

**New architectures**  
.....  
**for very high**  
**bandwidth access**

**J. C. Point**

---

# Agenda

- **Traffic scenarios**
- **Network architecture solutions**
- **QoS**
- **Conclusion**

# **Market trends**

- **Deregulation : Operators struggling to offer multiservice (video/voice/data)**
- **Customer : demand for bandwidth will explode (from .5 Mb/s to 10+ Mb/s) : WHY?**

# Technology trends

- **Bidirectional bandwidth available**
  - Cable/ADSL offer that to the subscriber
- **Cost of bandwidth reducing in access:**
  - 40 GHz LMDS technology affordable
  - FTTH technology available
- **Bandwidth capacity exploding in backbone :**
  - WDM transport, high speed routers
- **Price of storage exponentially decreasing :**
  - VOD / local storage cost effective

# **Bandwidth demand increase**

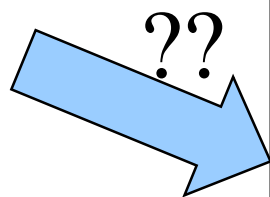
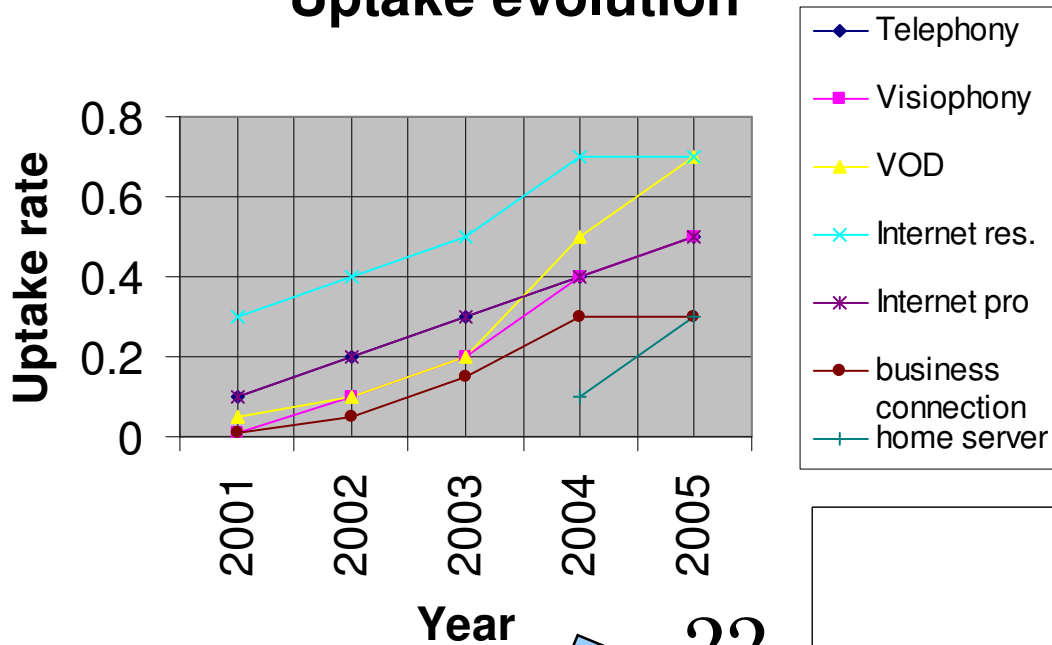
- **Customer has access to higher bit rate with Cable/DSL, and becomes bandwidth demanding**
- **Applications begin to appear :**
  - **Multicast events**
  - **“NOD/VOD” becomes available**
  - **VOD trials show positive customer reaction**
  - **Content exchange applications appearing (Napster, etc.); can extend to video**

# **conclusion**

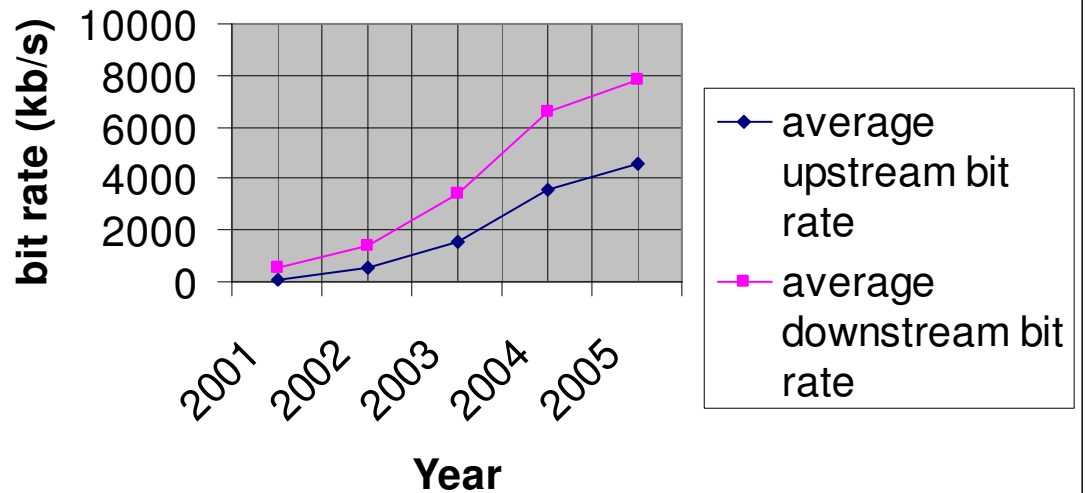
- **Technology is ready**
- **Applications are there**
- **Customer has an enthusiastic reaction**

# Scenario example

## Uptake evolution



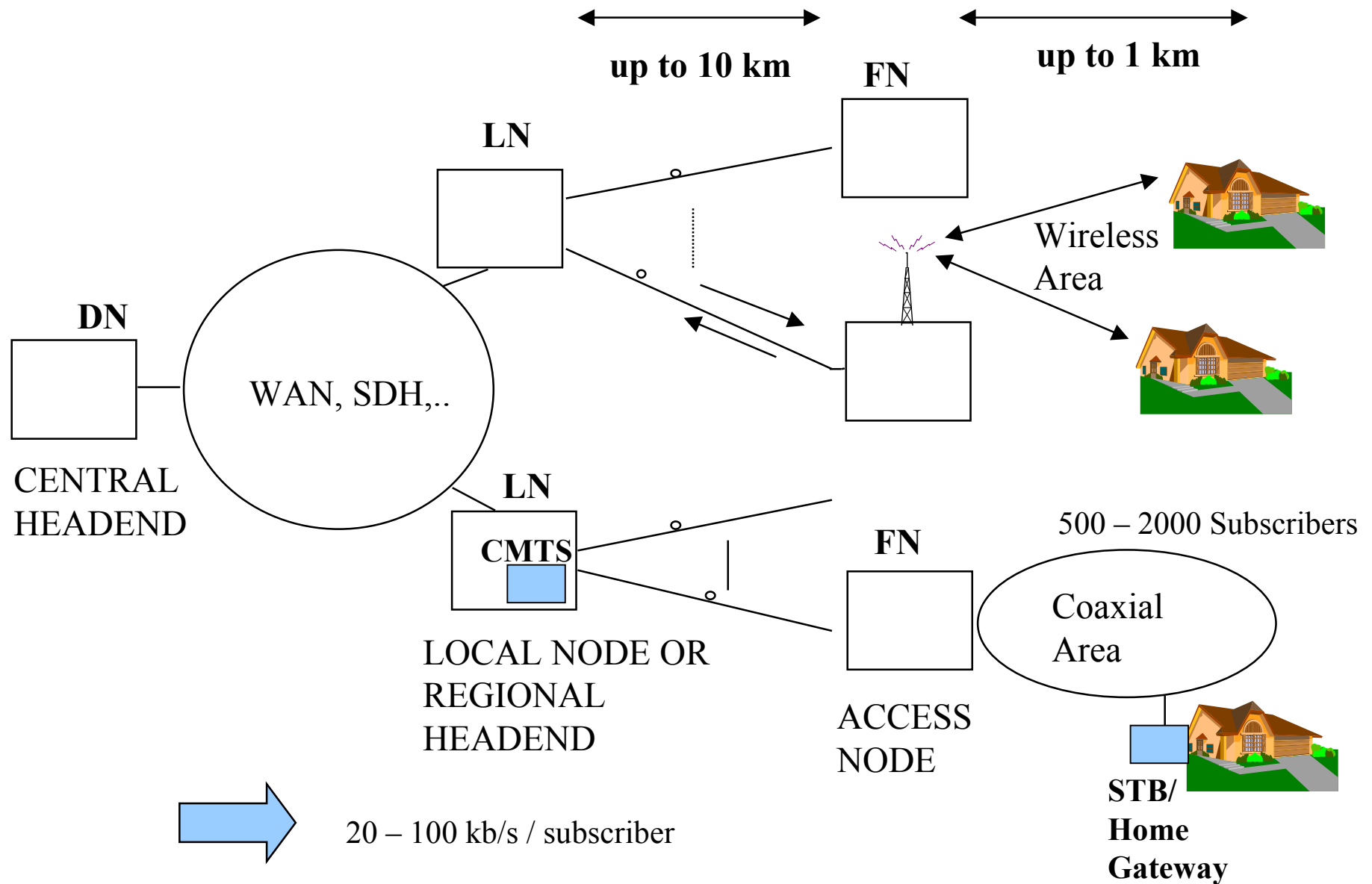
## Average bit rate per sub.



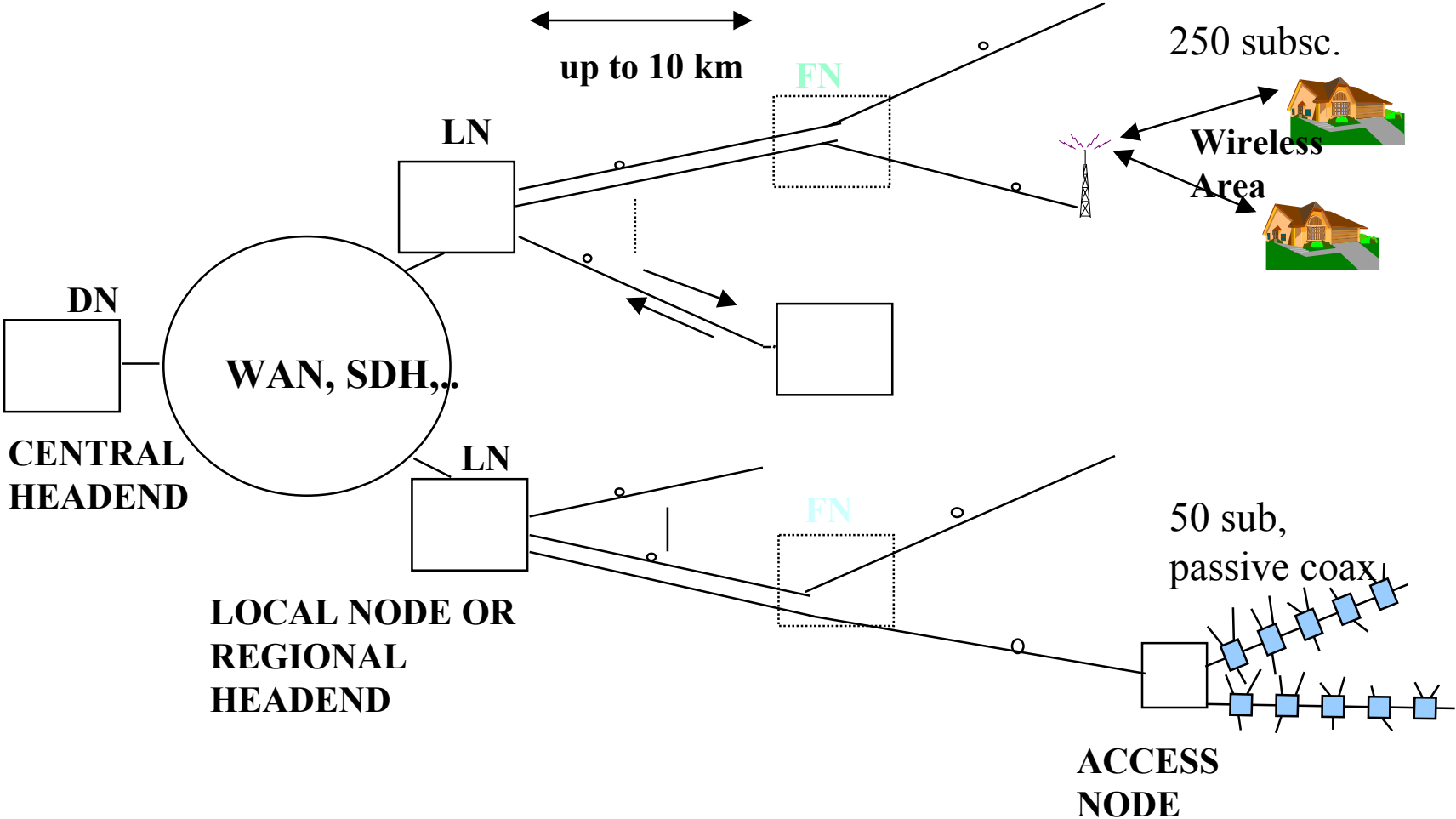
# Agenda

- **Traffic scenarios**
- **Network architecture solutions**
- **QoS**
- **Conclusion**

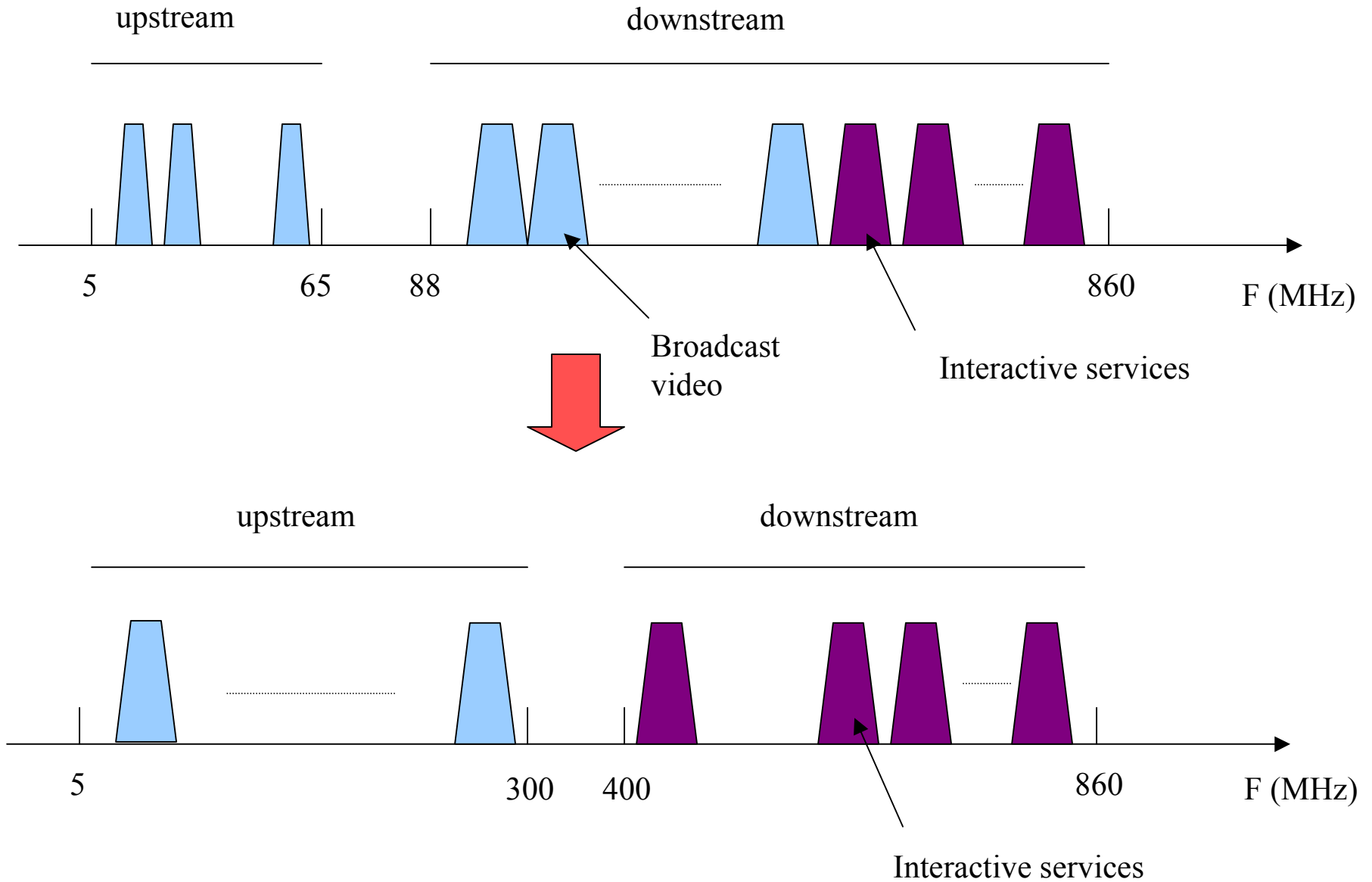
# Network architecture



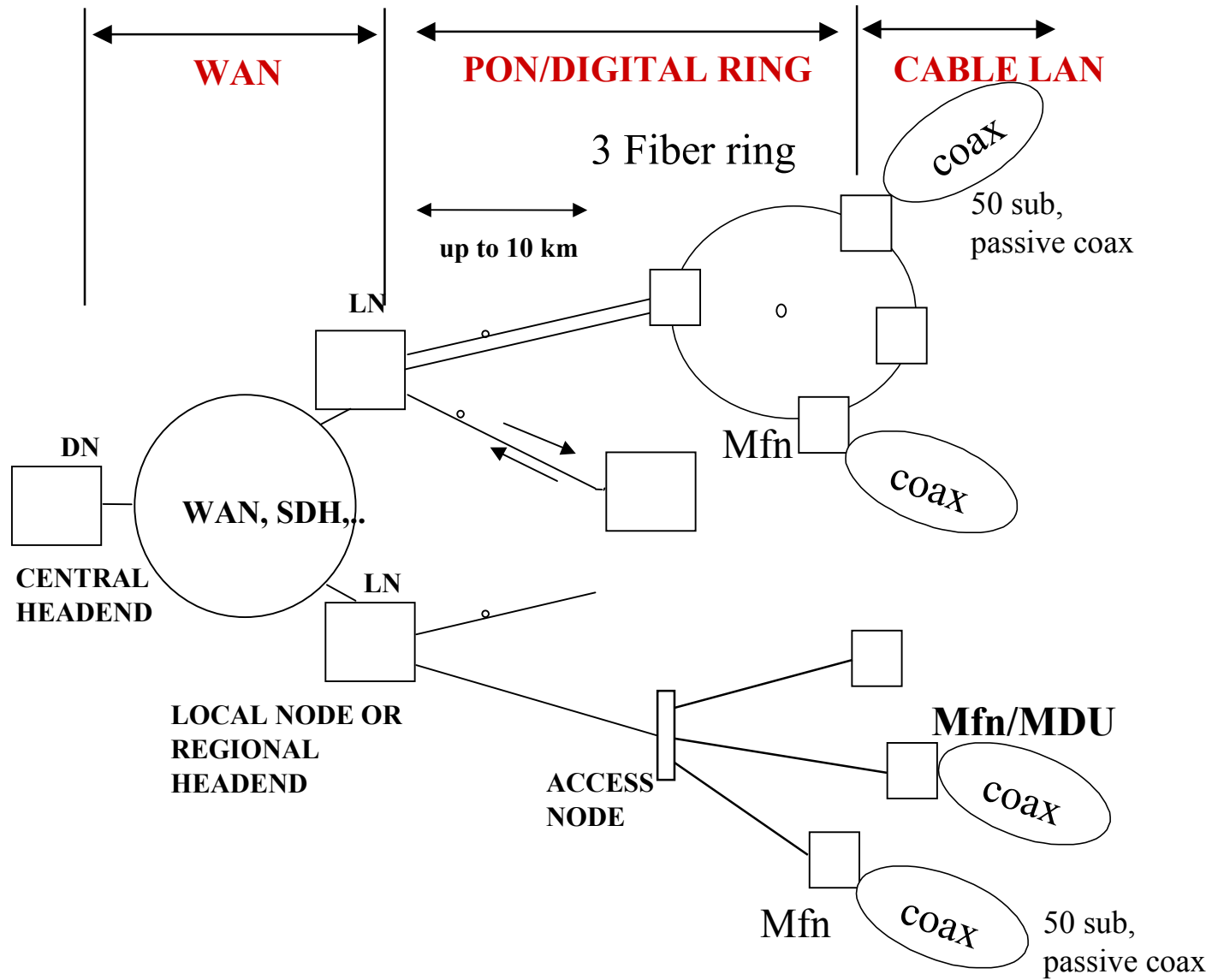
# Evolution for 2Mb/s +



# Spectrum allocation evol.



# Mini Fiber Node



# MfN vs Classical HFC

- **Cost / Scalability**
- **Digitisation of transport network**
- **Management simplification**
- **Can support up to 20 Mbps per user (coaxial cells of 30-50 subscribers)**
  
- **Doesn't support legacy system**
- **Change in system paradigm (broadcast-unicast to multicast-unicast)**

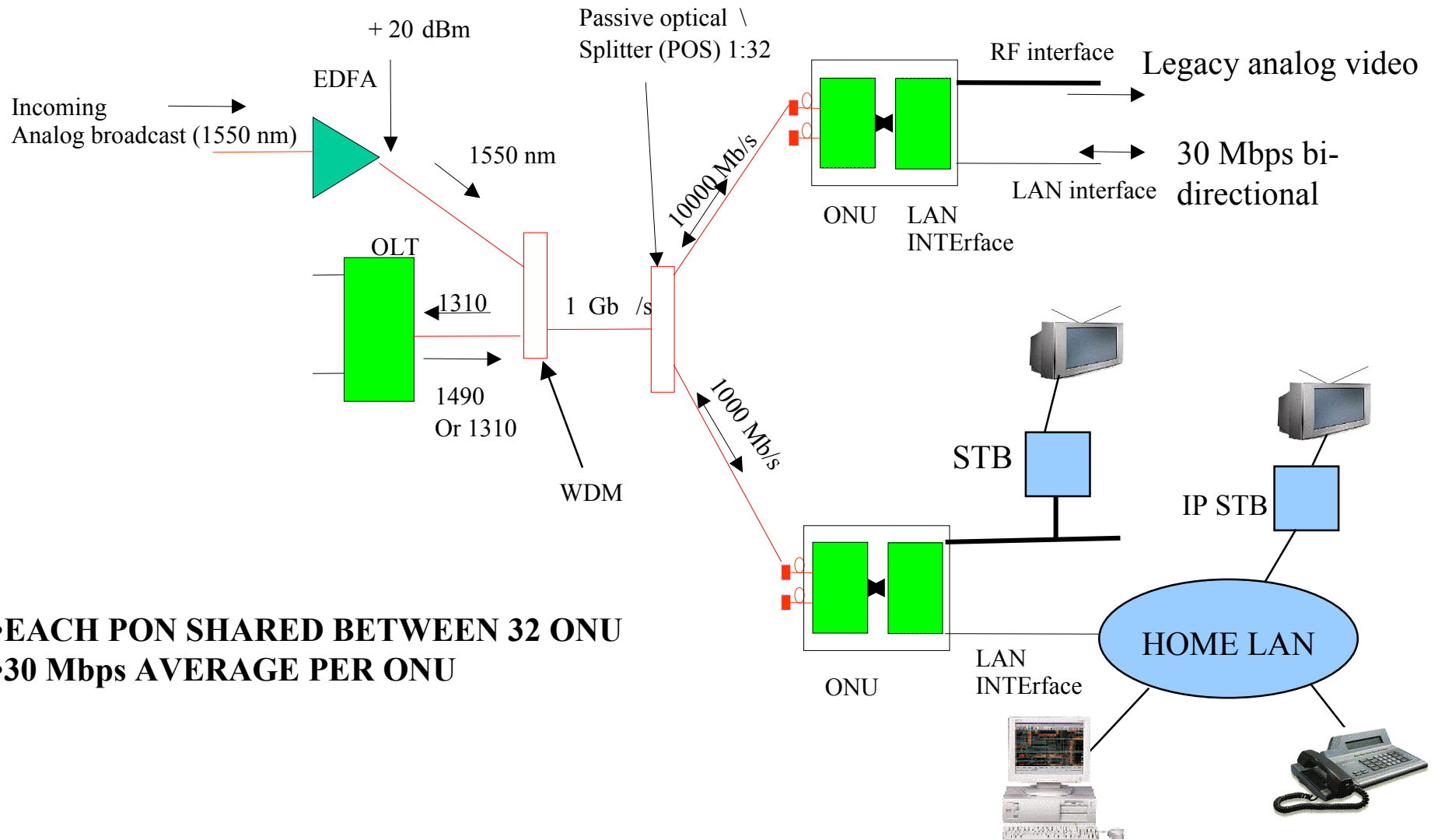
# **Network availability for cable telephony**

# **Network availability for cable telephony**

## **Second step : shared fiber**

- **Traffic model evolves towards 30 Mbps+ (1 Gbps peak) per subscriber**
- **New operators don't want to upgrade fiber transport**
- **Mso / VDSL Telcos don't want to upgrade fiber distribution**
- **Shared PON (passive optical network) is the solution**

# Block diagram



- **EACH PON SHARED BETWEEN 32 ONU**
- **30 Mbps AVERAGE PER ONU**

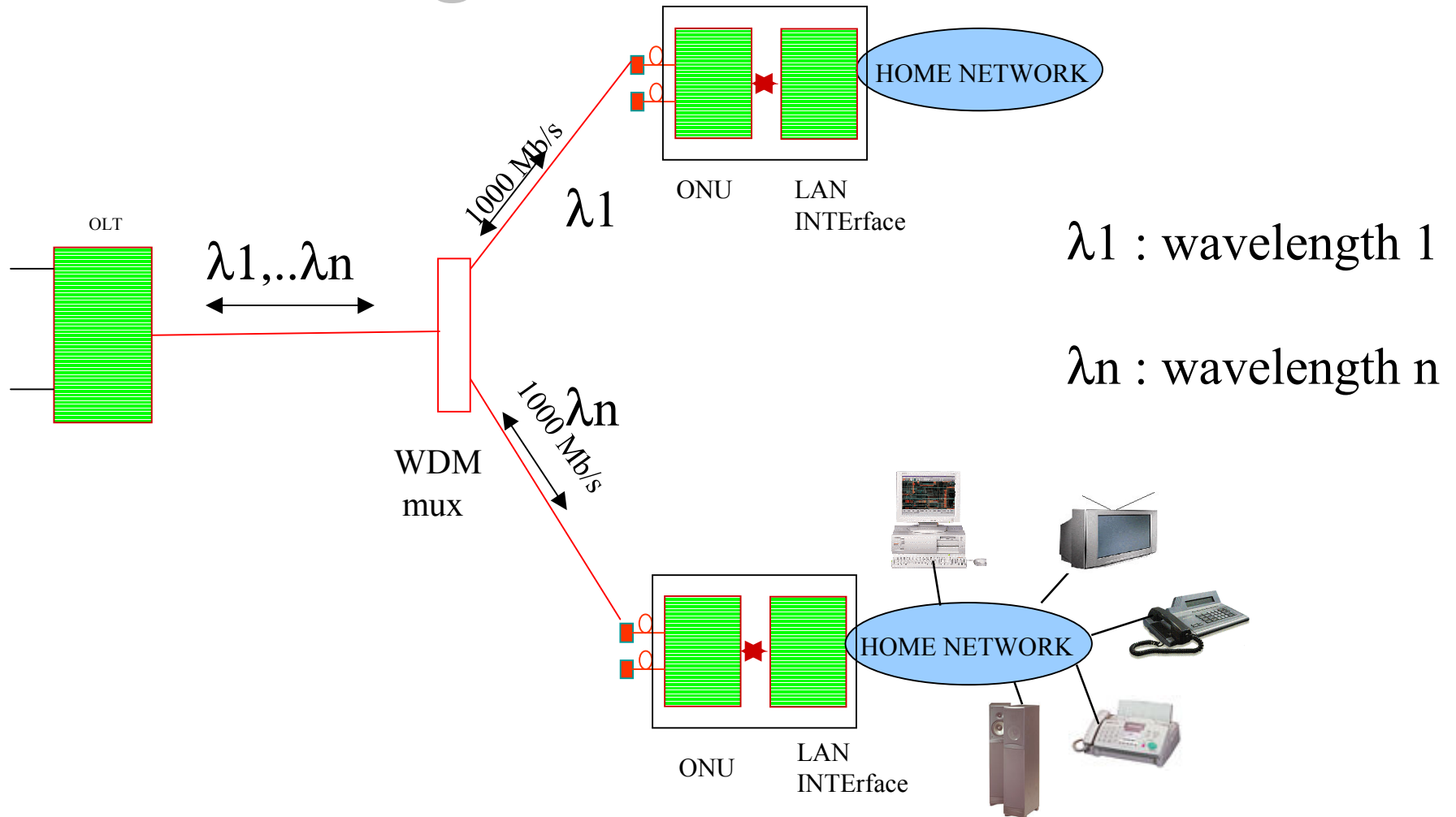
# **Shared PON feature**

- **Shared bandwidth both in upstream and downstream between 32 users**
- **30 Mbps+ average, 1 Gbps peak**
- **QoS support**
- **Security layer to support privacy**
- **Legacy video support at 1550 nm**

# Ultimate step : Gbps to the user?

- **Video Napster : download time :**
  - **CM (1 Mbps) : 6 hours**
  - **Fiber PON : 18 min**
  - **Gbps PON : 20 sec..**
- **Based on Point to point architecture :**
  - **Short term (Point to Point) requires major plant upgrade**
  - **Medium term (Point to Multipoint WDM) requires technology price decrease**

# Block diagram WDM access



- N TIMES 1 GBPS POINT TO POINT LINKS AT DIFFERENT WAVELENGTH
- ADVANTAGE : SEAMLESS EVOLUTION FROM PON

# Hurdles for FTTH

- **Cost :**
  - Still expensive, but comparable to HFC
- **Legacy :**
  - Normally multicast/singlecast model, but analog video support at 1550 nm
- **Technology :**
  - PON realisable NOW
  - WDM cost issue, but migration possible later

# COMPARISON TABLE

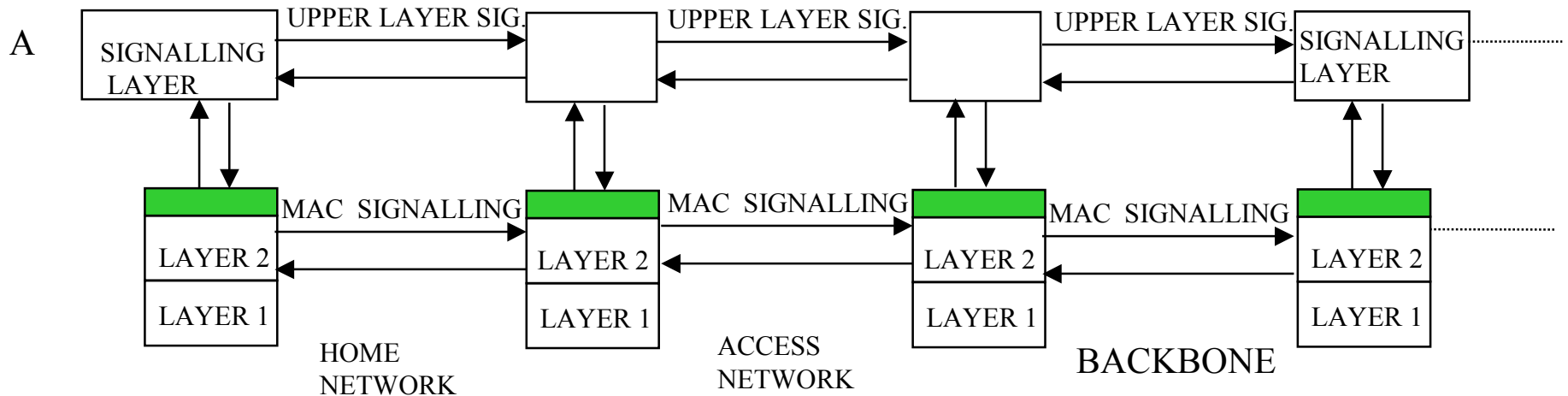
	FTTH PTP	FTTH PON	LMDS	CABLE
IFC/SUB, 100% up	3	2	1	1.3
installation	Very slow	slow	fast	Slow
scalability	The best	best	medium	Medium
Maintenance issues	Fiber cut	Fiber cut	EMC, cell to cell, line of sight	EMC, ingress, ageing
security	simple	Needs layer 2 sec.	Need layer 2 sec.	Need layer 2 sec.
unbundling	simple	simple	Medium	Medium
Main advantages	Bandwidth, simplicity	Limited IFC, scalability	Low cost, rapid installation	Scalability, legacy video support
Main issues	Fiber management, IFC price	IFC price	Regulation, technology	IFC price, network powering
Bandwidth per user	100 Mbps+	30 Mb/s+	2-10 Mb/s	2-10 Mb/s

# Agenda

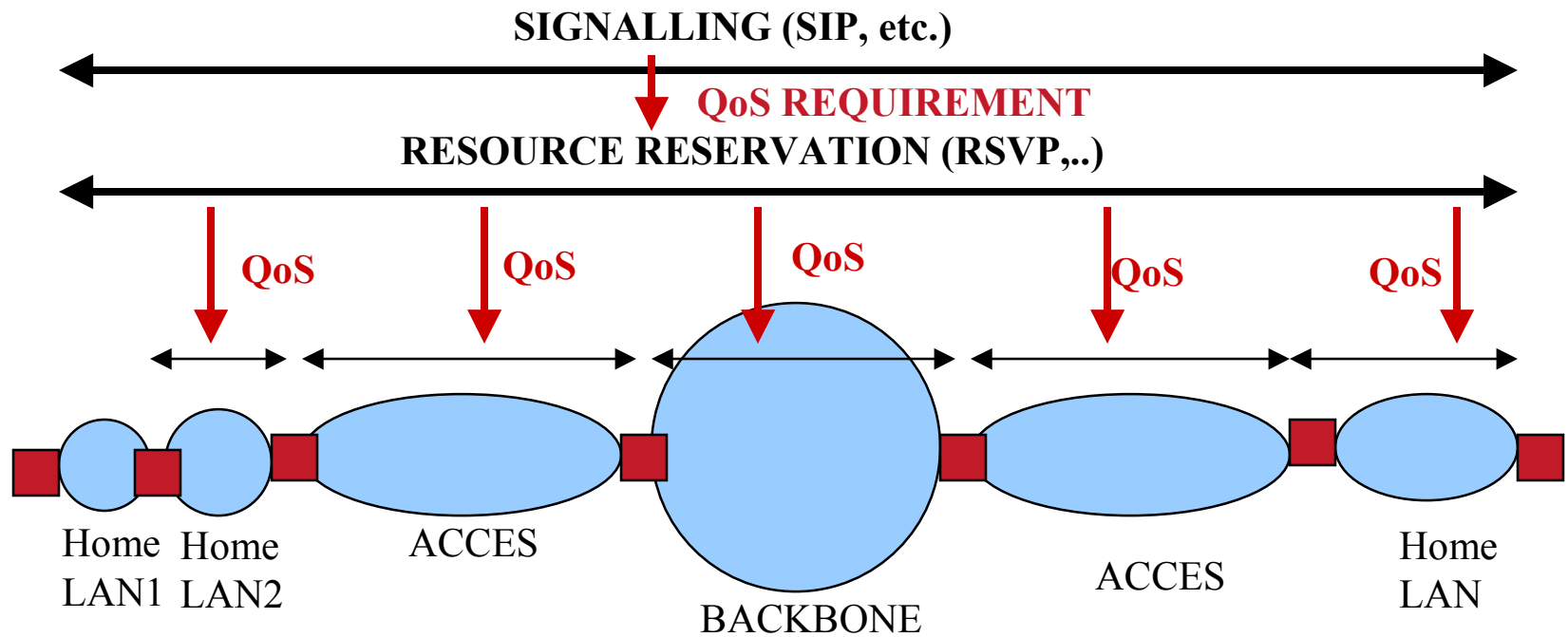
- Traffic scenarios
- Network architecture solutions
- QoS
- Conclusion

# General QoS issue

- **LAYER 3 AND ABOVE COPE ABOUT END TO END TRANSMISSION**
- **LAYER 2 MANAGES THE TRAFFIC IN THE LOCAL NETWORK**
- **AN EXCHANGE OF INFORMATION MUST EXIST BETWEEN LAYERS IN ORDER TO TRANSMIT :**
  - **COMMUNICATION OR SESSION OPENING REQUEST**
  - **REQUIRED QOS INFO + ADDITIONAL FEATURES**



# QoS transmission between layers



- QoS Info contained in SDP info in Signalling protocol
- Translated into RSVP flow spec
- Translated into MAC layer QoS requirements (MAC dependant)

# **Underlying MAC features**

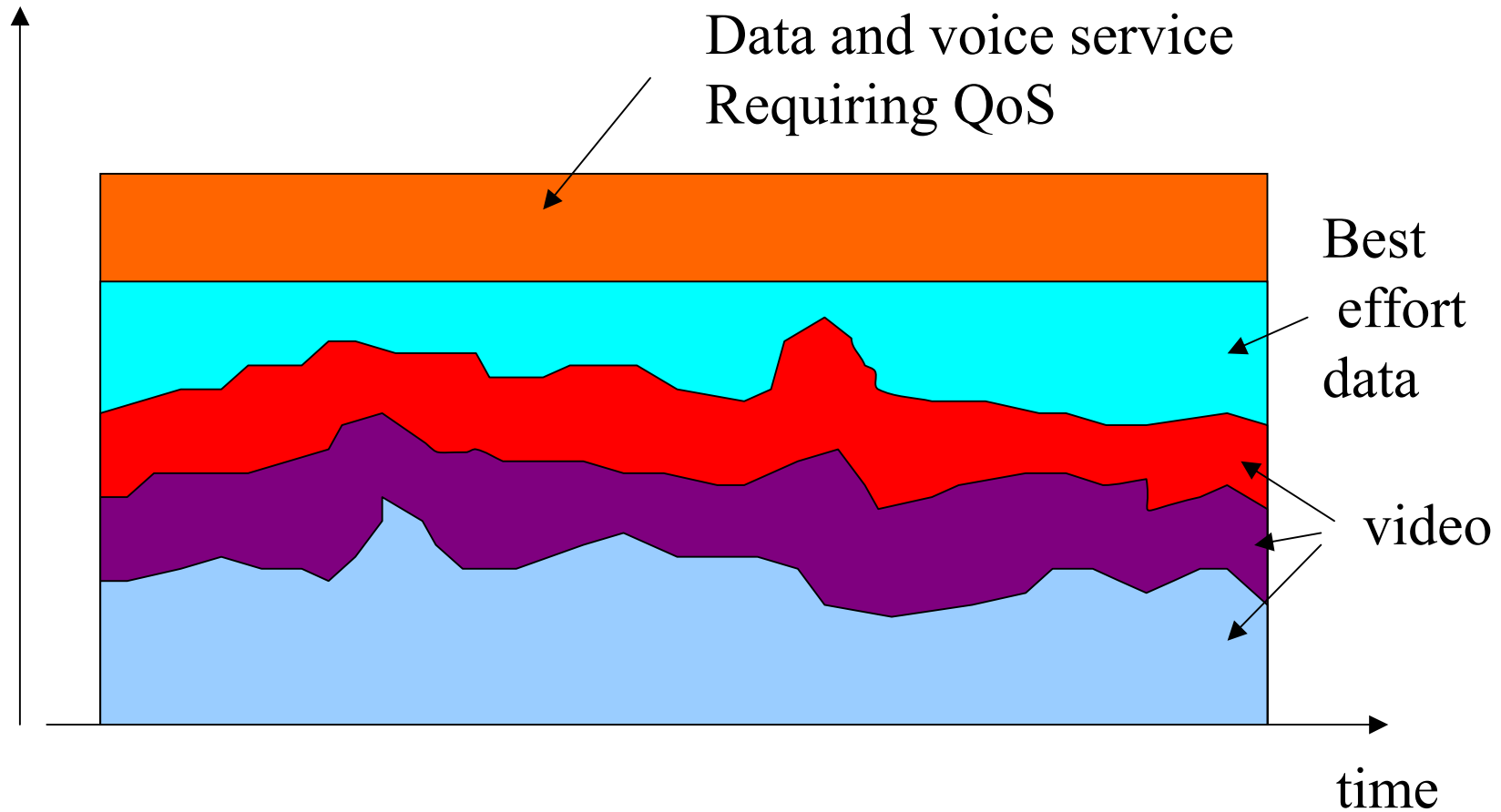
- **QoS support :**
  - **CBR/ VBR / ABR types of QoS support**
- **Packet fragmentation support**
- **Traffic optimisation mechanisms (Haeder compression/suppression)**
- **Authorisation mechanism necessary (linkage with COPS)**
- **Complex API to signalling layers**

# QoS provisioning in RF networks

- **DOWNSTREAM :**
  - **Use of the DVB mechanisms :**
    - MPEG CLASSICAL TRANSPORT
    - BEST EFFORT DATA FILLING THE HOLES
    - FIX BIT RATE STREAM FOR QoS SERVICES (VOICE,..)
- **UPSTREAM :**
  - **FIXED BIT RATE / RESERVATION CAPABILITIES**
    - DATA USES RESERVATION ACCESS
    - VOICE USES FIXED BIT RATE (WITH VAD)
    - VIDEO USES FIXED BIT RATE OR RESERVATION

# Downstream/upstream

Bit rate



NB : reservation can be used for video with relaxed spec

# Other ways to see “QoS”

- **Idea : 10 Mbps + available per subscriber leads to overdimensionning**
  - Fixed traffic pipes per subscriber for unicast traffic
  - Agregated pipes for multicast traffic
  - Simple MAC layer (allocation/deallocation of fixed bit rate pipes)
- **Advantages :**
  - Very simple system
  - Guaranteed QoS
- **Issues :**
  - Non optimal use of Cable/ wireless / fiber shared medium (but after all, do we care?)

**Ultimate idea : why not best effort with Gbps per user?**

# Conclusions

- **Bandwidth demand explosion is expected from 100 kbps+ to 10-100 Mbps+**
- **Cost of bandwidth exponentially decreasing, both in Backbone and access**
- **Several viable solutions :**
  - **HFC migration towards 2-10 Mbps**
  - **Fixed wireless for new installation**
  - **FTTH PON for 30 Mbps +**
  - **FTTH Point to Point or WDM for unlimited bandwidth**

# Conclusions (2)

- **Migration from Broadcast to multicast-unicast model**
- **IP as common network layer**
- **QoS paradigm change from Dynamic QoS and Intserv to more simple model (diffserv, overprovisionning,..)**

---

**Thank You**

**Contact us**

