ERICSSON

Next Generation Networks

Ericsson's Concepts and Visions

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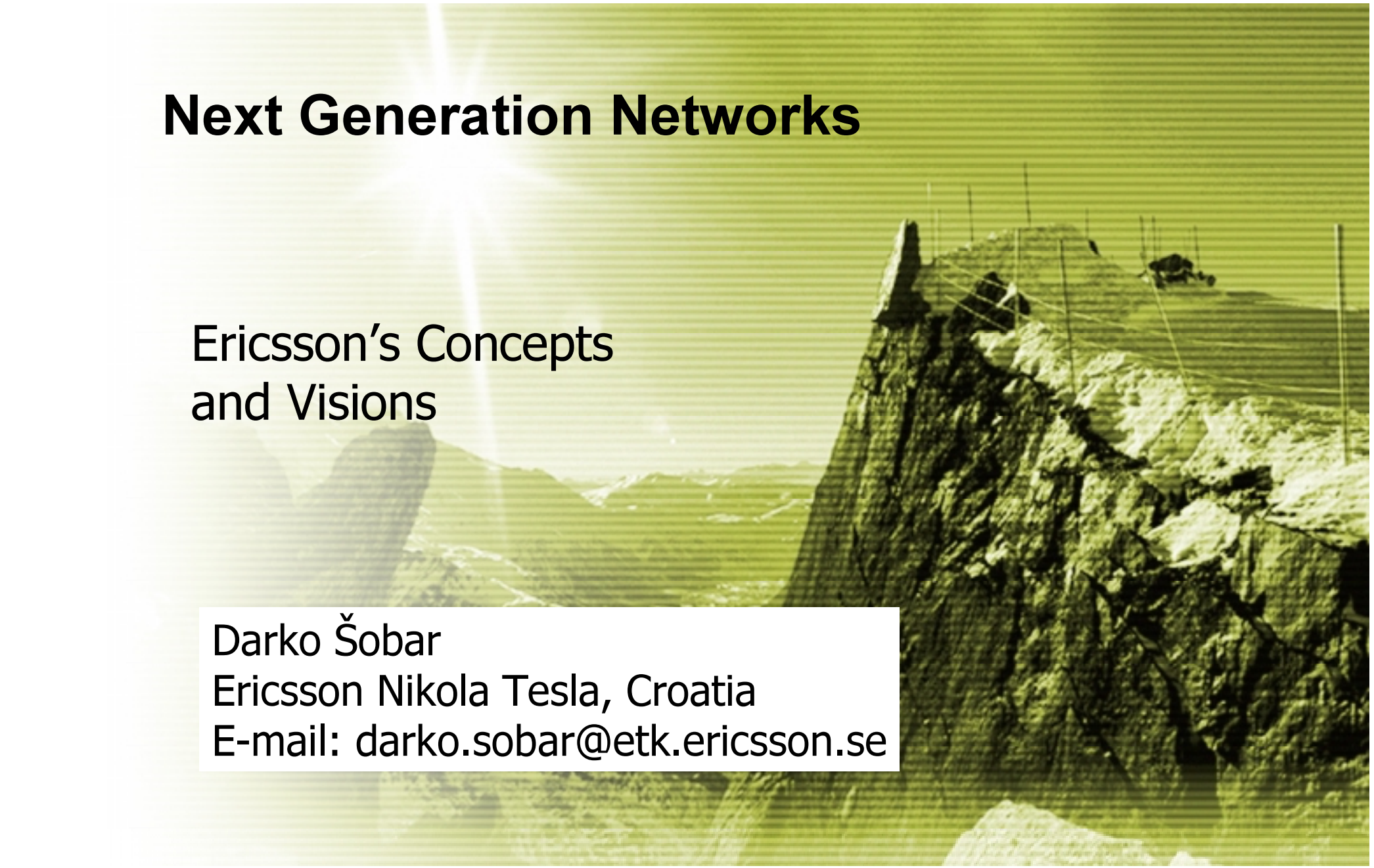
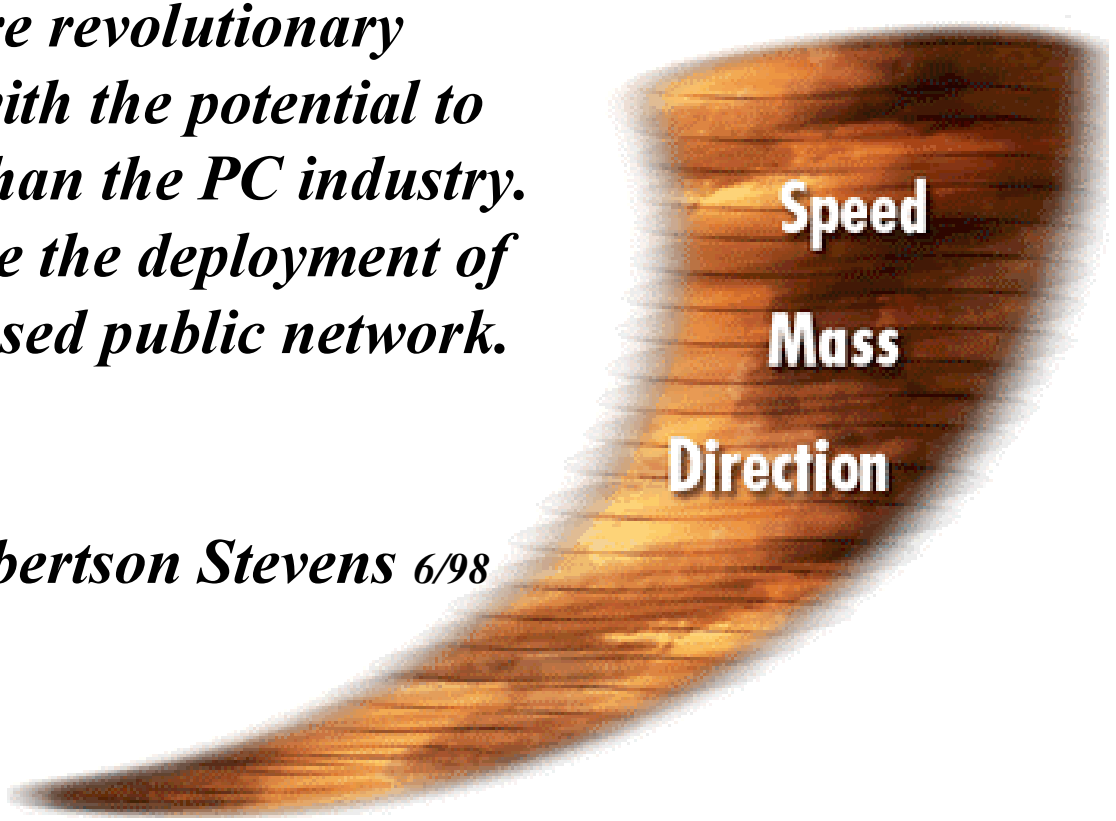


Rapid Market Transformation

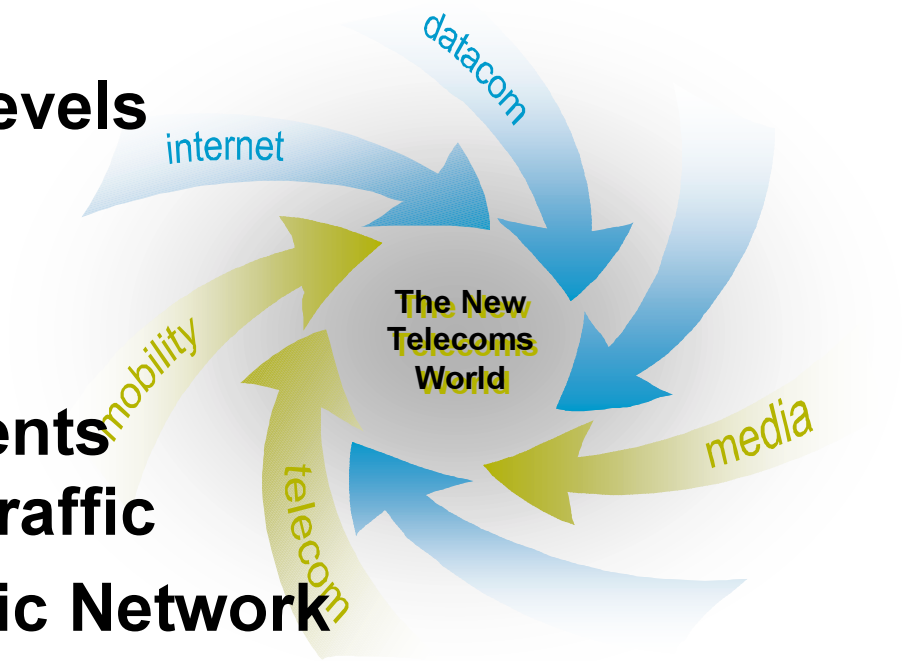
We believe a really big tornado is forming on the horizon. Bigger than the world's telephone network, more revolutionary than the Internet and with the potential to generate more wealth than the PC industry. The next tornado will be the deployment of a broadband, packet-based public network.

Paul Johnson,
BancBoston Robertson Stevens 6/98

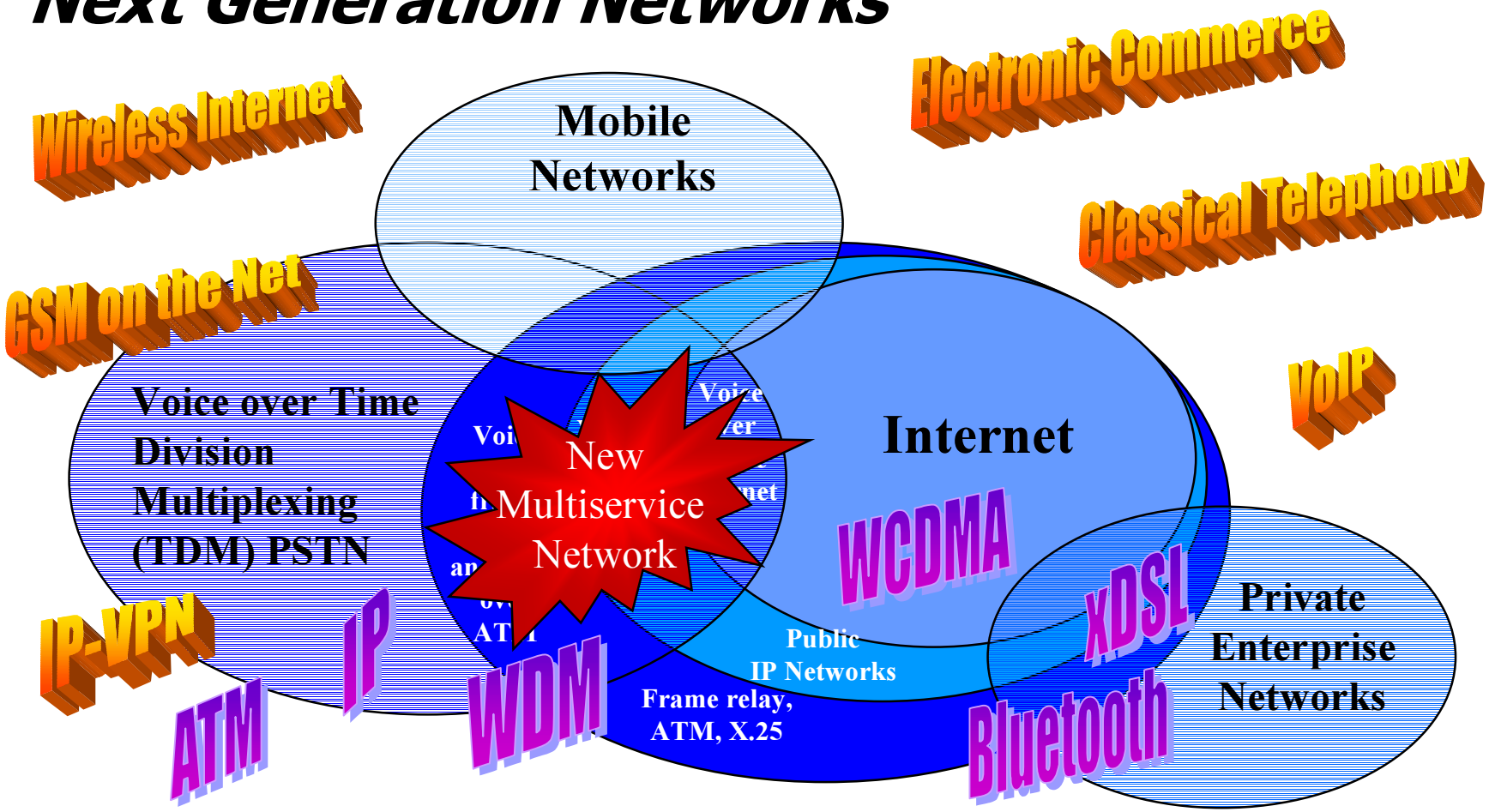


Rapid Market Transformation

- Convergence at multiple levels
  - Suppliers
  - Operators
  - Technology
- High bandwidth requirements driven by increased data traffic
- Evolution of the New Public Network
  - Voice services (narrowband) --> Multi-services (broadband)
  - Several networks --> One, end-to-end converged network
- Next generation services

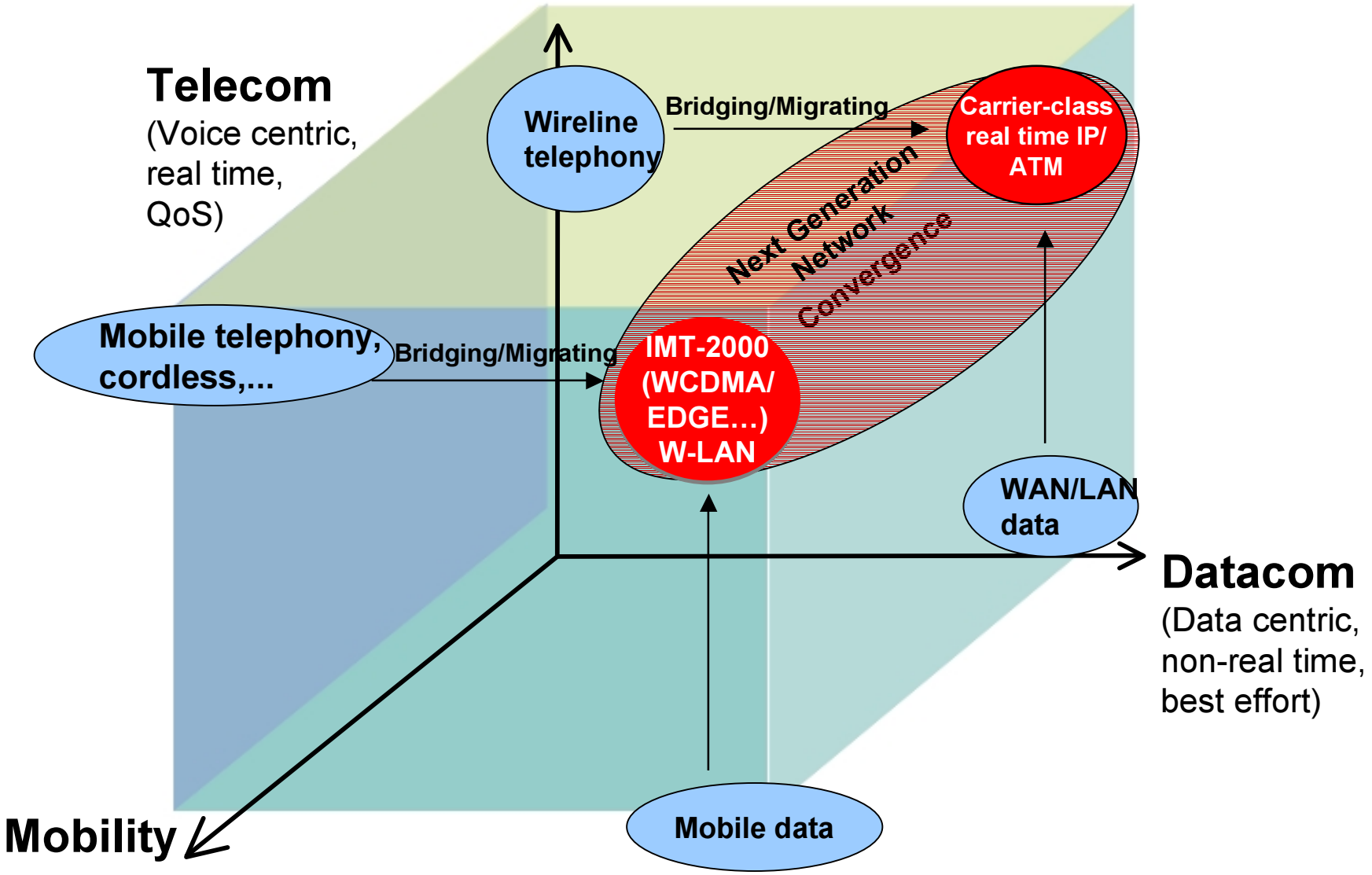


Next Generation Networks

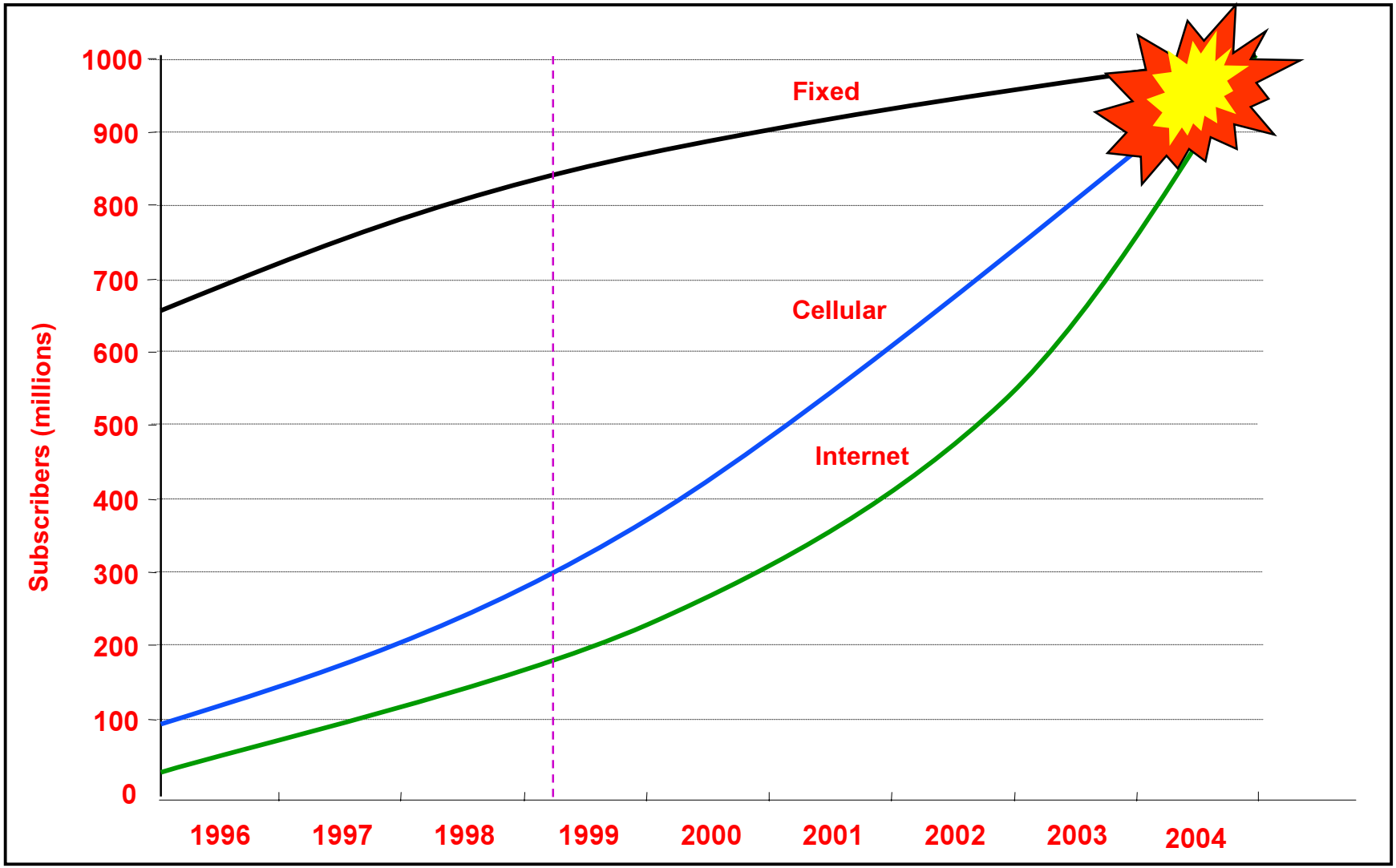


In March 1999, ATT announced that it is installing its last class four circuit switch, and from now on it will spend 6 BUSD a year on migrating its network to packet technology.

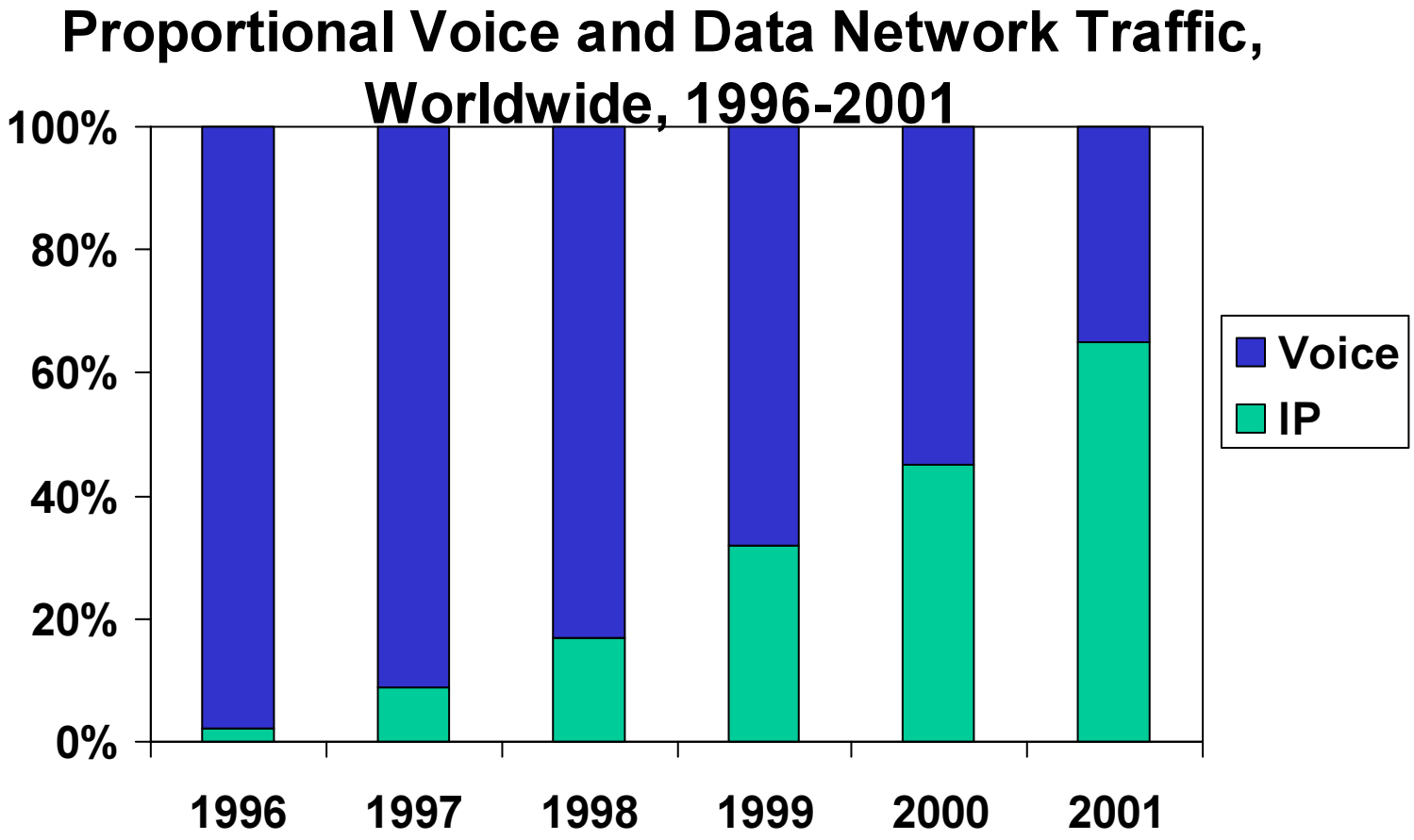
The Services Cube



Increased Subscriber Growth

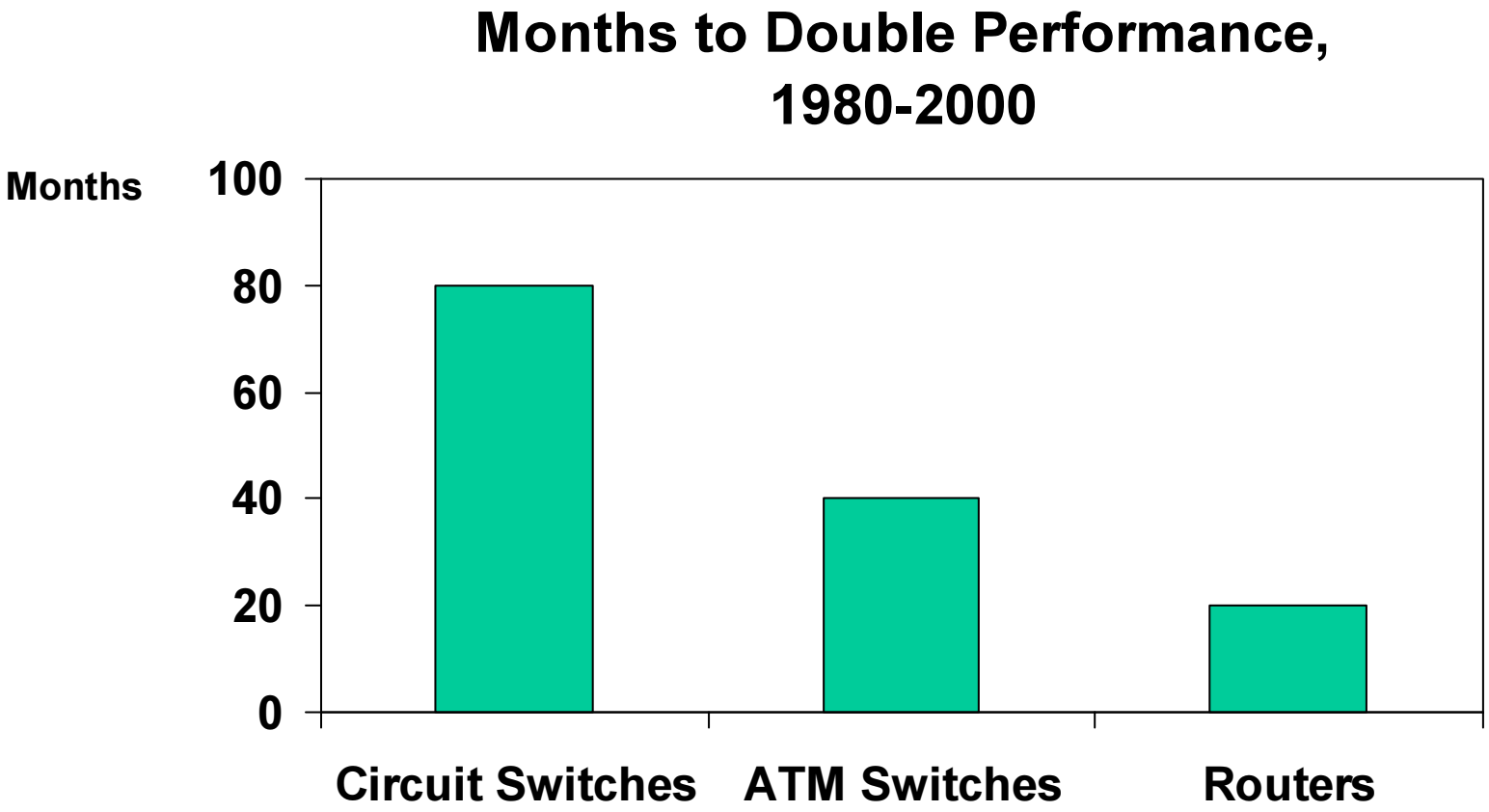


Data Continues to Grow as a Percentage of Total Network Traffic

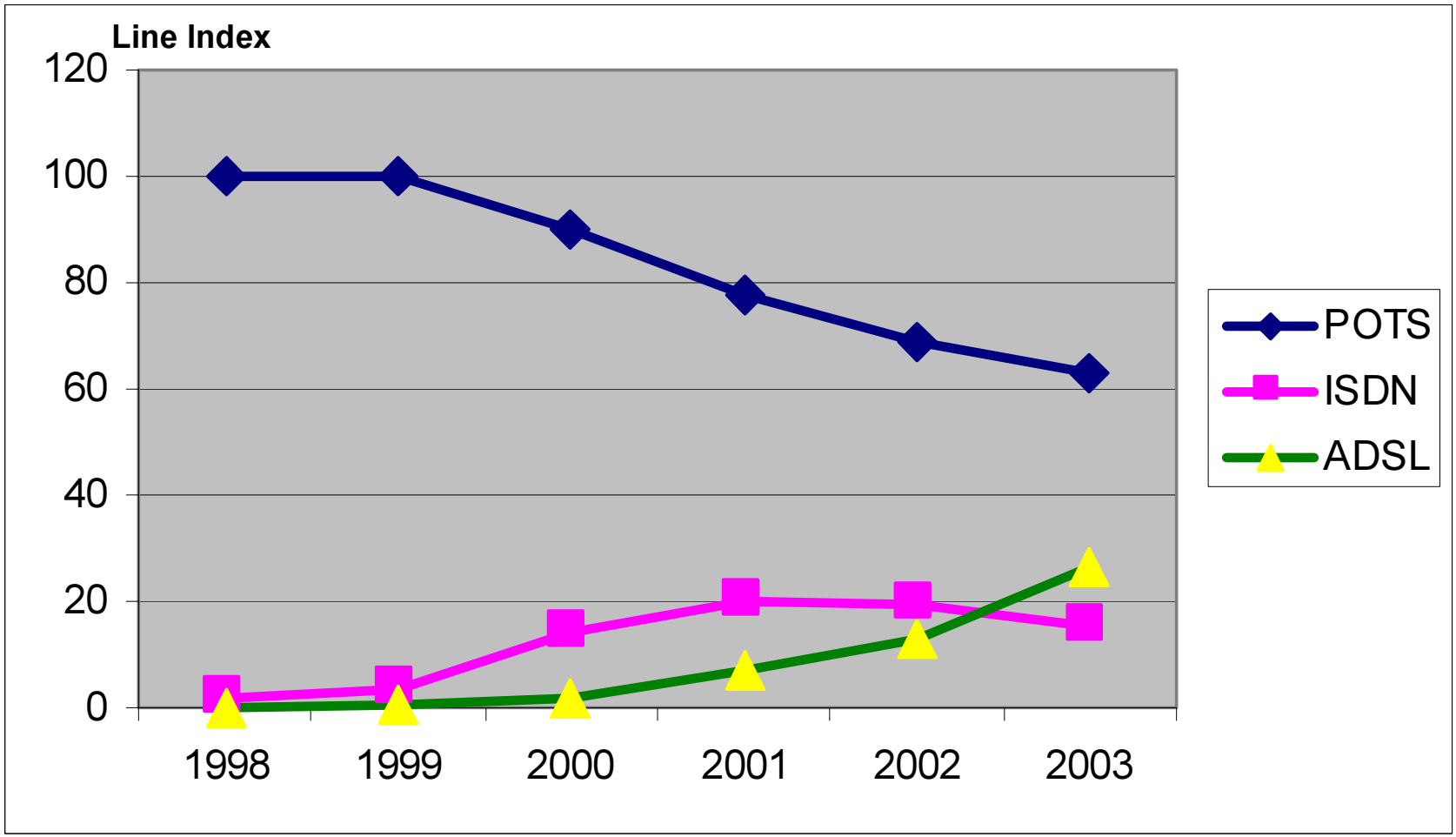


Source: the Yankee Group, 1999

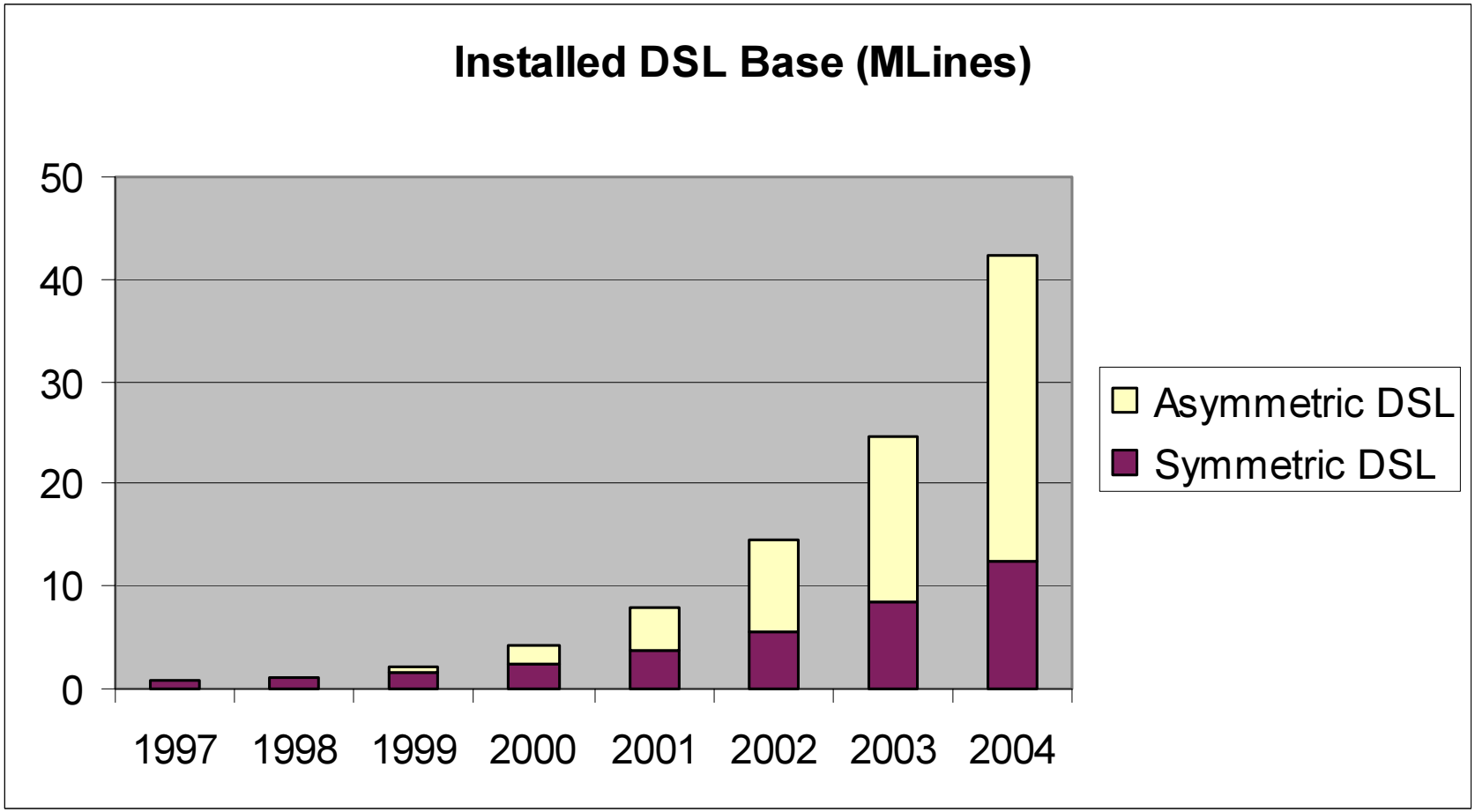
Packet Switch Performance Grows More Rapidly than Circuit Switch



Access Technologies Deployment



xDSL Volumes



Multiservice Networks Consist of:

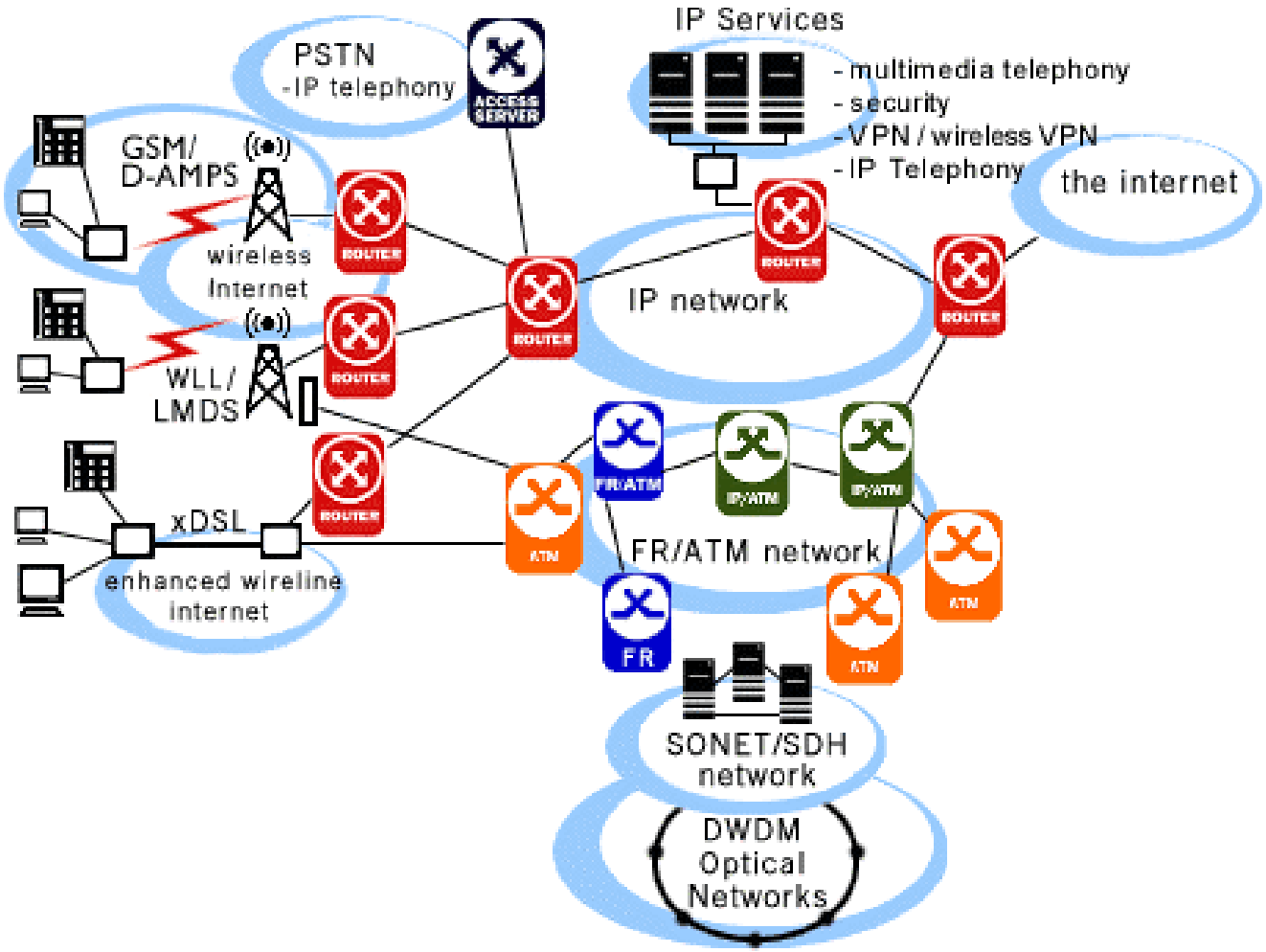
CPE

Service-Enabling Applications

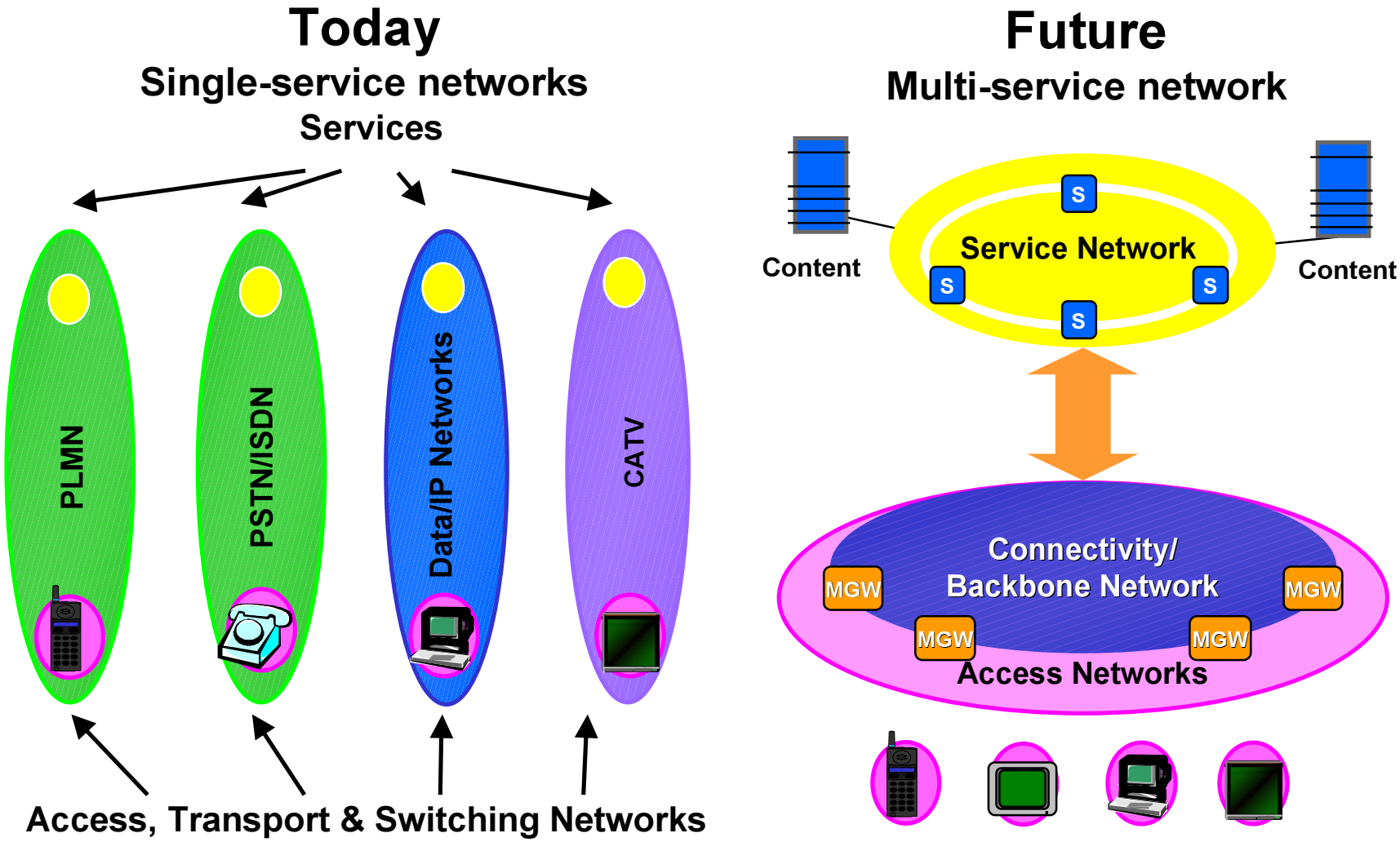
Access

Core Network

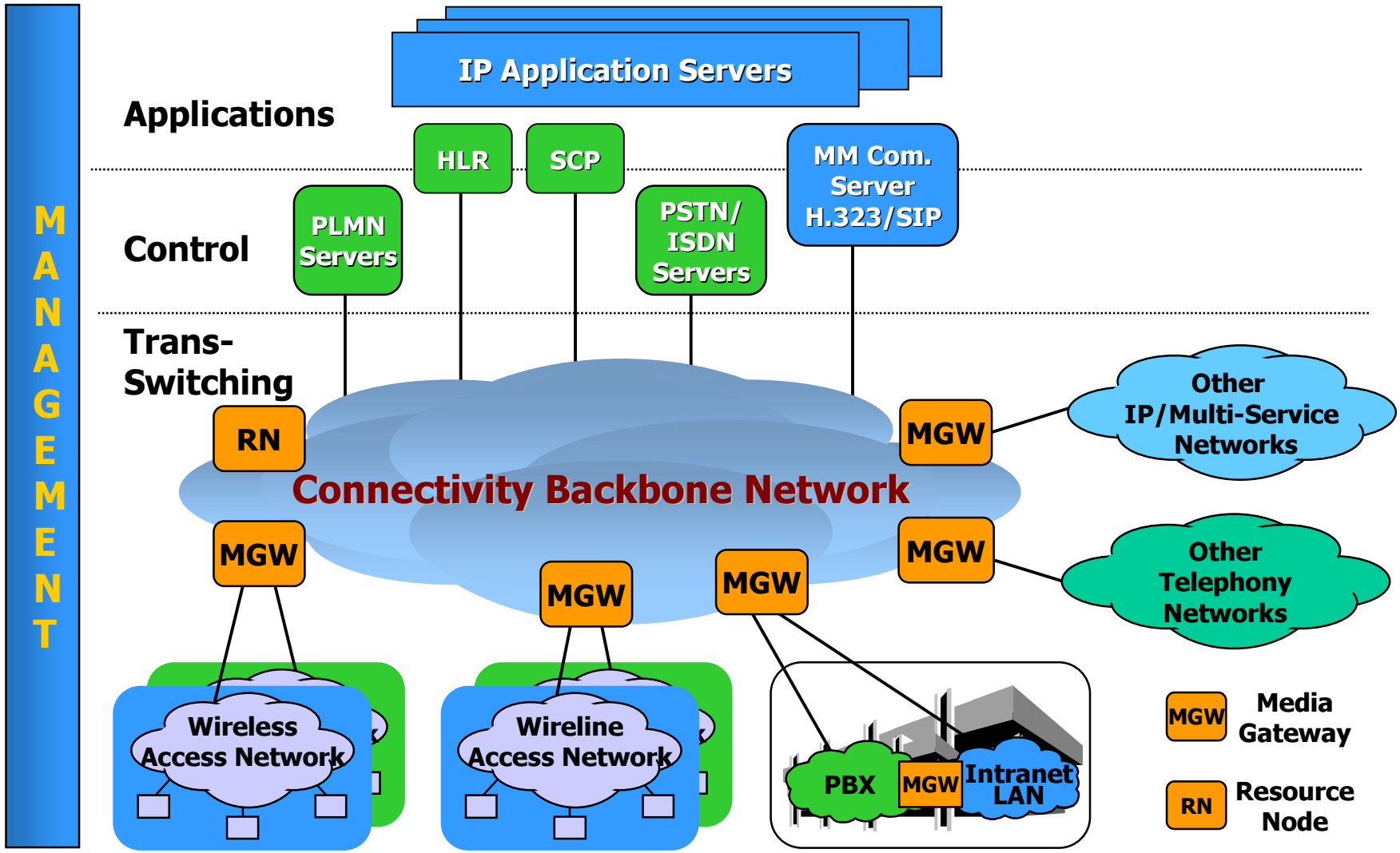
Transport



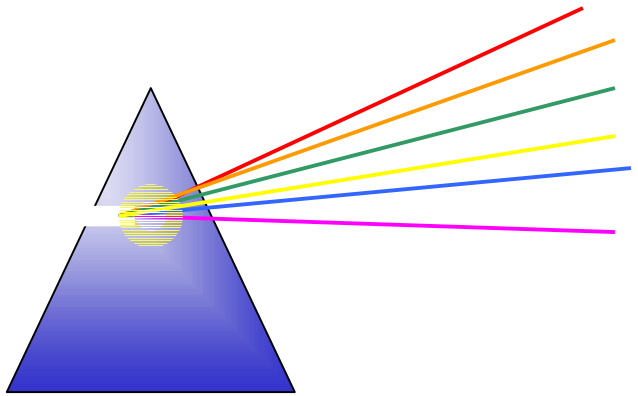
Next-Generation Network Structure



Next Generation Network Architecture

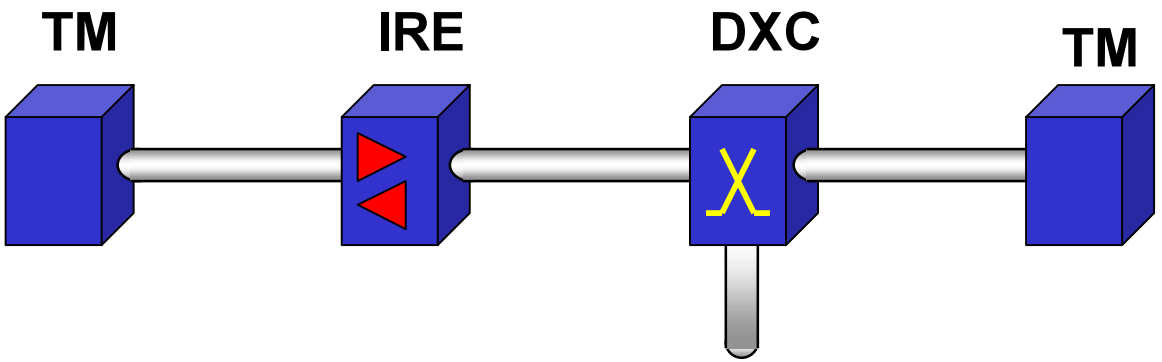


Why DWDM?



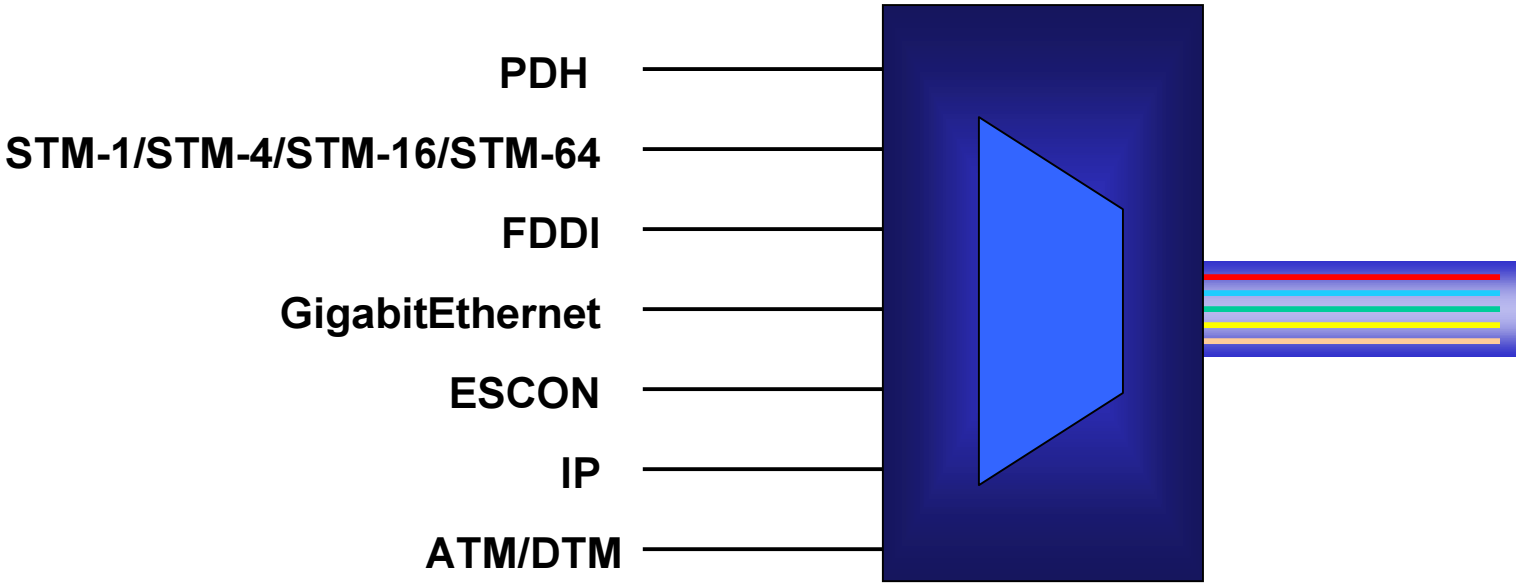
- **Resolve fiber exhaustion in existing network**
- **New business opportunities via leasing of dark fibers**
- **Generic, client independent transport network.**
- **Scaleable in capacity upon need.**

Why not SDH?



- SDH network cannot be scaled as much as DWDM
- SDH can only carry certain traffic types
- Larger electrical DXCs expensive and difficult to realise.
- Long routes consume large amounts of equipment.
- STM-64 (10Gb/s) only provides four times capacity, and could be overwhelmed in two years

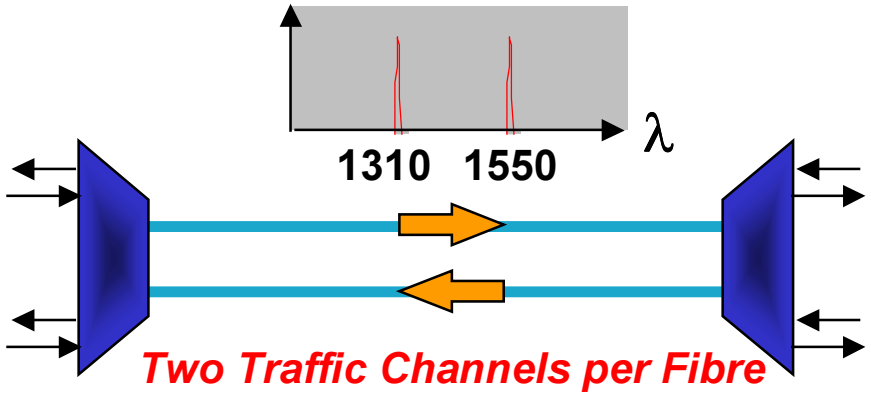
New services and traffic types



- DWDM offers a universal transport layer for all traffic types
- DWDM allows each layer to be right sized for its own traffic; saves on unneeded conversion equipment
- DWDM can adapt to tomorrow's traffic mix

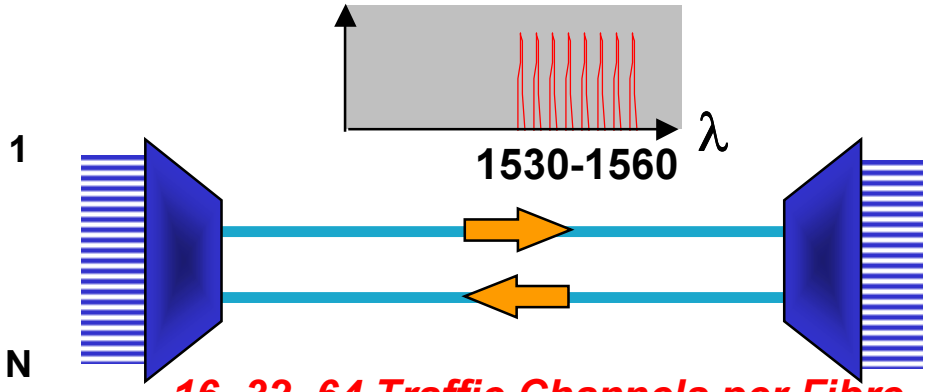
WDM vs DWDM

Yesterday:
WDM
Wavelength Division Multiplex



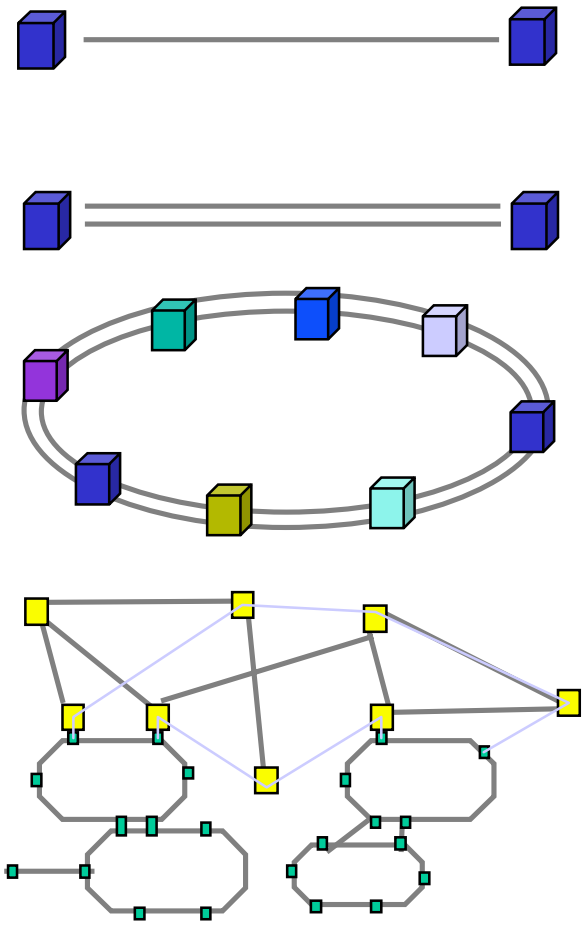
Two Traffic Channels per Fibre

Today:
DWDM
Dense Wavelength Division Multiplex



16, 32, 64 Traffic Channels per Fibre

DWDM network evolution



- Point-to-Point to enhance capacity and solve fiber exhaust.
- Point-to-Point with traffic protection features added.
- Optical ADM Ring topologies,
- More advanced - Wavelength reuse, switching capabilities, i.e *"Optical Networking"*.

Two complementary IP Backbone Strategies

- IP over SDH/SONET - Gigabit Routers

  a basic high bandwidth router-to-router link network,
  ... requires high-capacity L3 routers

- IP over Switched Link Layer - ATM & MPLS

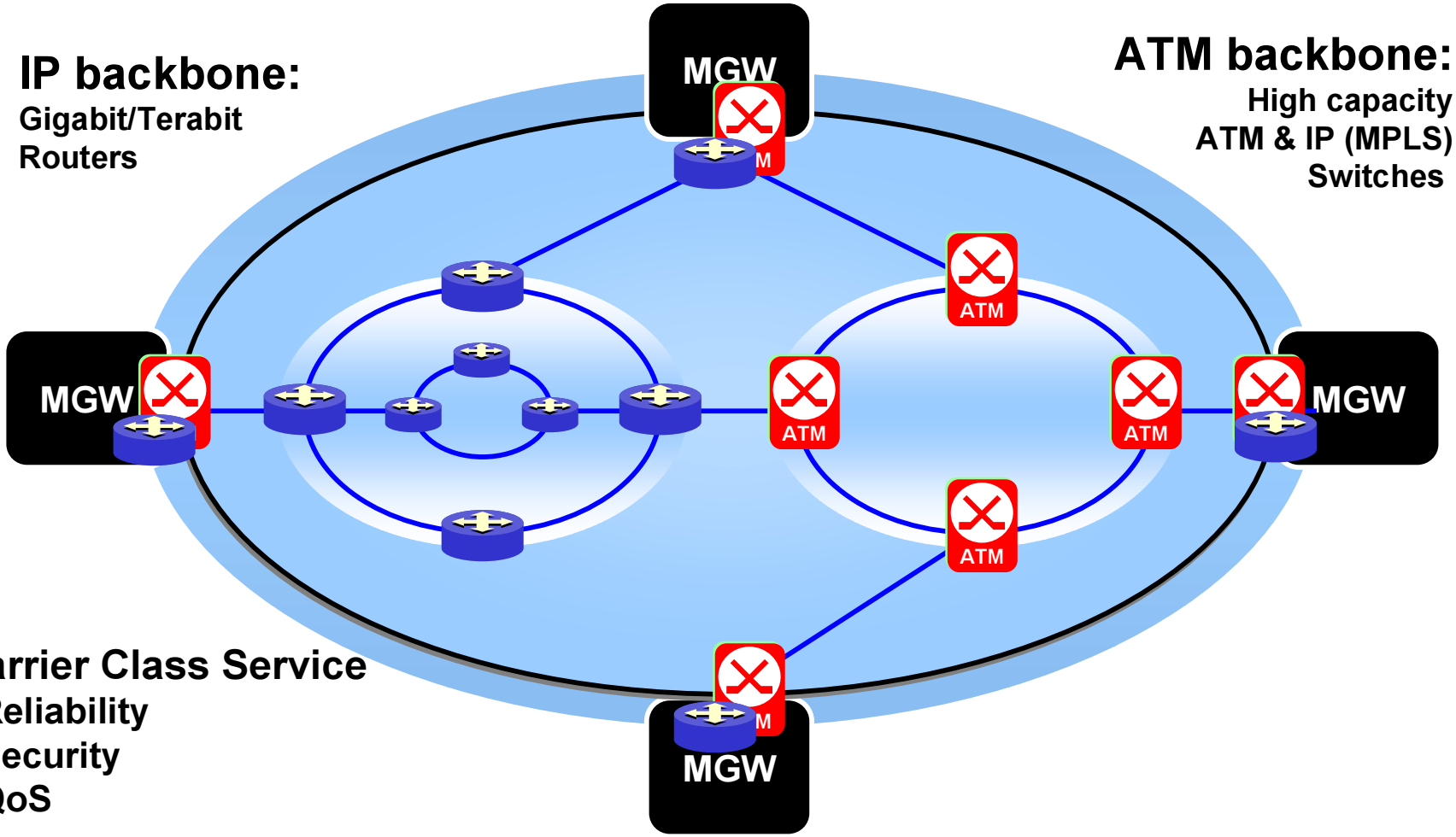
  an advanced high capacity switched network that efficiently runs IP,
  ...the network takes advantage of key features of ATM such as QoS and connection-orientation,
  …uses the ATM switch fabric to scale performance of the network nodes
  …enables a multi service network, Ships In The Night

The connectivity network

IP based, ATM based or with a mix of both depending on the needed services

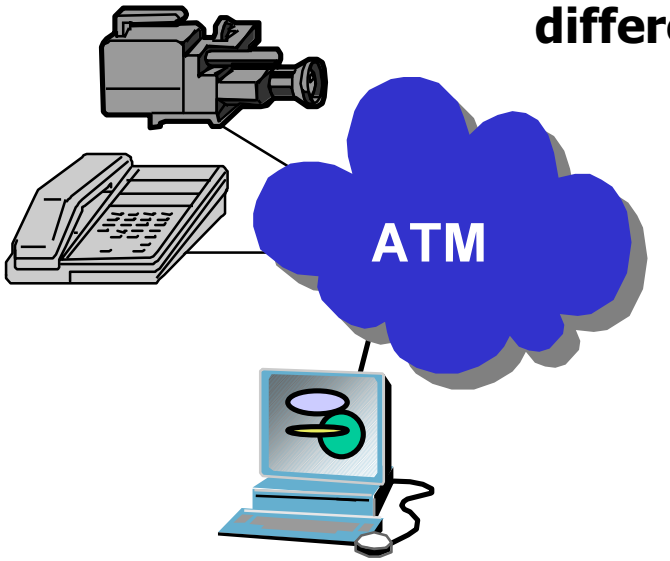
IP backbone:
Gigabit/Terabit
Routers

ATM backbone:
High capacity
ATM & IP (MPLS)
Switches



Carrier Class Service
- Reliability
- Security
- QoS

Why ATM !?



ATM can carry multi services with different QoS requirements (CBR, ABR, VBR…)

High capacity in back bone networks.

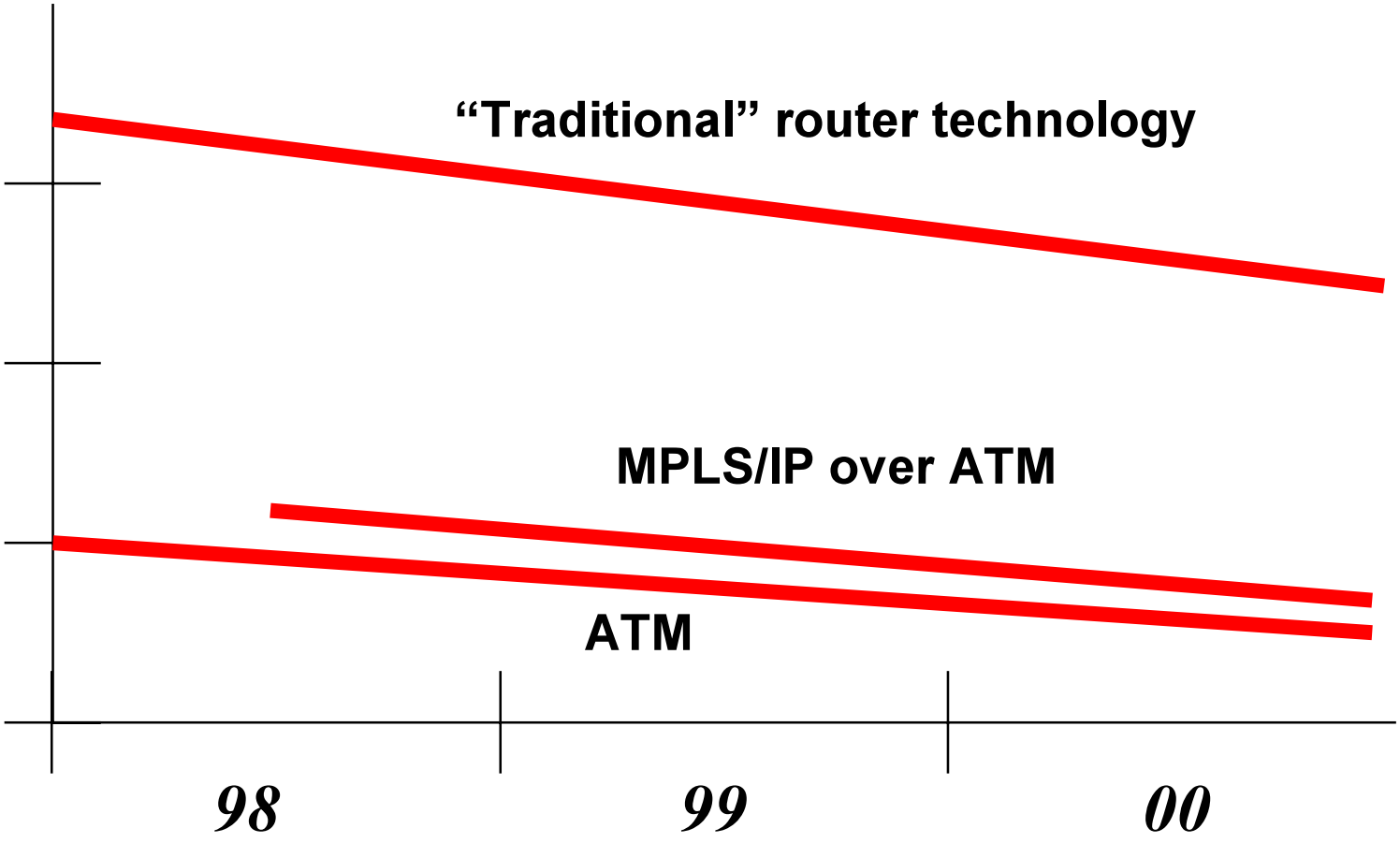
Efficient forwarding of IP-packets (MPLS)

Cost benefits

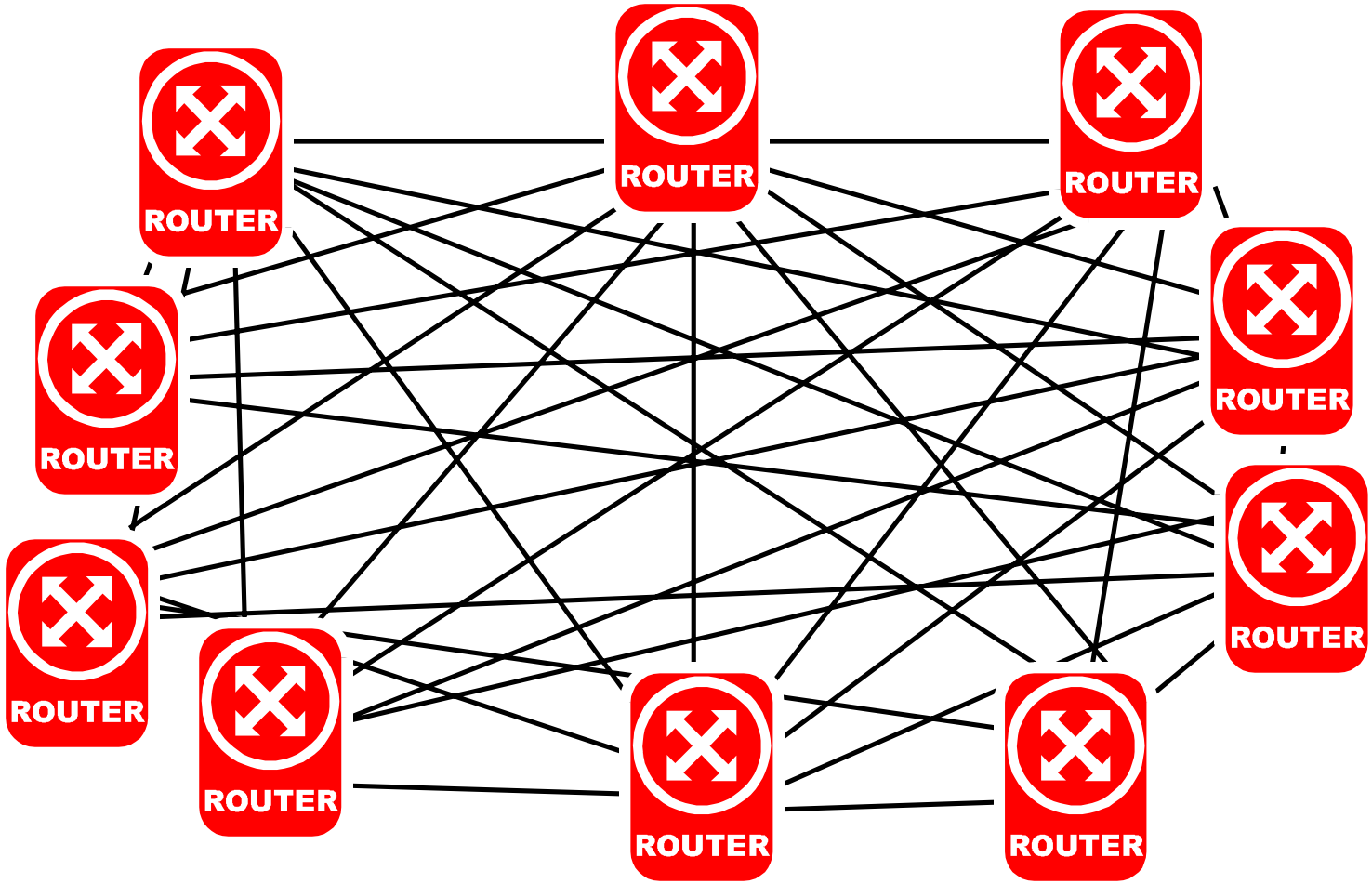
- **equipment and operations cost savings**
- **transmission cost savings**

Price/performance

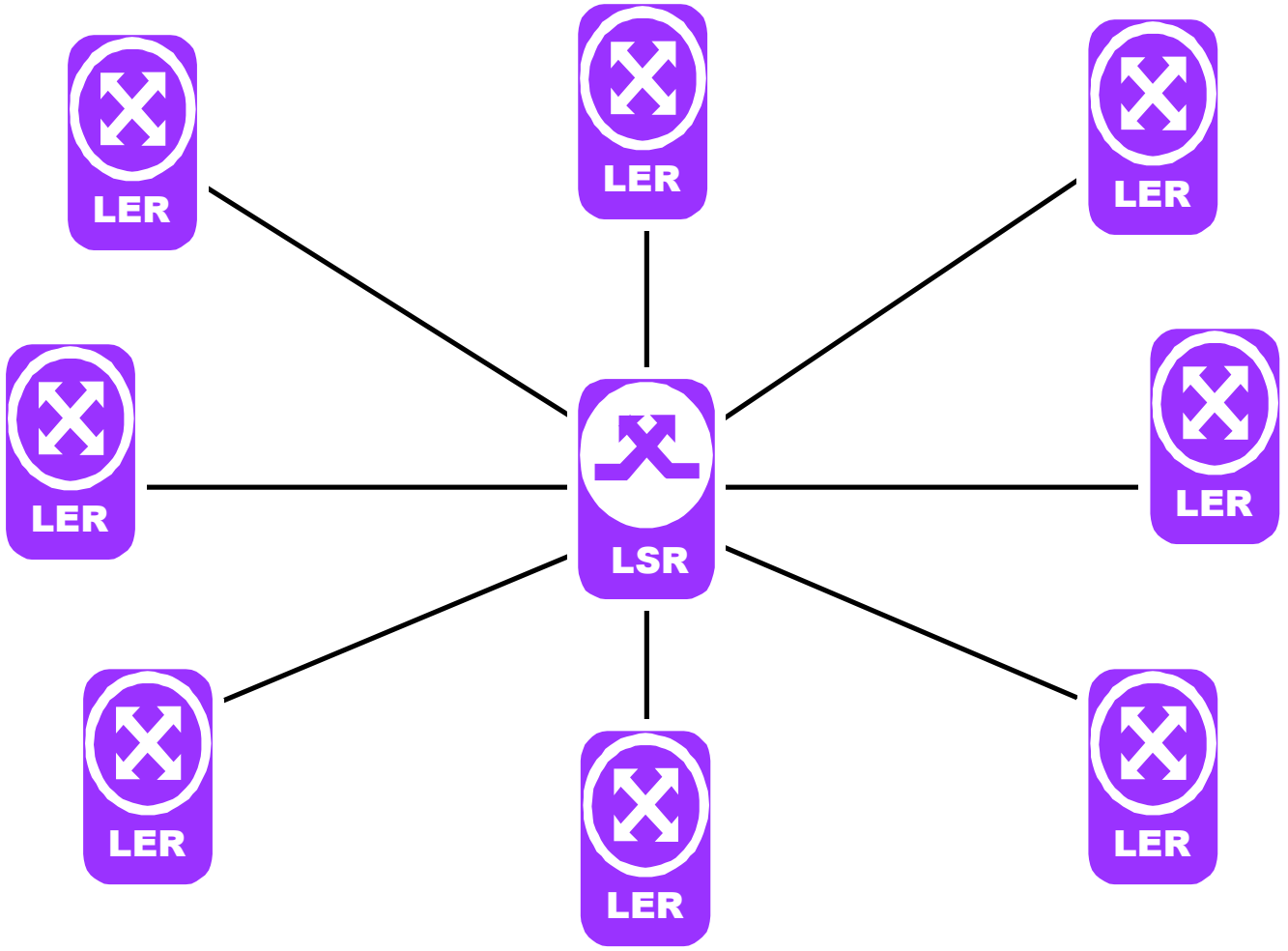
Price per OC-3/STM 1 port



Typical IP/ATM Scenario



MPLS/ATM Scenario



Initial motivation for MPLS

… was speed and cost of "switching"

- **"hop-by-hop" LDP was the "final solution"**
- **new algorithms and new ASICs changed that OC48c shipping, OC192c by the end of the year**
- **Label switching only reduces cost of the IP address lookup and forwarding decision, ie the impact on the cost of the whole system remain modest, ie. cost no issue**
- **applications for MPLS; Traffic Engineering, VPNs, support for DS/QoS, Integration of ATM, …**

… Multi Purpose Label Switching

[Yakov Rekhter]

MPOA and CSI compared to MPLS (1)

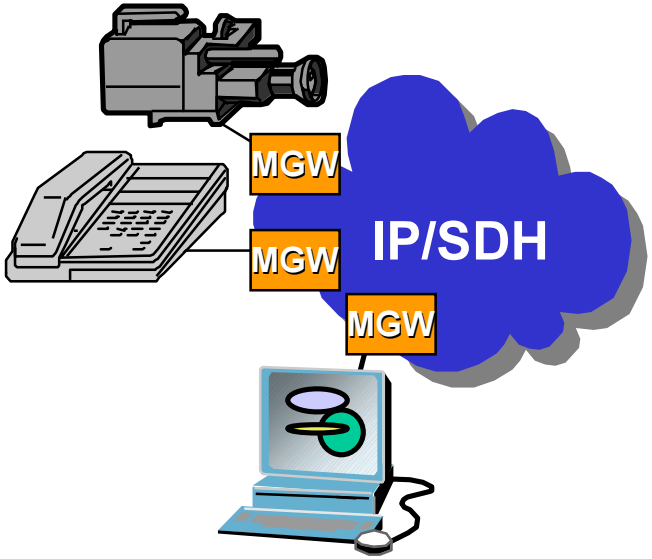
MPOA defined for private networks, CSI have proprietary additions to MPOA VPN and private addresses.	**MPLS defined for public networks.**
MPOA and CSI are ATM cut-through technologies, i.e. ATM only.	**MPLS defined for "all" infrastructures.**
Mix of L2 and L3 forwarding, set up time for shortcut required.	**Forwarding on Labels, no setup time.**

MPOA and CSI compared to MPLS (2)

Number of connections on the order of $O(N^2)$	Number of connections in the order O(N).
Connection setup capacity has to be high and fast.	Connection setup capacity moderate.
Uses standard ATM Forum signaling.	Uses the light-weight LDP protocol.
Specification by ATM Forum.	Specification by IETF.
CSI intend to hit market early.	LDP informational RFC this summer.

Why IP/SDH !?

Virtually all services are "going IP"



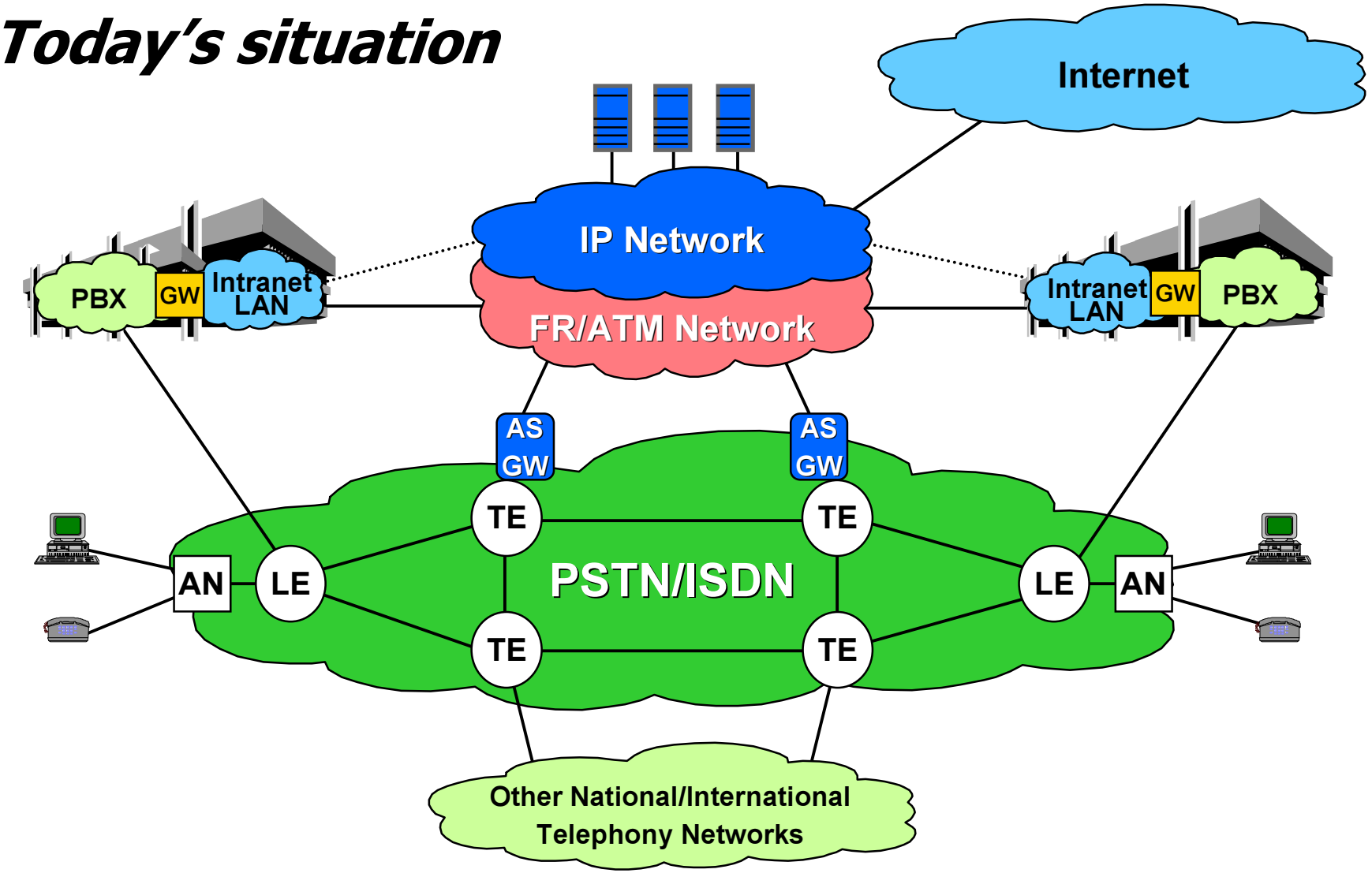
Growth in processor power makes it possible to route IP packets at wire speed.

Why pay the ATM "cell tax" and then SDH "pointer tax"?

Cost benefits:

- **equipment and operations cost savings**
- **transmission cost savings**

Today's situation



Traffic situation in backbone/tandem networks

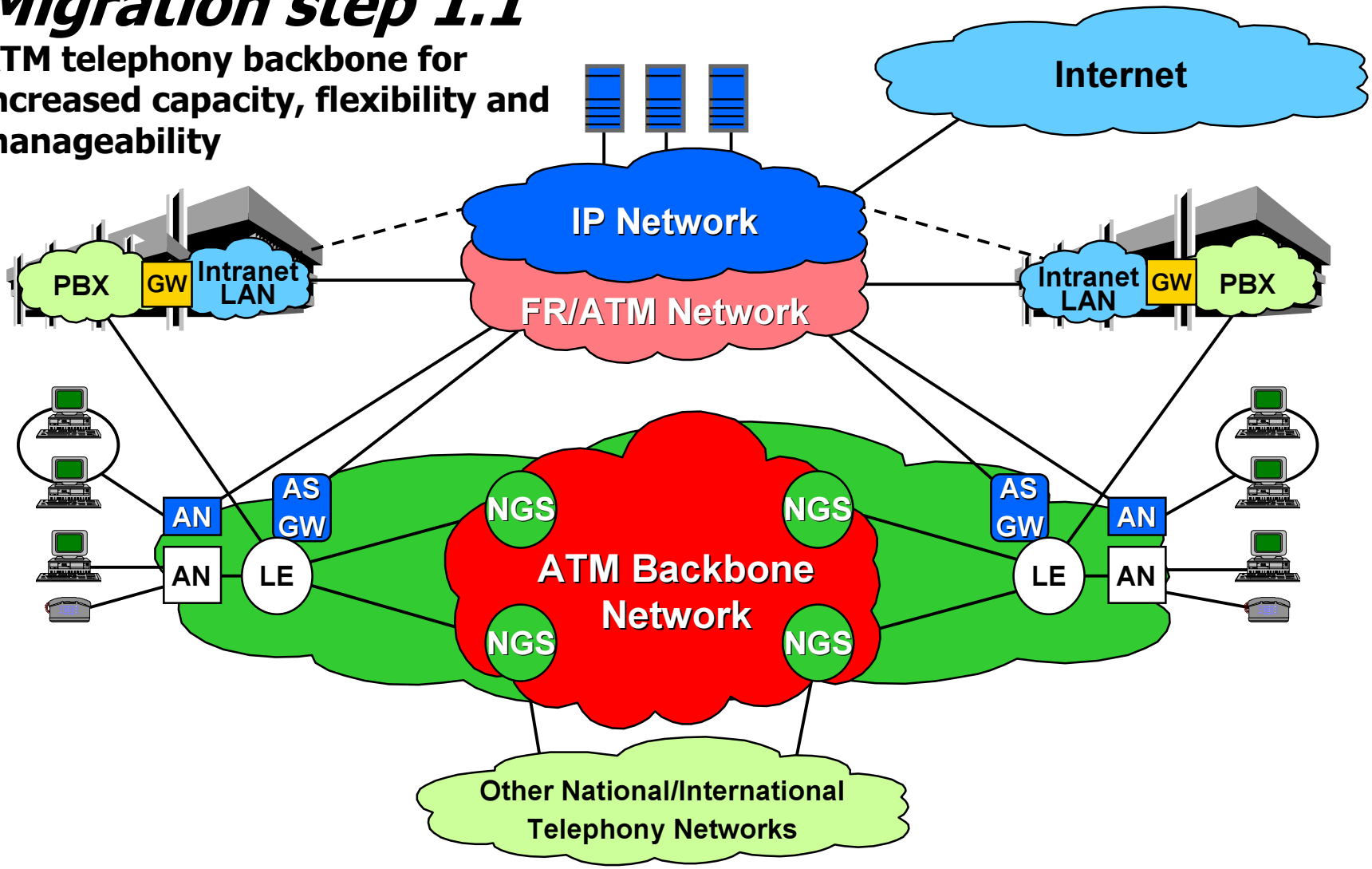
- growing internet traffic (20-25% in some networks)
- interconnect traffic
- increased traffic volume/complexity

More switching and processing capacity required

Capacity problems !

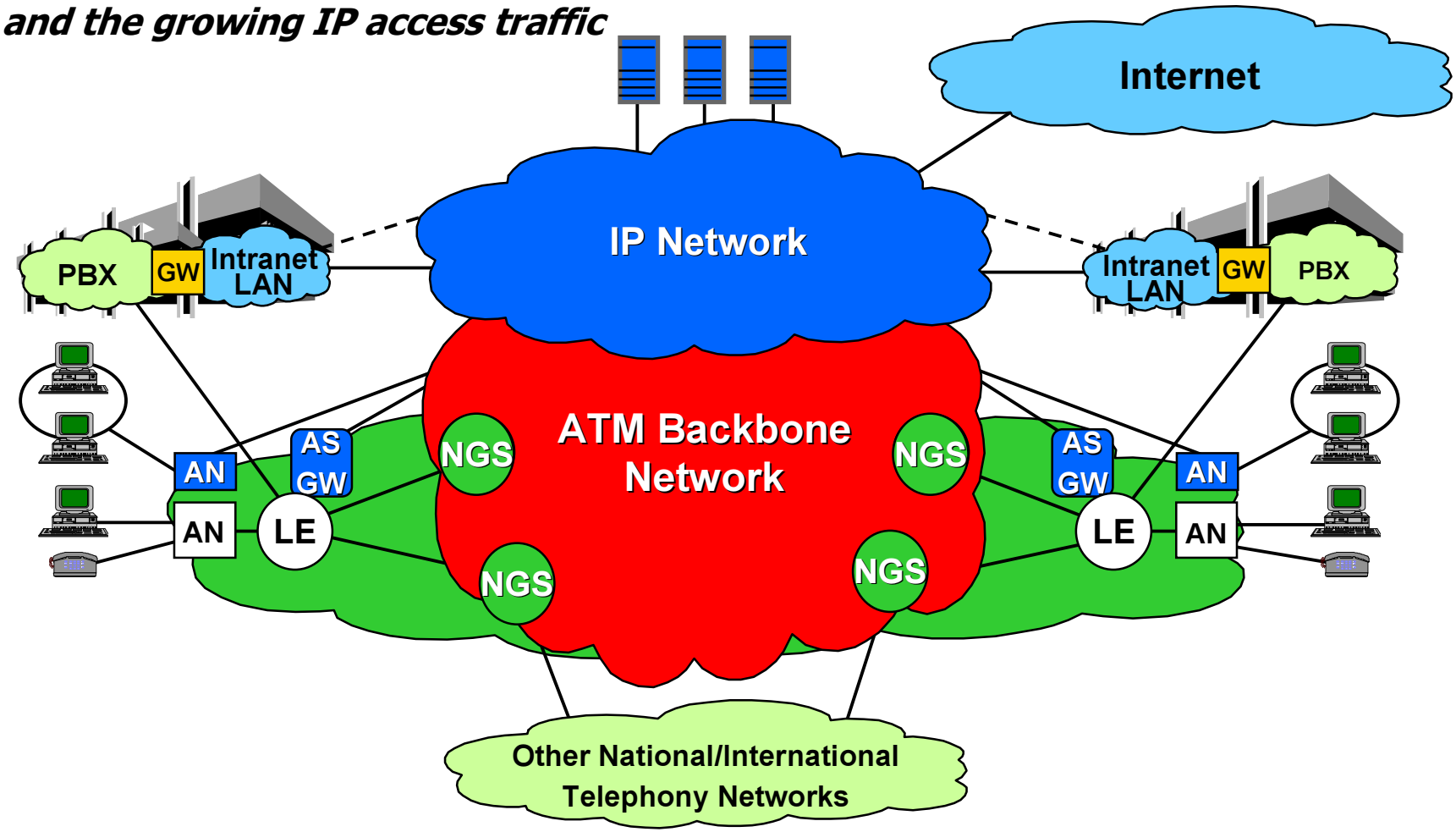
Migration step 1.1

ATM telephony backbone for increased capacity, flexibility and manageability



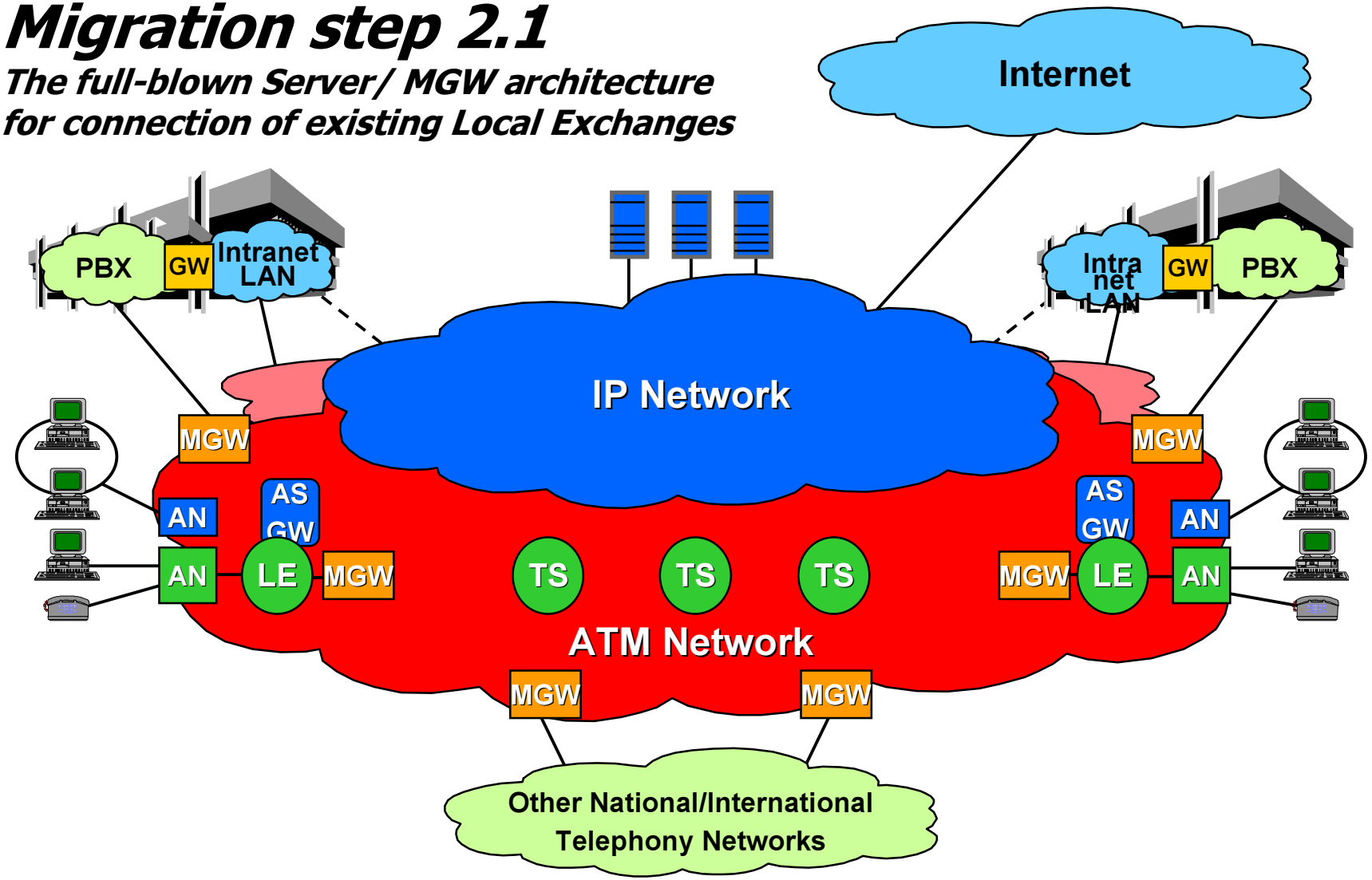
Migration step 1.2

Common ATM backbone for telephony and the growing IP access traffic



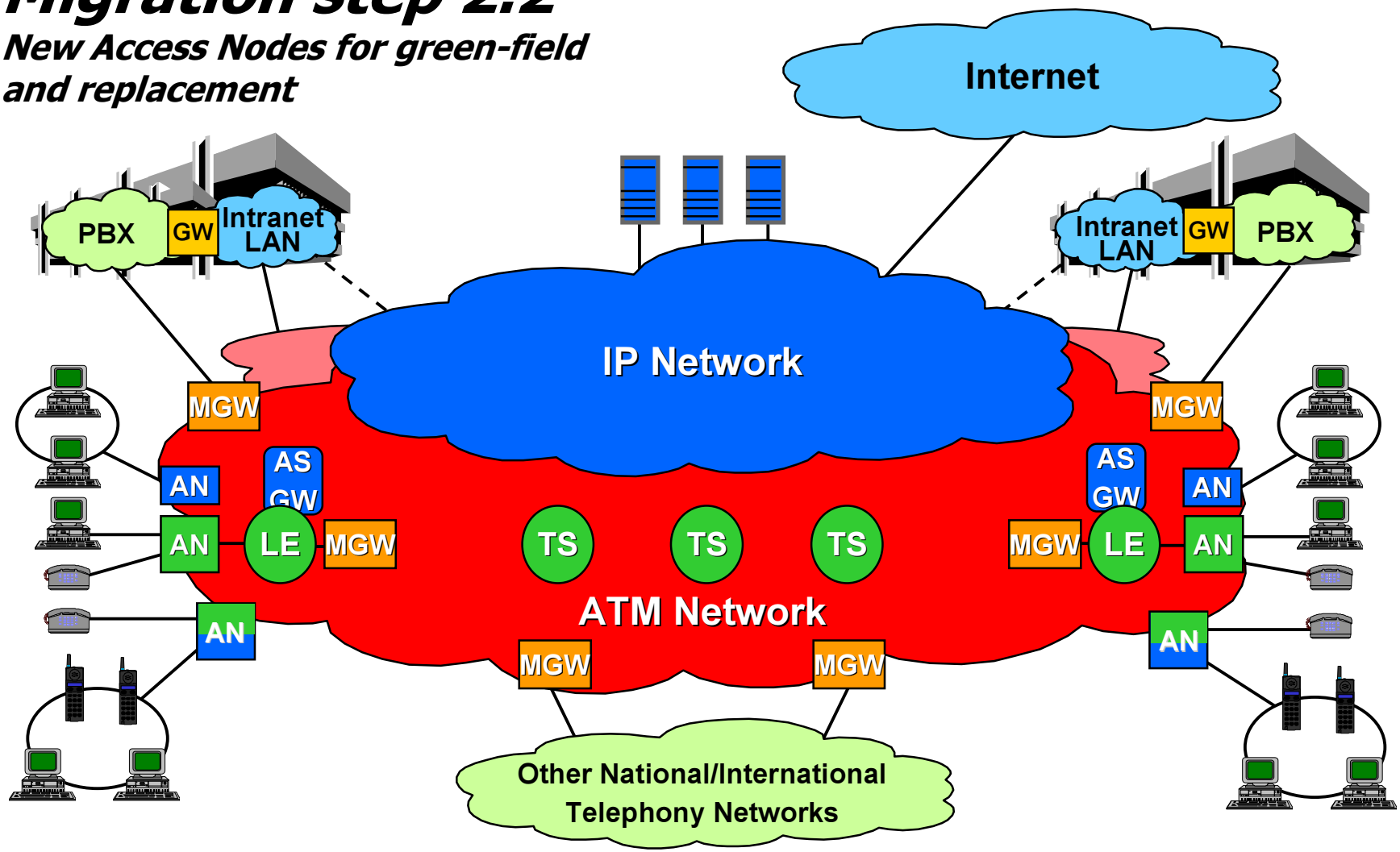
Migration step 2.1

The full-blown Server/ MGW architecture for connection of existing Local Exchanges

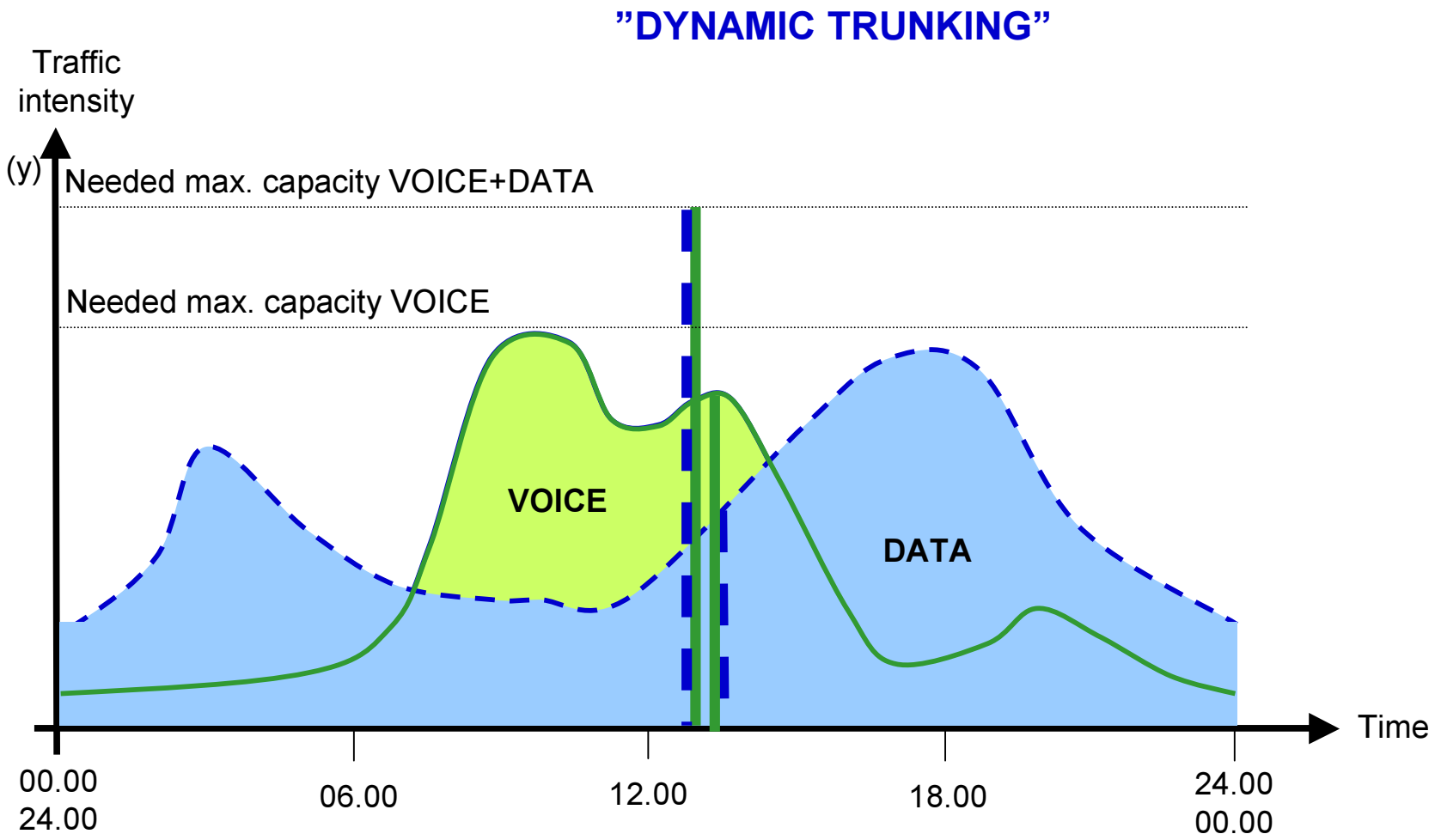


Migration step 2.2

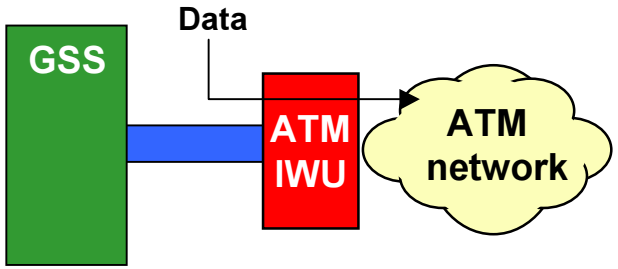
New Access Nodes for green-field and replacement



Traffic variations for voice & data traffic

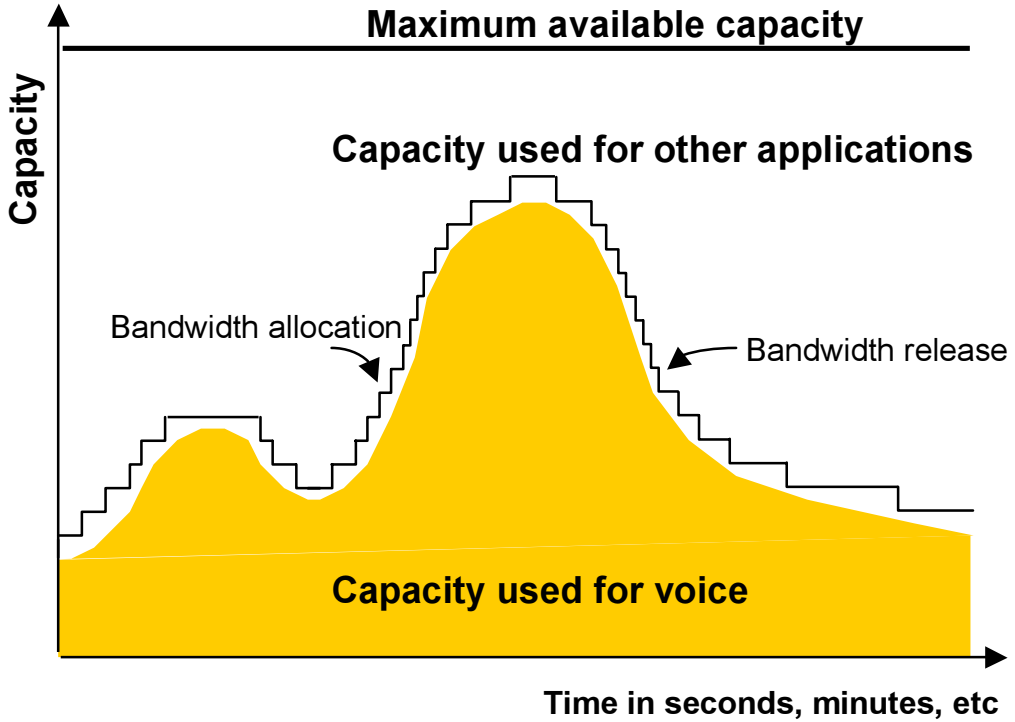


Additional revenues from other applications



- Which traffic/services ?
- Estimation of value ?

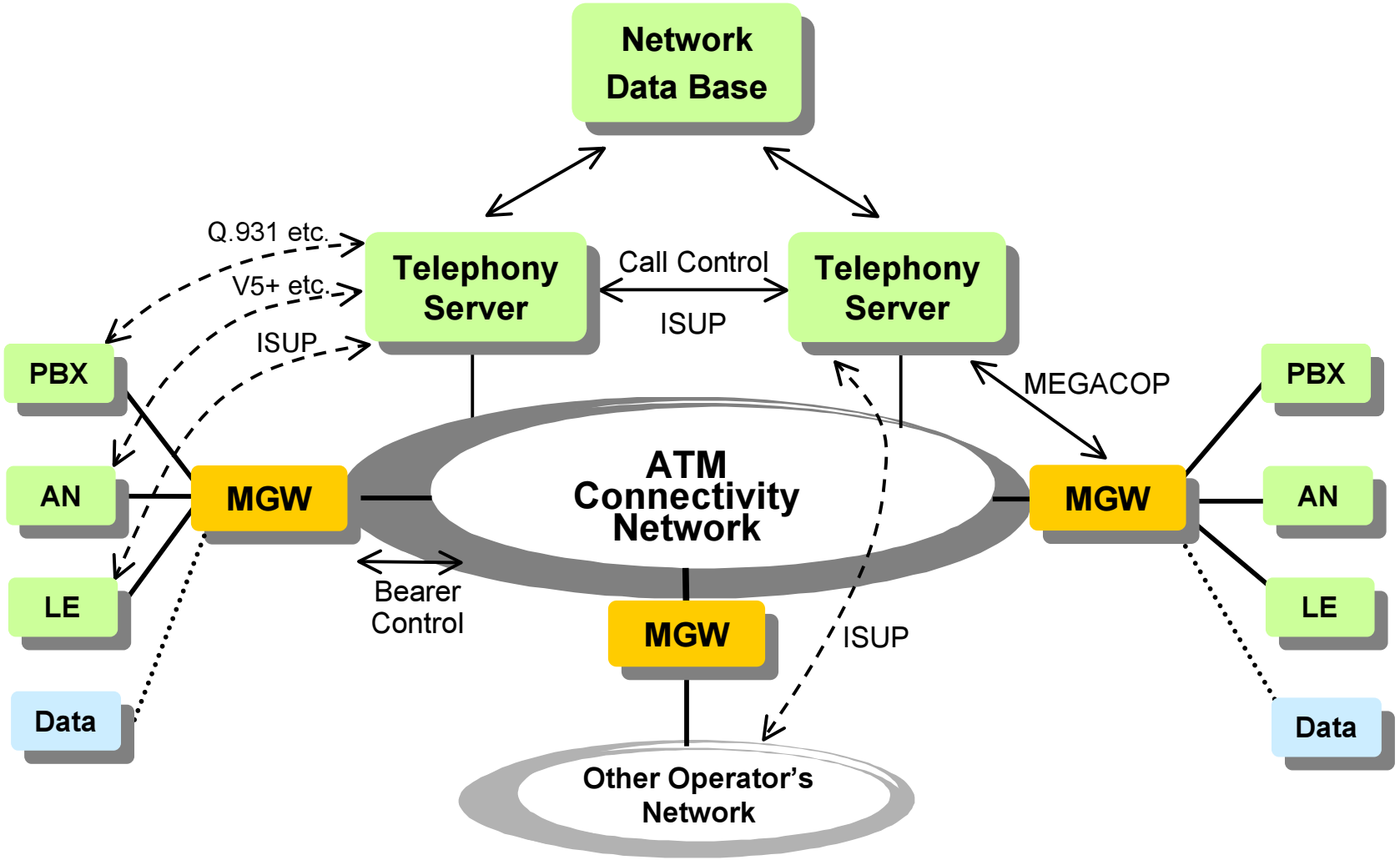
bandwidth allocation/release



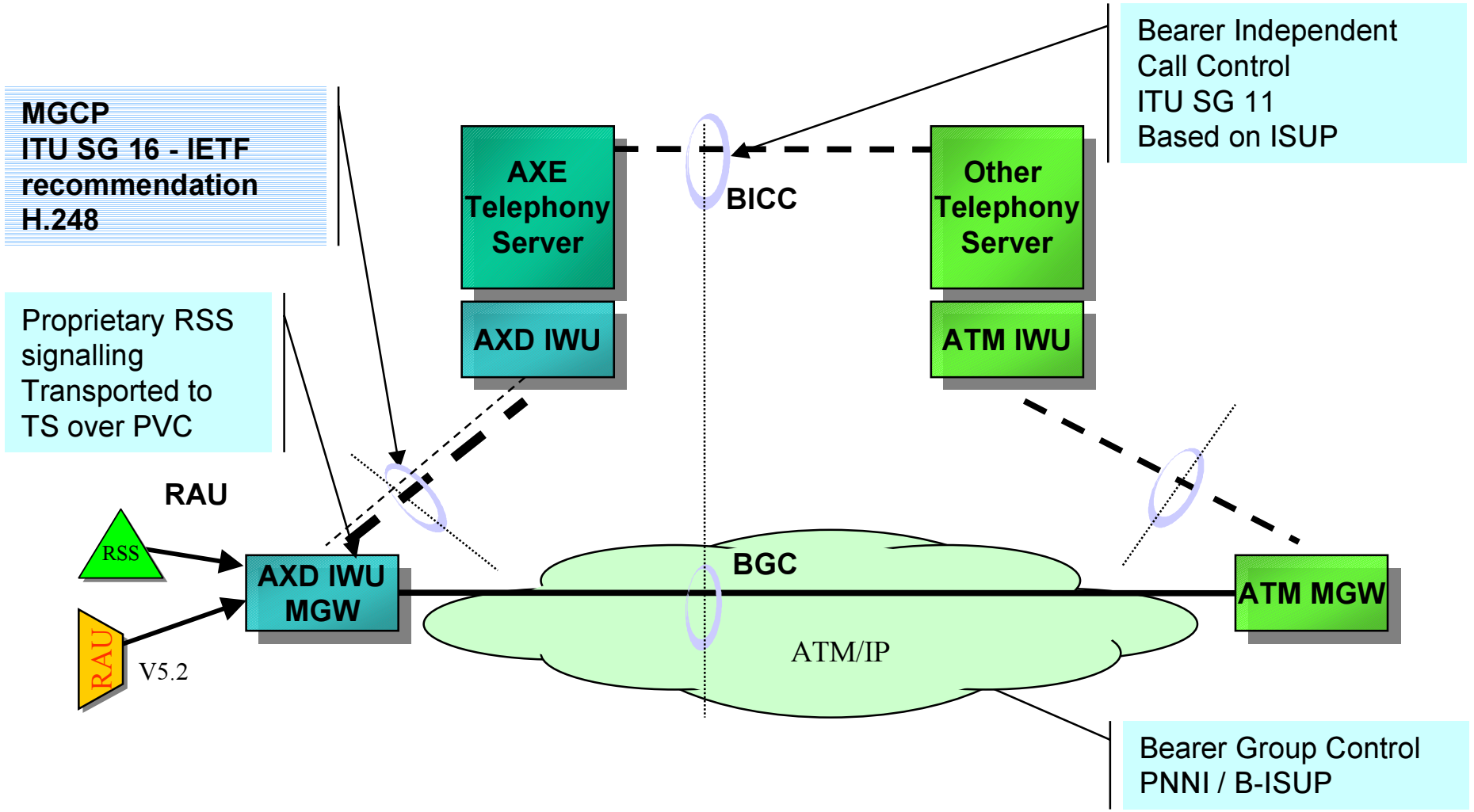
Quick response to fast growing traffic
High utilisation of allocated resources

Handling of Telephony in ATM connectivity networks

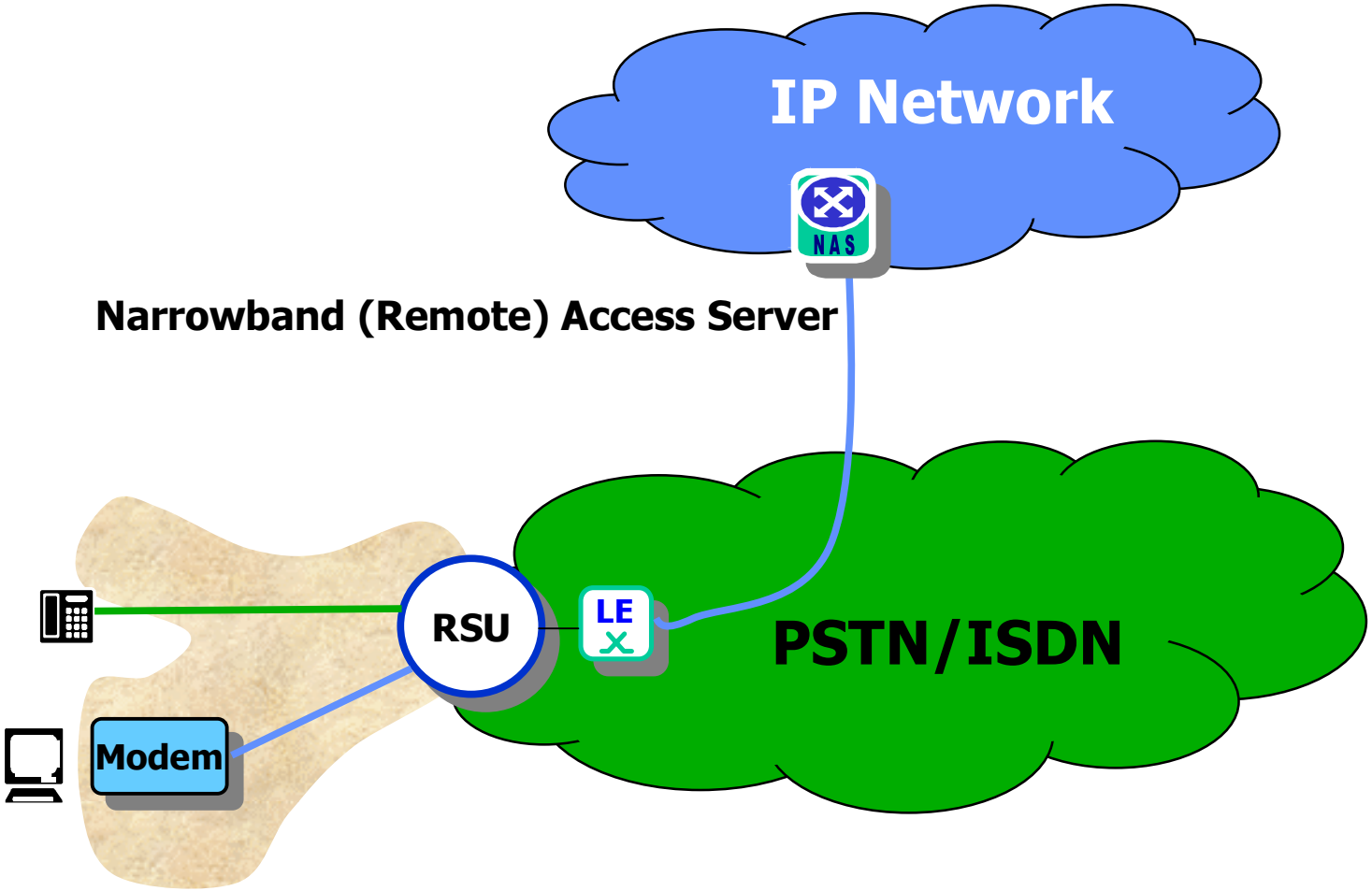
Signaling and control principles



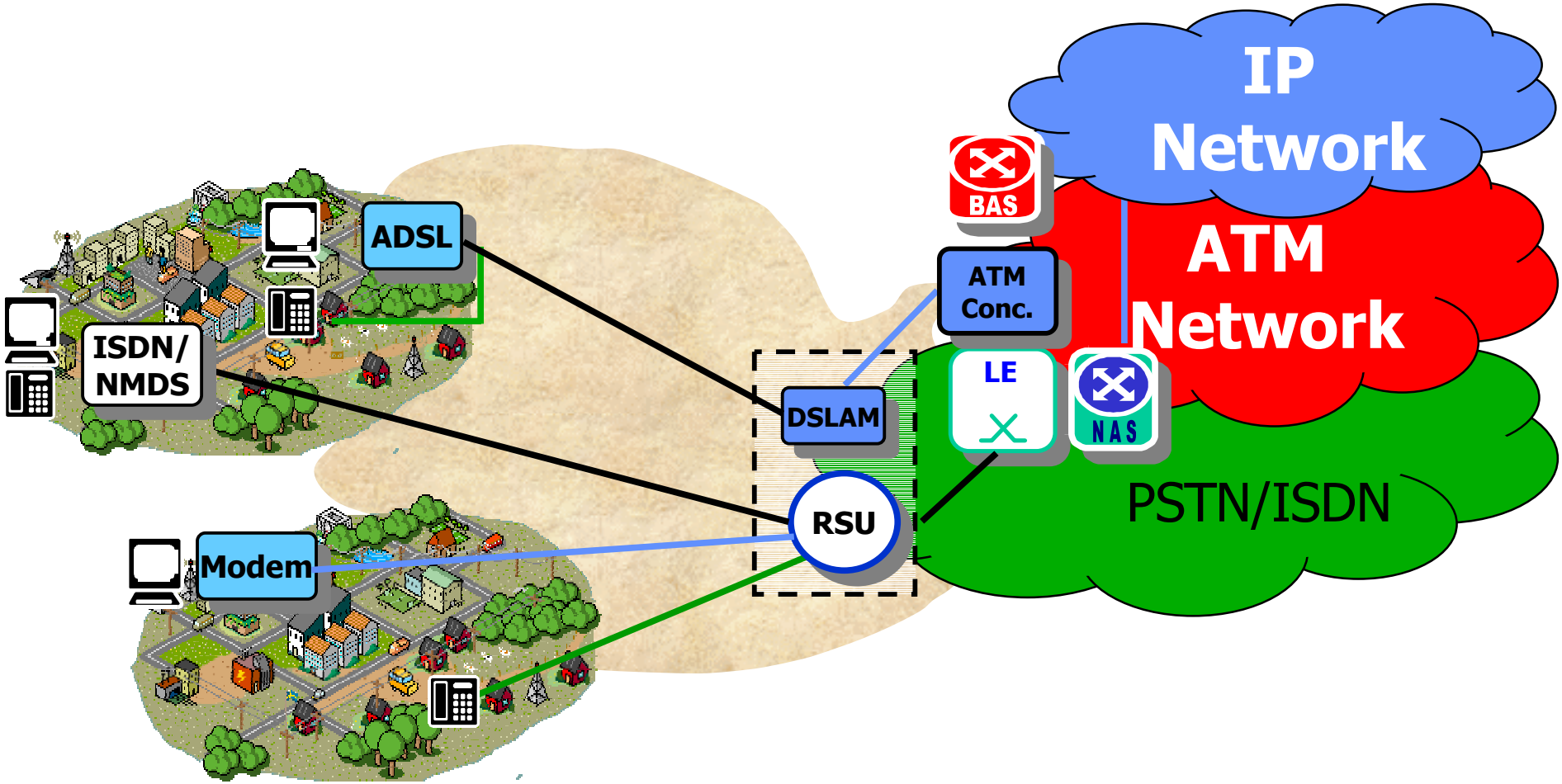
Standardisation and Interworking



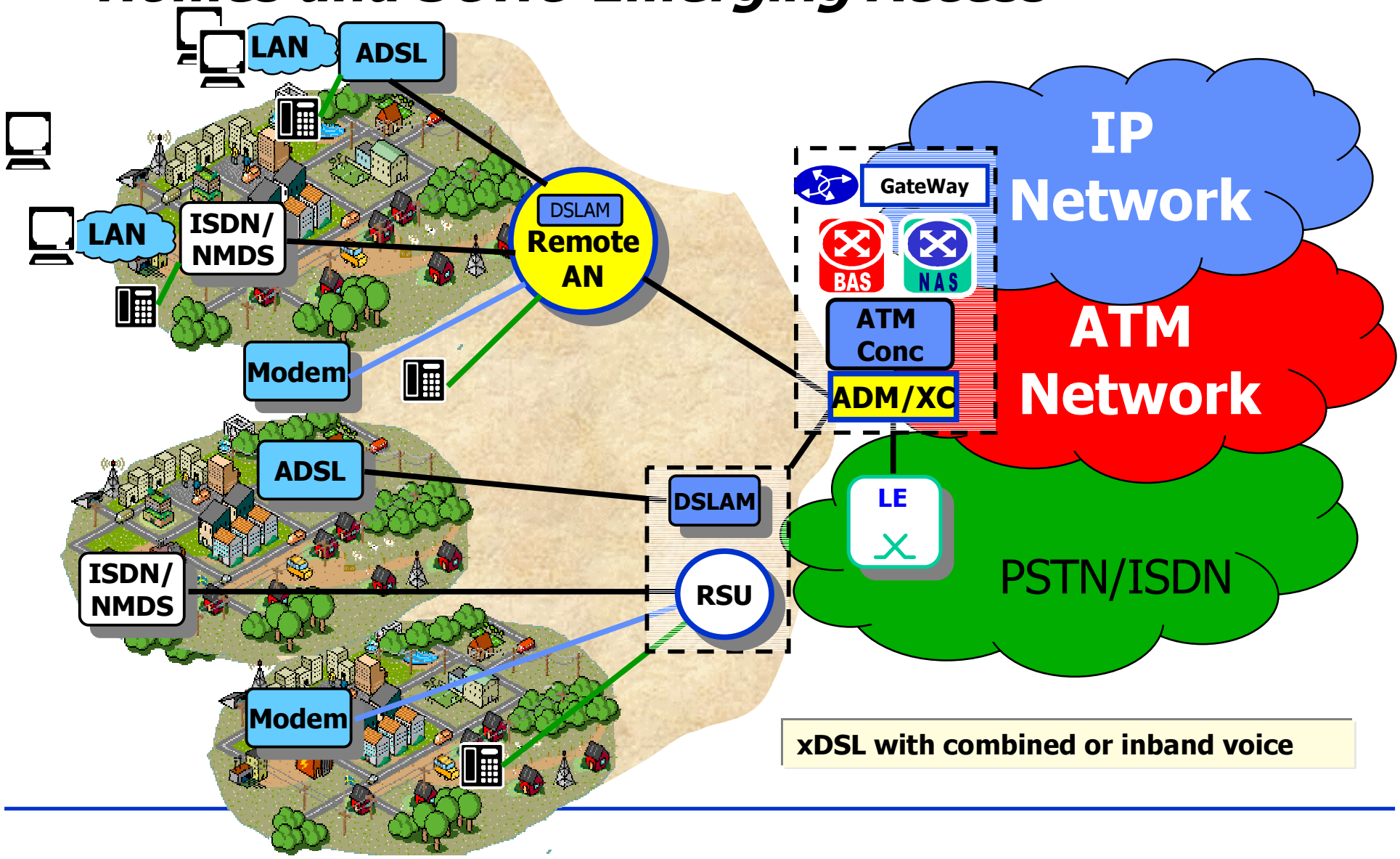
Homes and SOHO , Current Access



Homes and SOHO Emerging Access

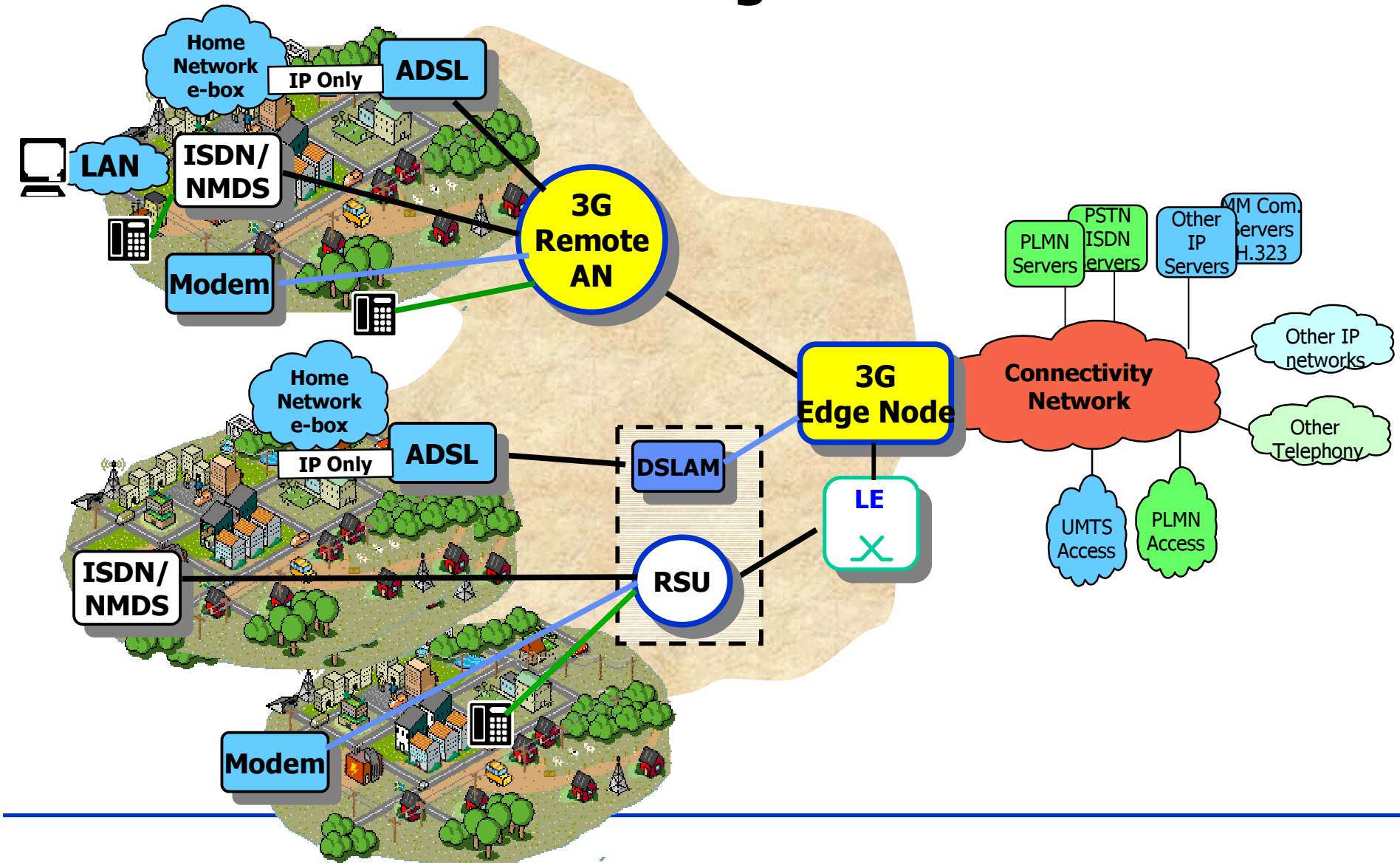


Homes and SOHO Emerging Access

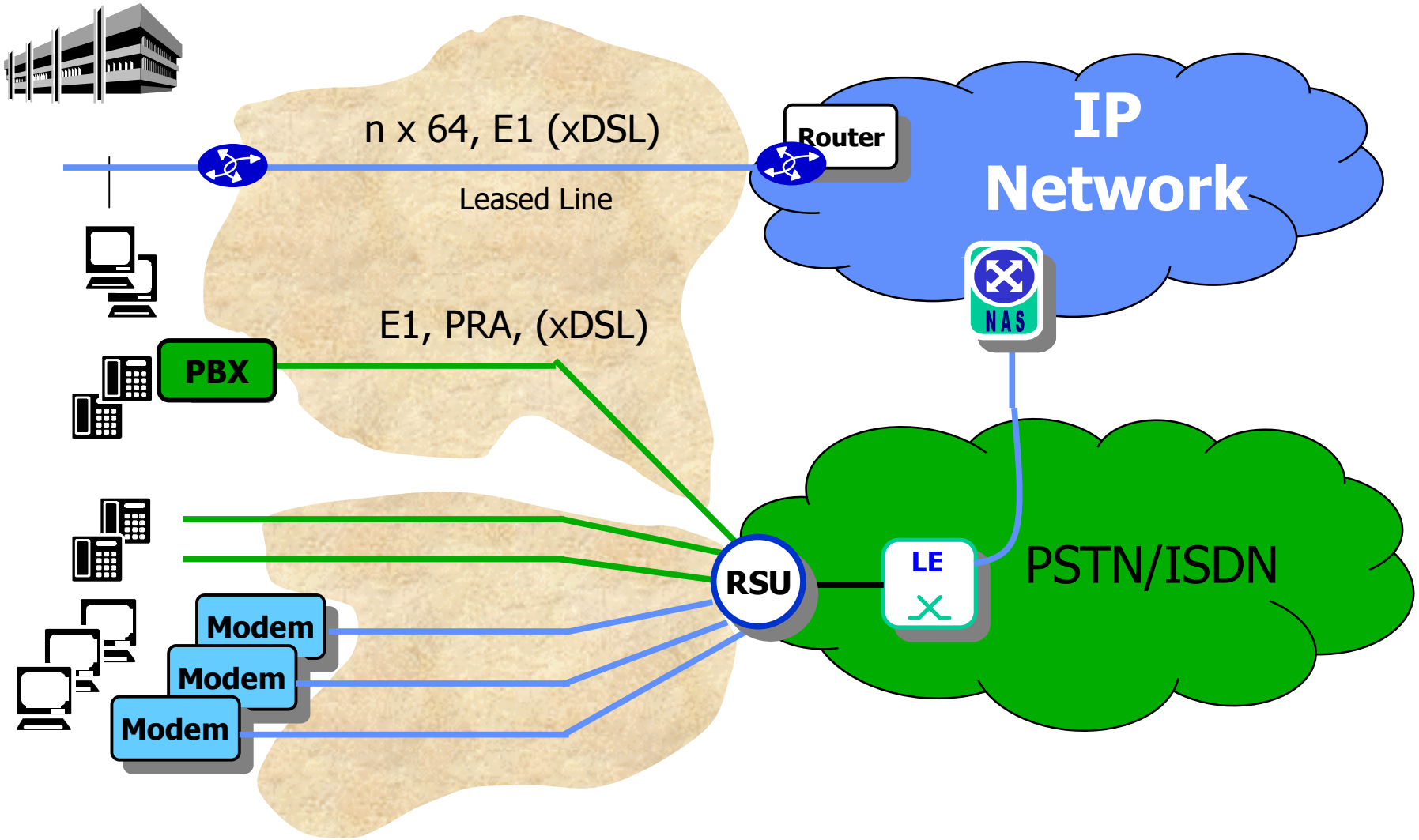


xDSL with combined or inband voice

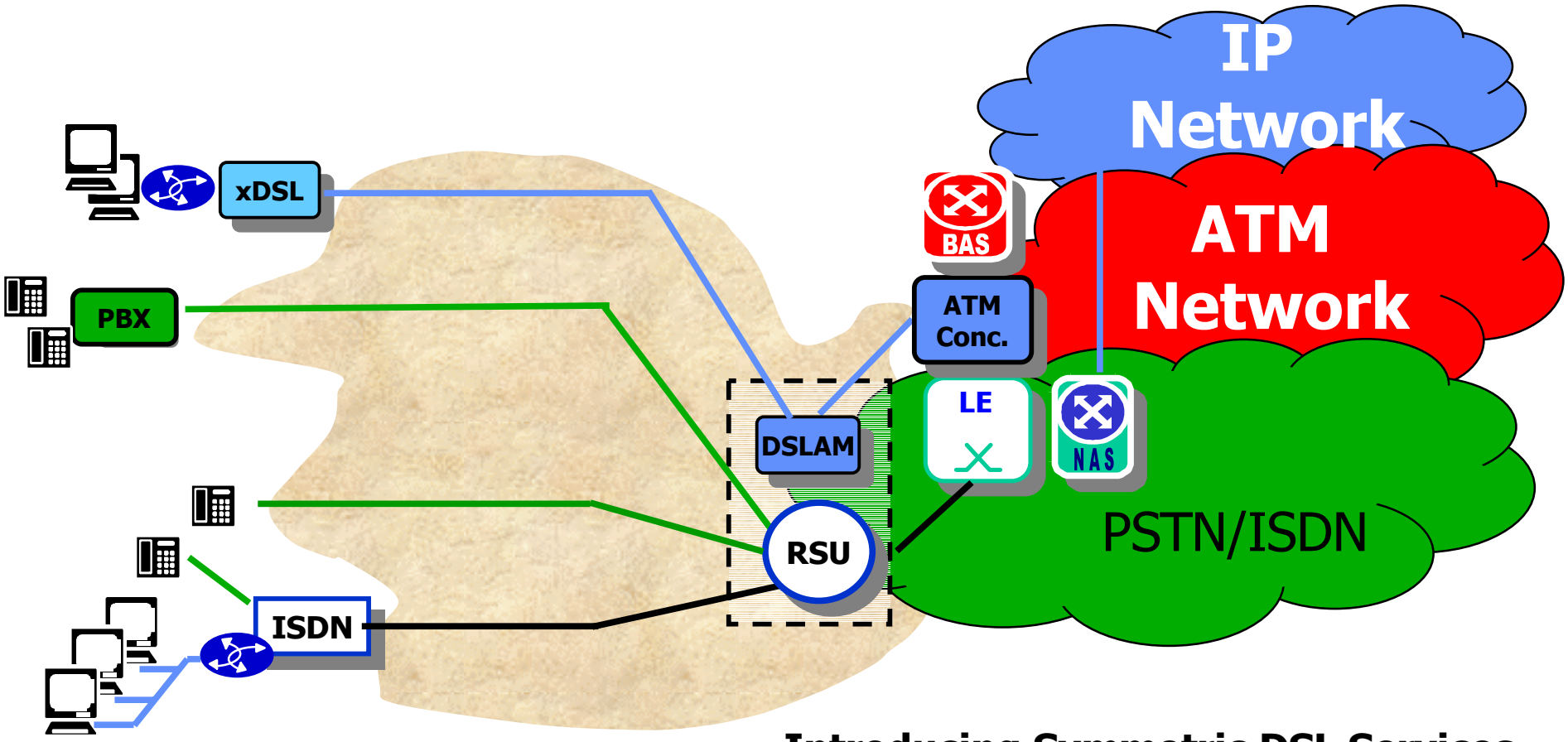
Homes and SOHO's Target Access Network



Small and Medium Enterprises Current Access

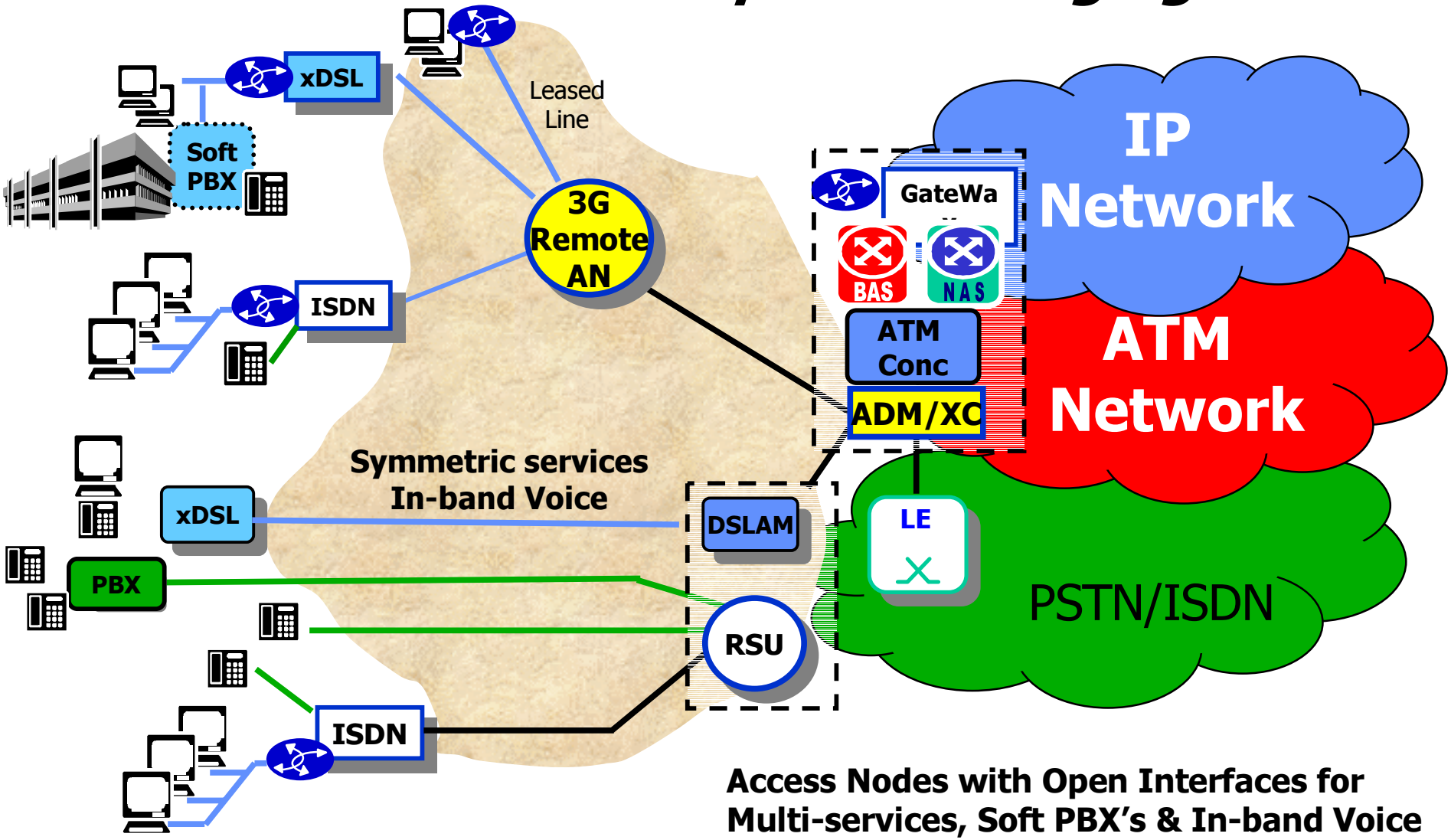


Small and Medium Enterprises Emerging Access



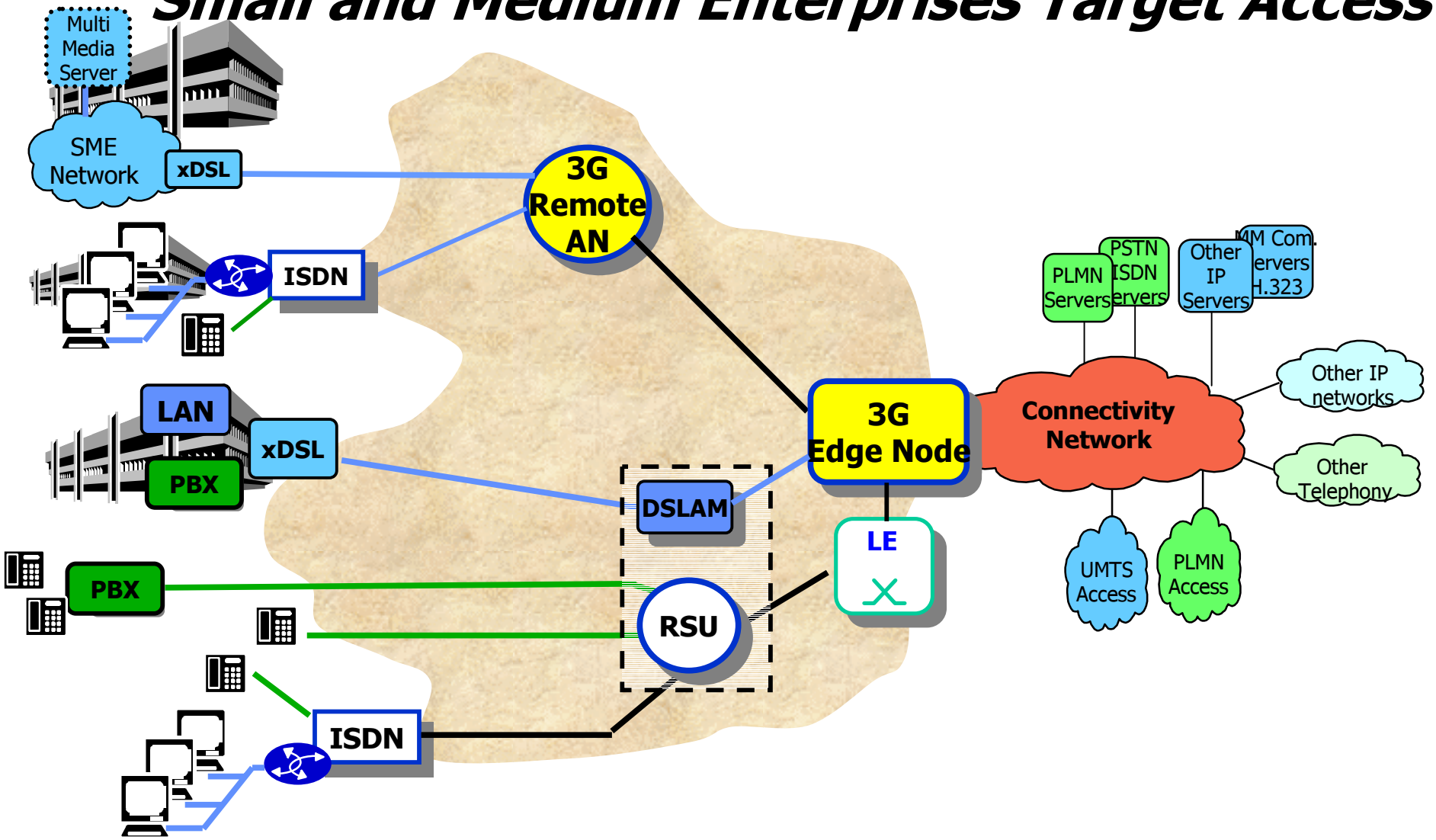
Introducing Symmetric DSL Services

Small and Medium Enterprises Emerging Access

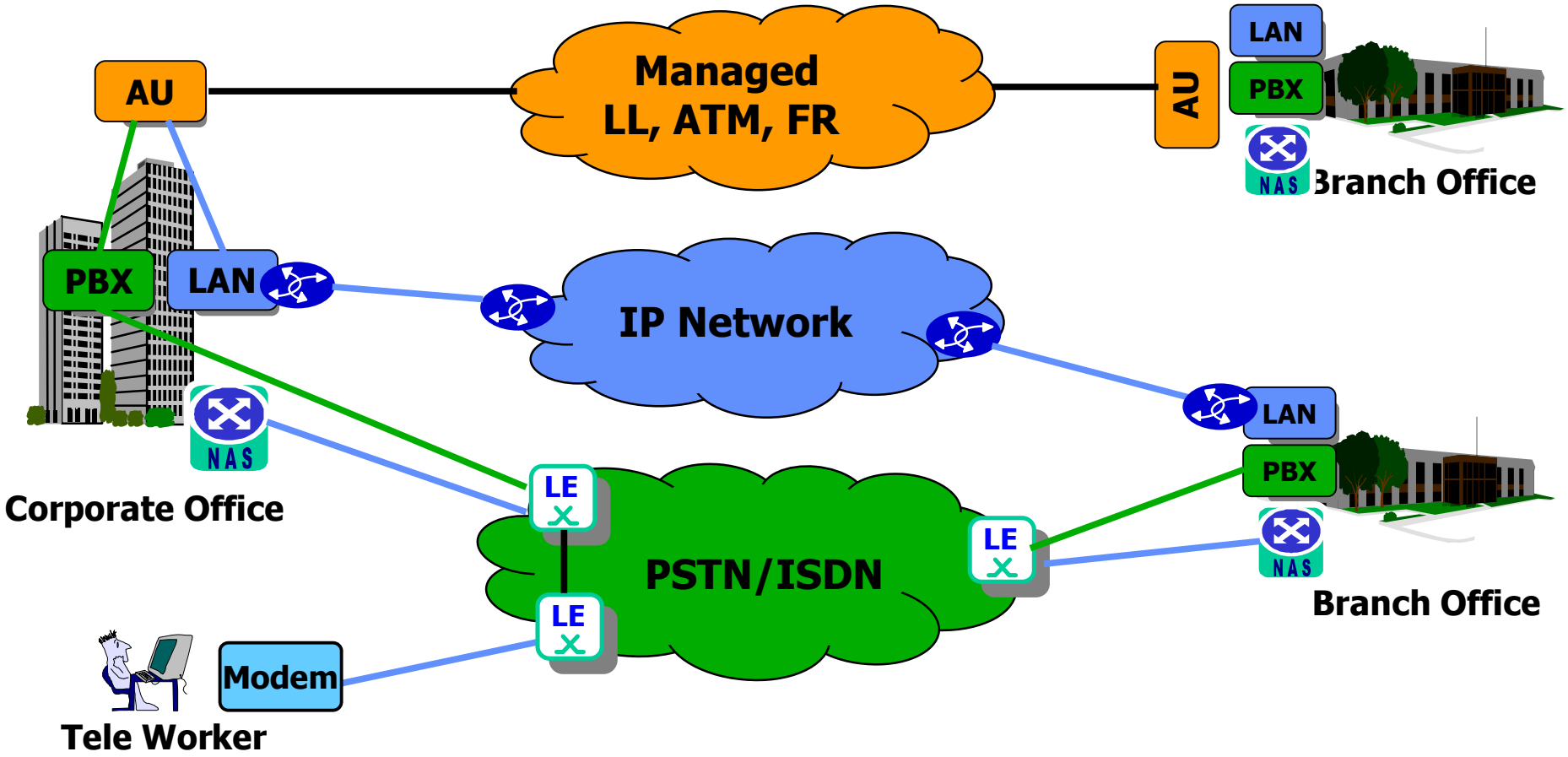


Access Nodes with Open Interfaces for Multi-services, Soft PBX's & In-band Voice

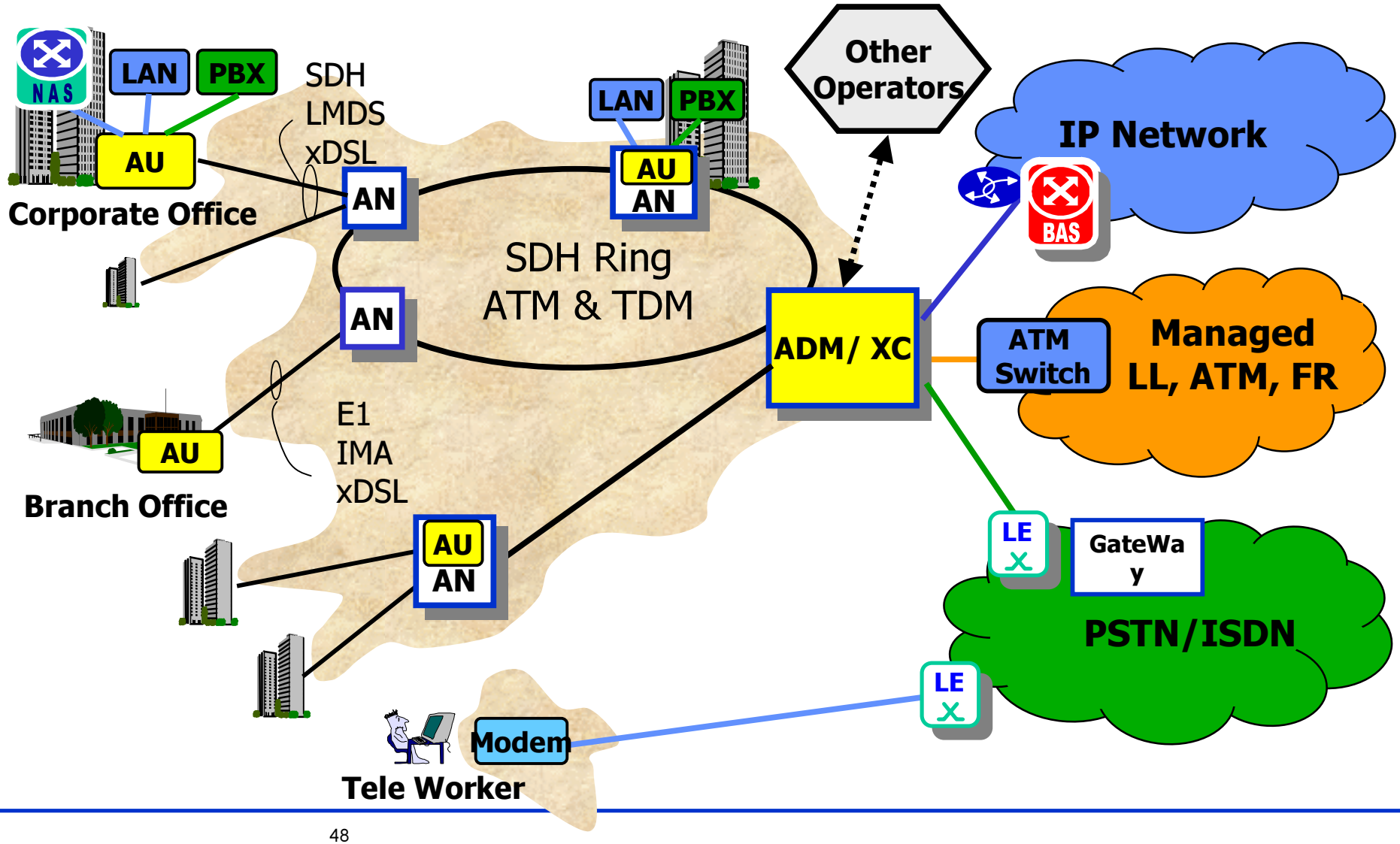
Small and Medium Enterprises Target Access



Current Large Enterprise Access to the Public Infrastructure



Emerging Large Enterprise Access Network



Large Enterprise Target Access Network