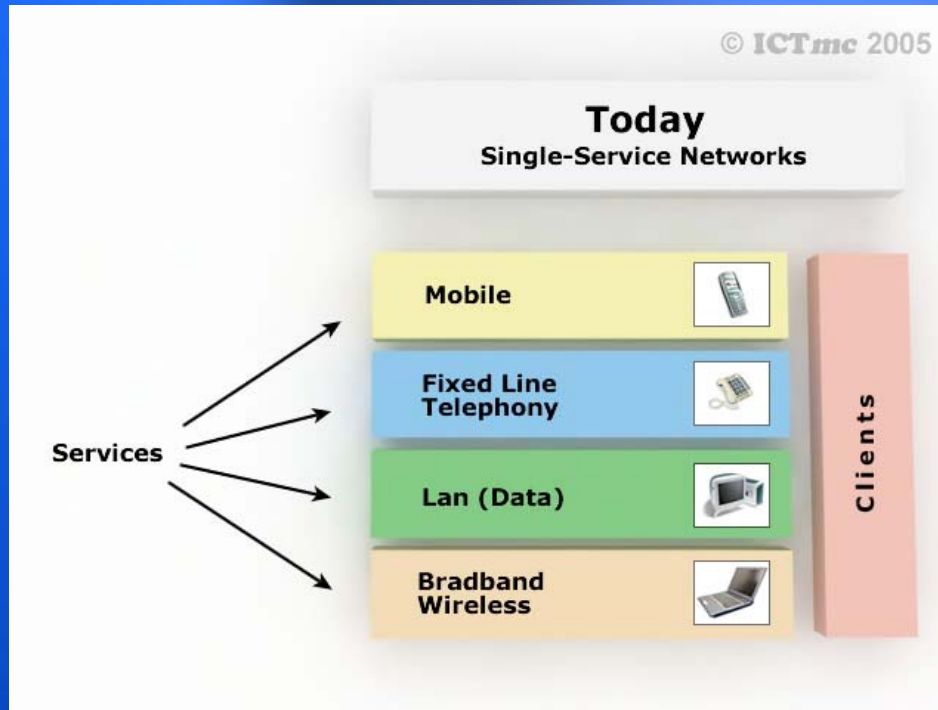
Consumers

Content & Applications

IMS

Network Infrastructure

Access

2.5G

3G

Broadband wireless access

DSL
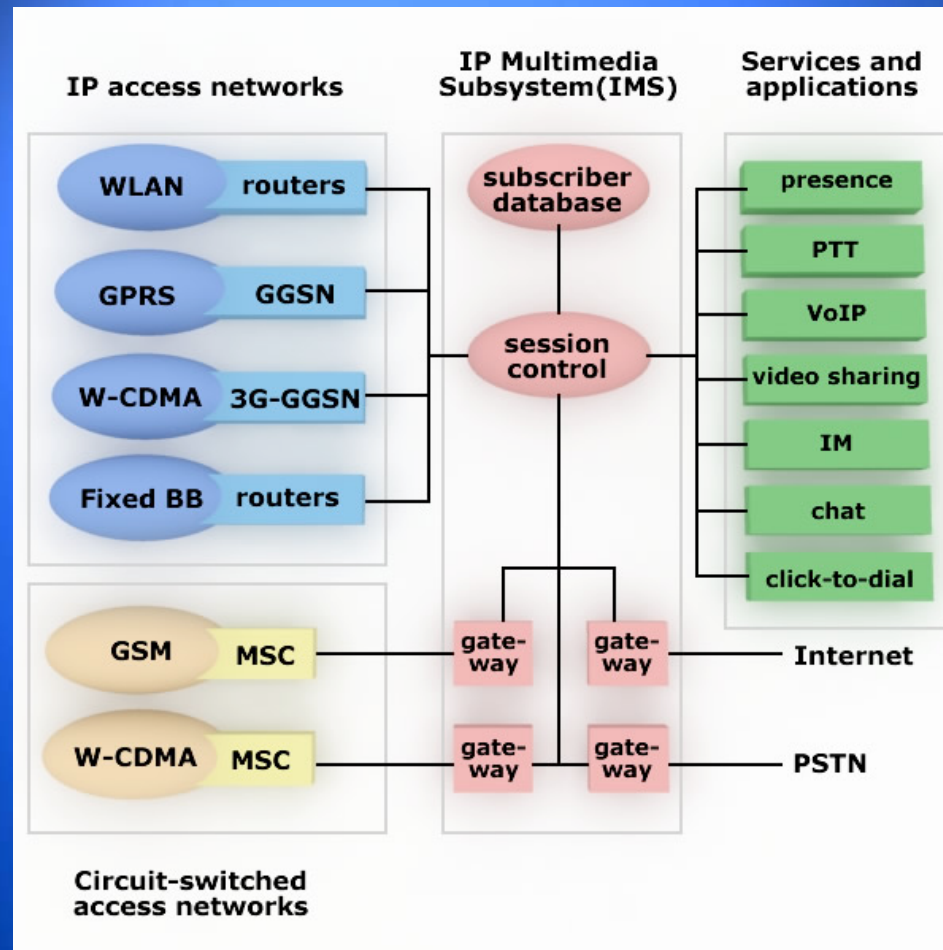
Fixed line
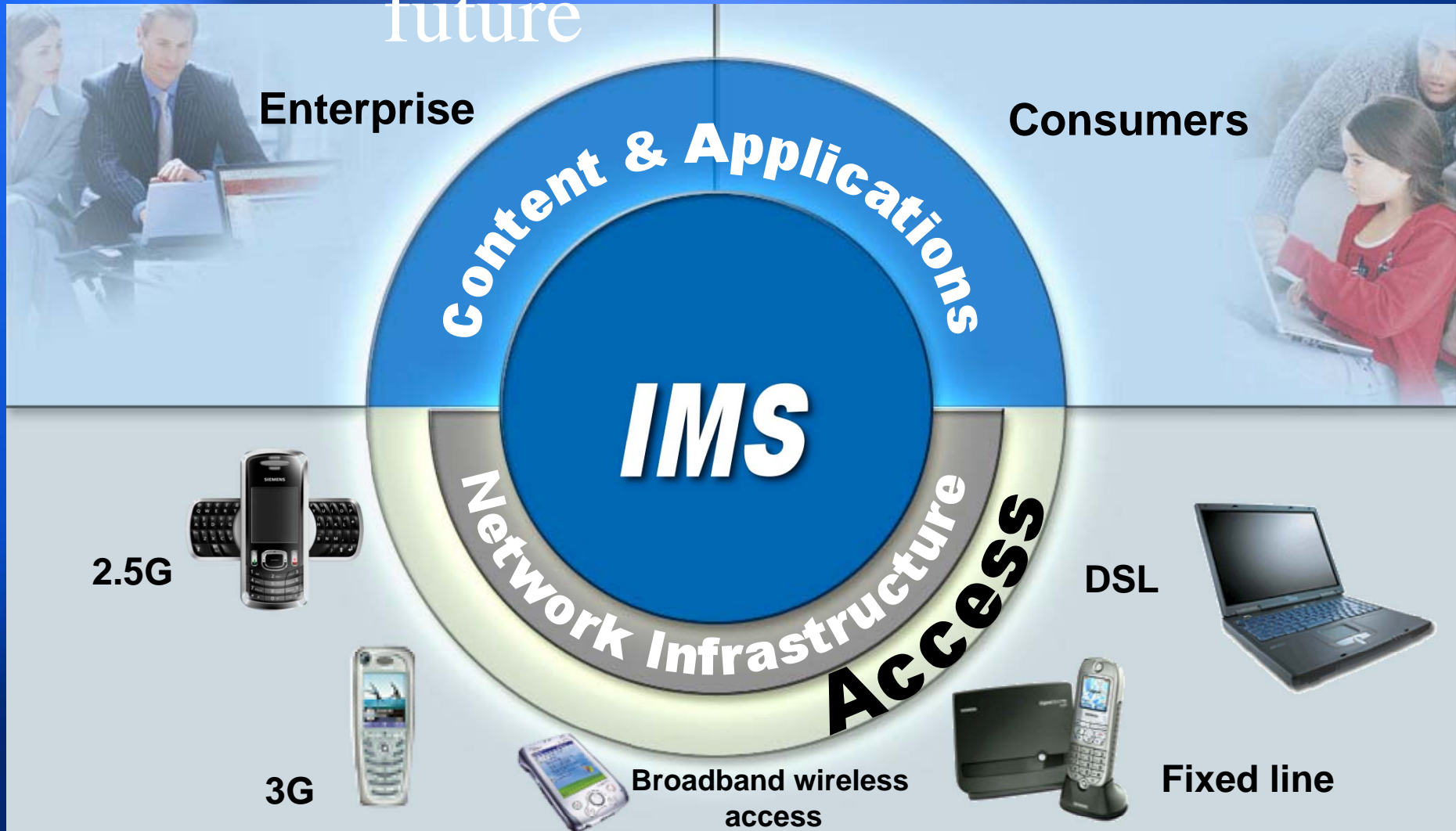
Emerging services

- **Triple-play services (QP) :**
  - **Telephony**
  - **High-speed Internet**
  - **Broadcast TV and PPV**

Communication

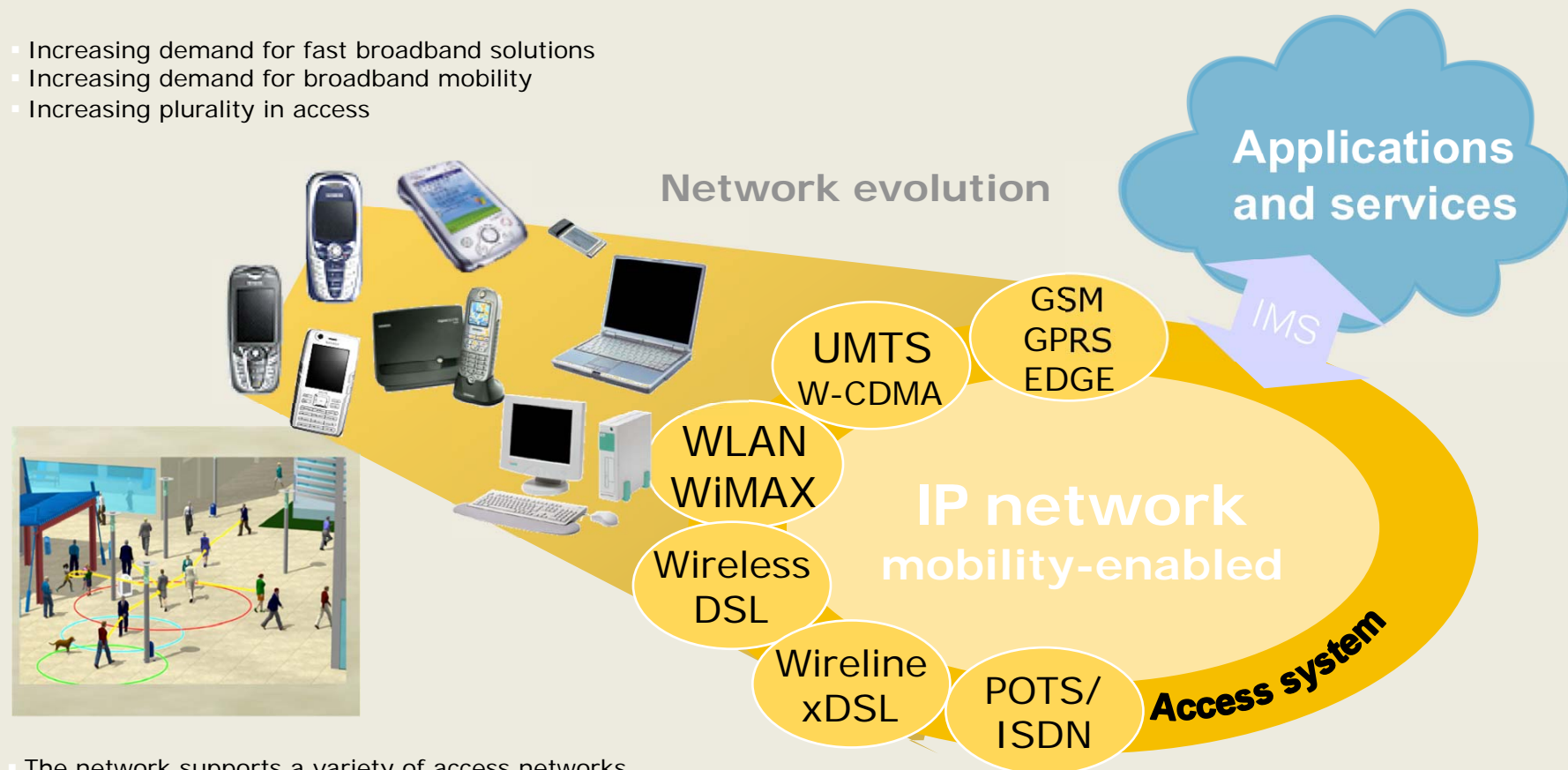entertainment

Game Console DVD Player/Recorder Set-top /PVR

information   Control

- Increasing demand for fast broadband solutions
- Increasing demand for broadband mobility
- Increasing plurality in access

Network evolution

Applications and services

IMS

GSM GPRS EDGE

UMTS W-CDMA

WLAN WiMAX

IP network mobility-enabled

Wireless DSL

Wireline xDSL

POTS/ ISDN

Access system

- The network supports a variety of access networks
- The majority of traffic is IP-based with increasing peer-to-peer and machine-to-machine traffic
- Opens possibilities for new radio interfaces based on improved air interfaces (OFDM)
  and support for multi-hop, ad hoc and self-organizing networks

Convergence UN & RW