

PON and Ethernet in FTTH Networks: Incompatible or Complementary?

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Today's Speakers



INFONETICS
RESEARCH

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ZHONE®

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Agenda

- Market Trends
- The Bandwidth Dilemma
- Moving Forward with Fiber: Assessing the Solutions
- Deployment Approaches
- Conclusions
- Q&A

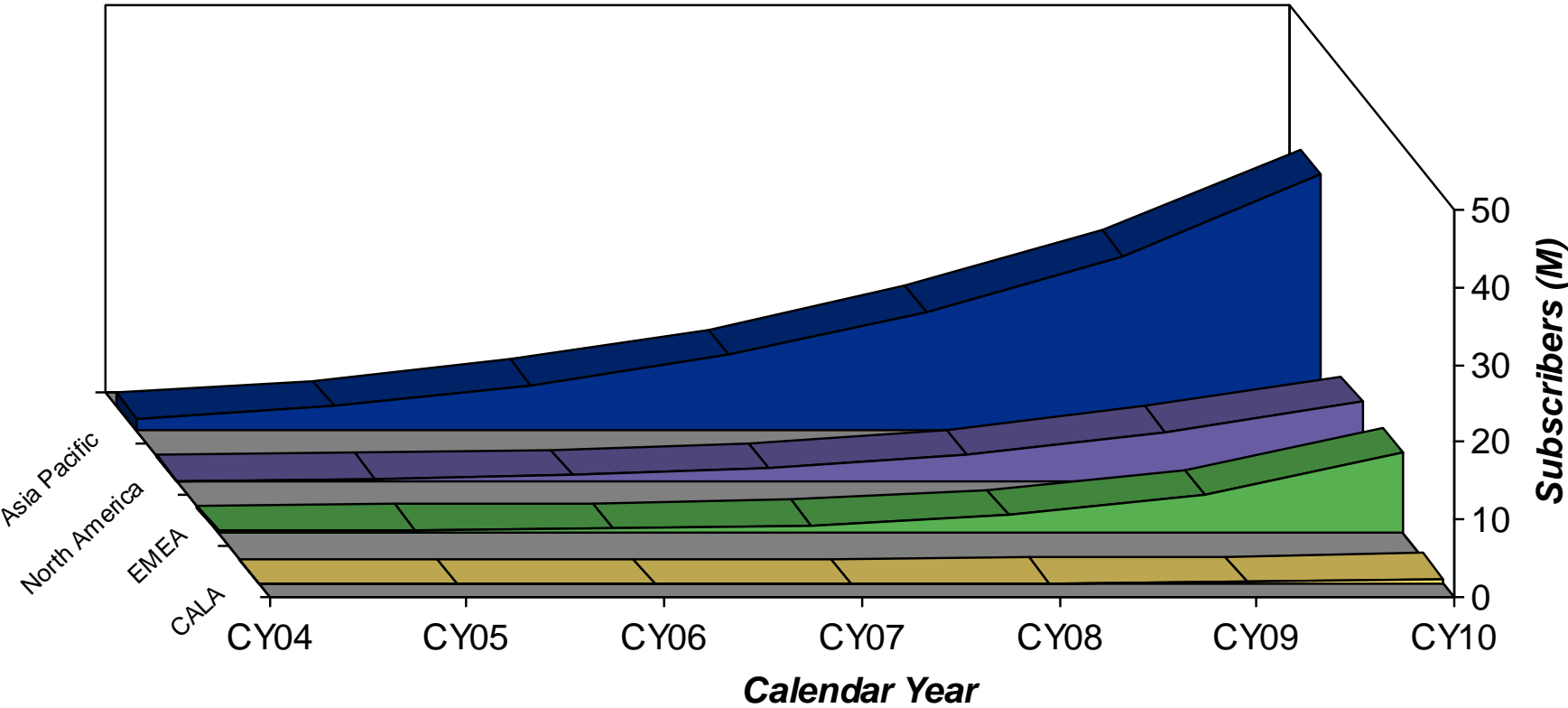
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Trends in FTTH Networks

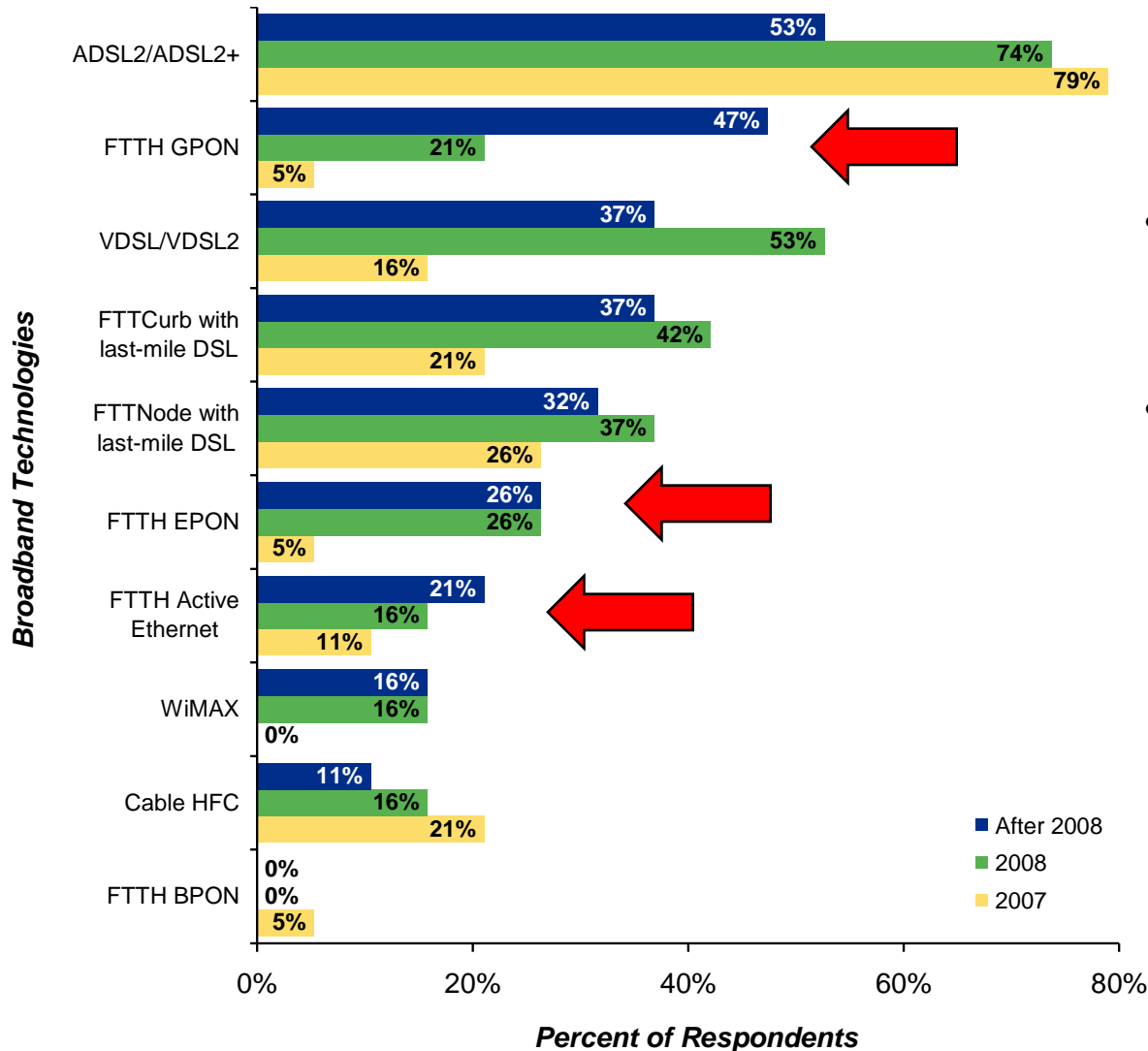
- Video services driving demand for more bandwidth
- ADSL-ADSL2+ won't satisfy long-term subscriber bandwidth demands
- Success of FTTH in Japan, Korea, France, and the US plus component cost reductions are bolstering the FTTH argument
- That said, many providers still on the fence about FTTH
 - High initial costs to pass initial set of homes
 - Costs to train labor force
 - Opex costs associated with maintaining two networks
 - Regulatory hurdles: right of way access, video franchising
- Finally, technology arguments still abound, especially between Ethernet FTTH and PON
 - Capex and long-term opex are major concerns

FTTH Subscribers by Region



Source: Infonetics Research, *PON & FTTH Equipment & Subscribers Market Share & Forecasts*

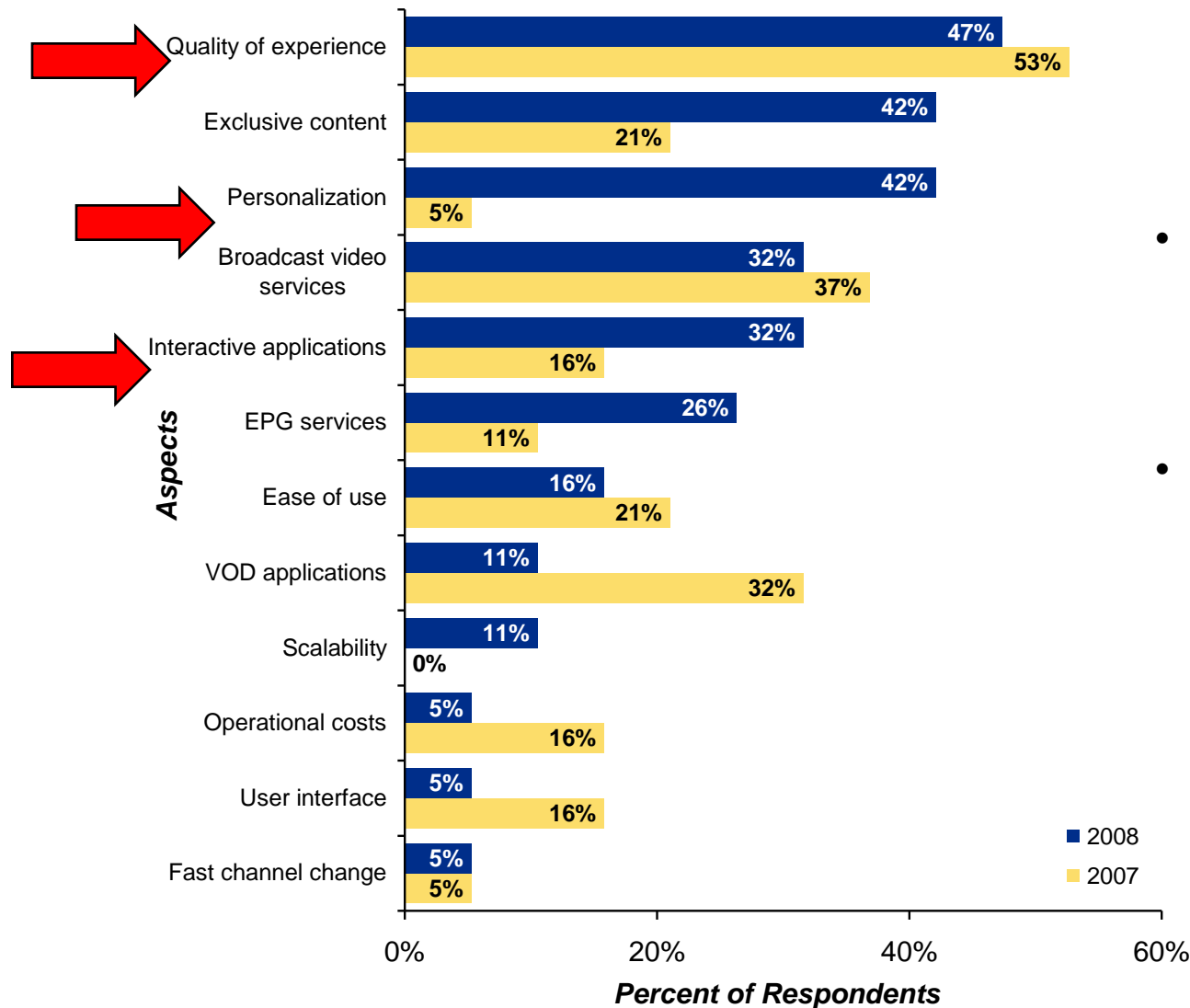
Access Network Technologies for IPTV and Video



- Both PON and Ethernet replacing copper over time
- Multiservice access networks are the trend

Source: Infonetics Research, *Service Provider Plans for IPTV and Video: North America, Europe, Asia Pacific 2007*

Critical Aspects to Increase IPTV Subscribers



- 3 of top 5 responses depend on service and policy intelligence in the access network
- QoE dependent largely on access network bandwidth

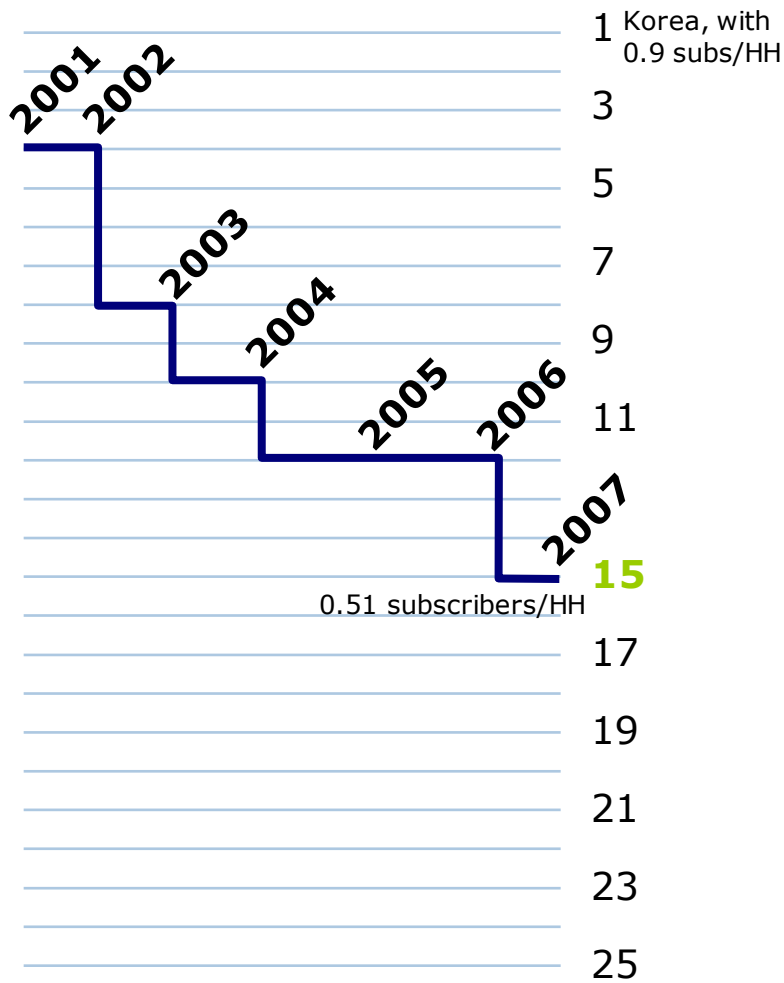
Source: Infonetics Research, *Service Provider Plans for IPTV and Video: North America, Europe, Asia Pacific 2007*

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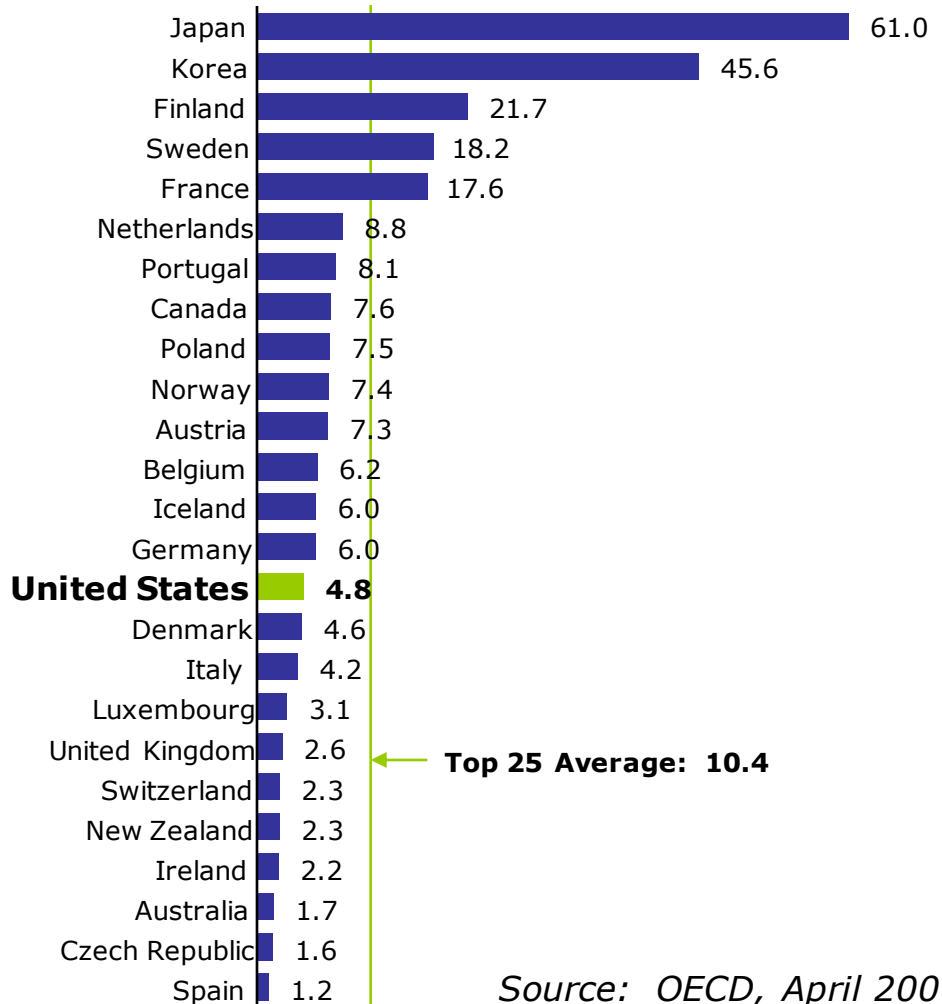
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Broadband as a Competitiveness Issue

US Broadband Penetration Rank



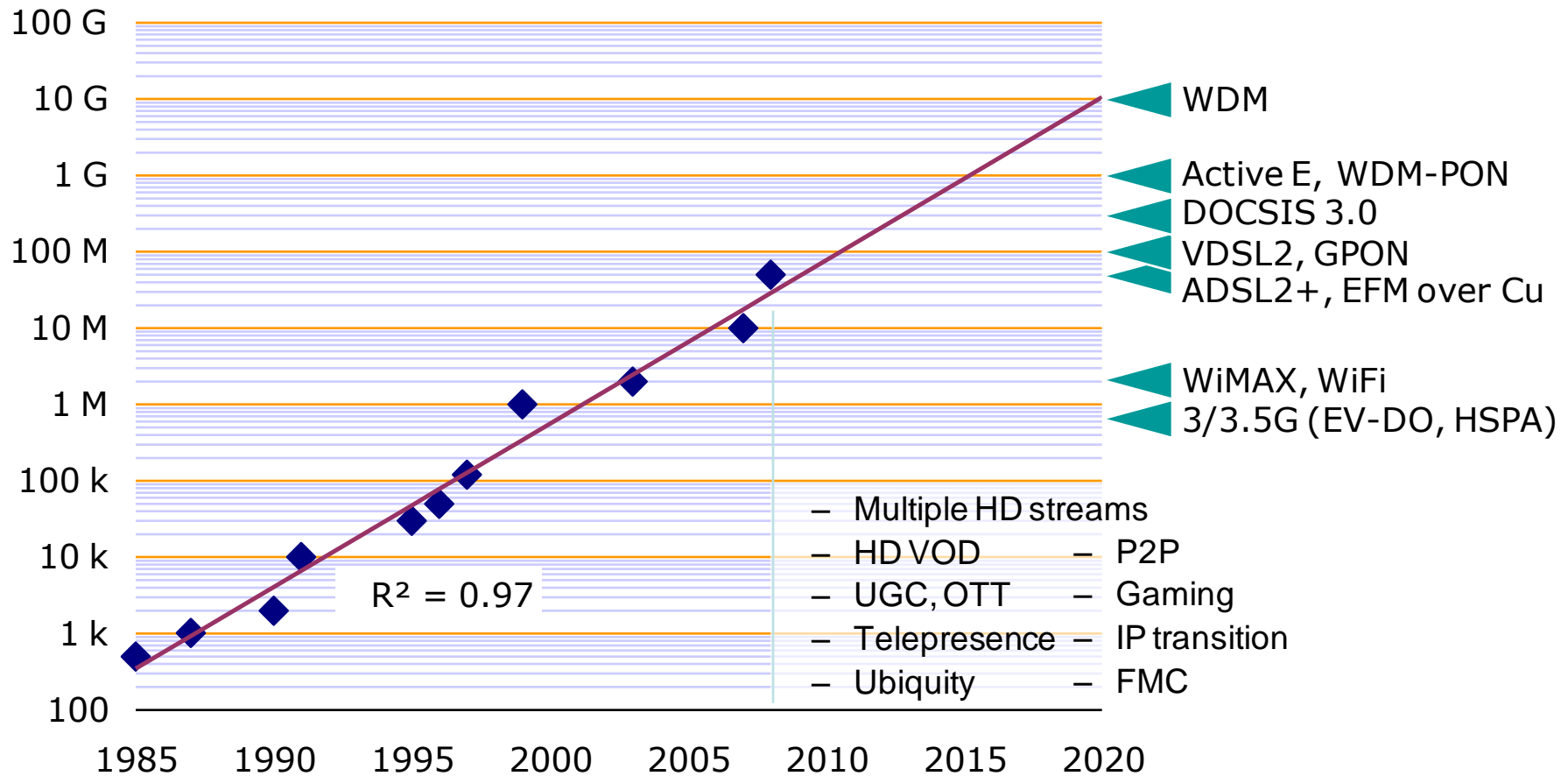
Average Broadband Subscriber's Data Rate, Mbps



Source: OECD, April 2007

Subscriber Demand Follows a Trend

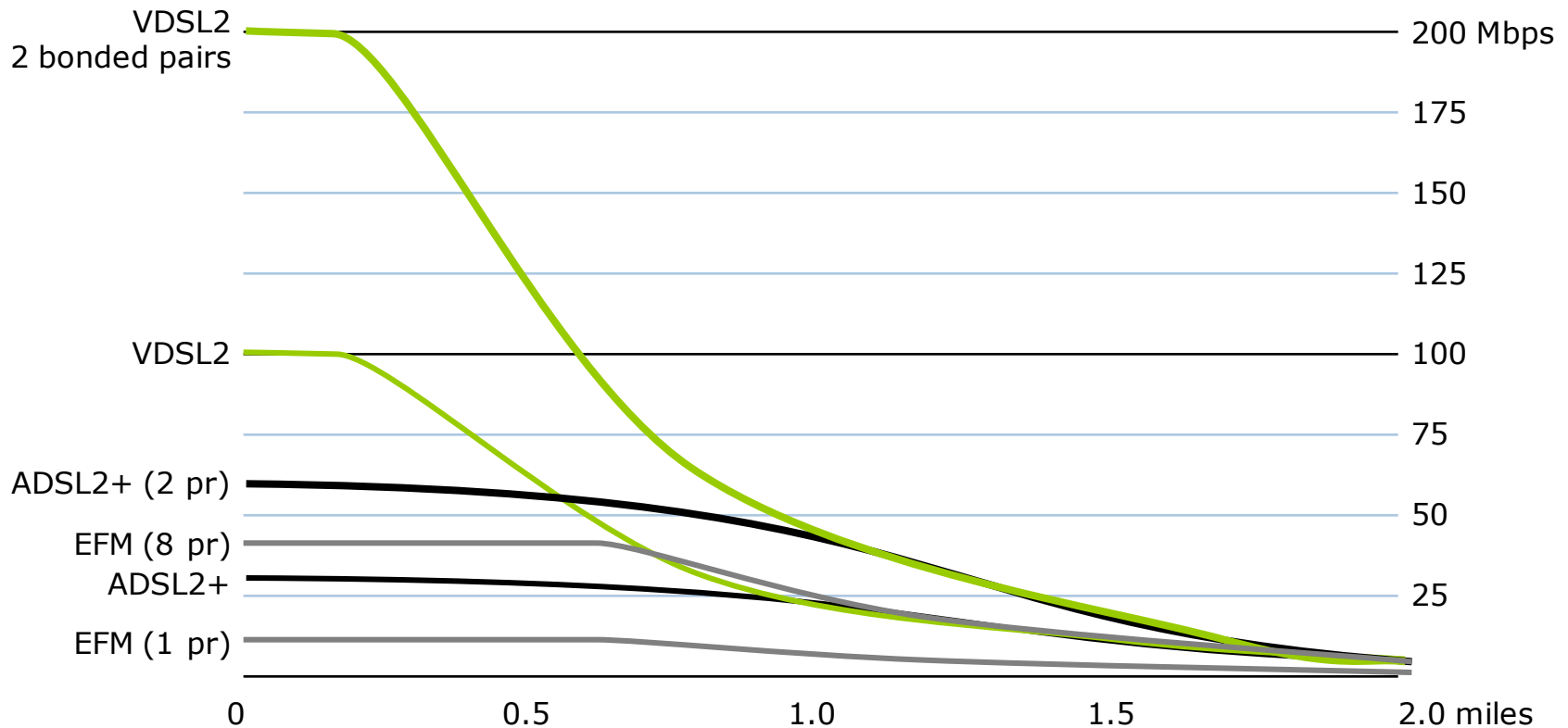
Per-Subscriber Data Rate v. Time (bps)



Source: Jakob Nielsen

Copper-based Approaches Fall Short

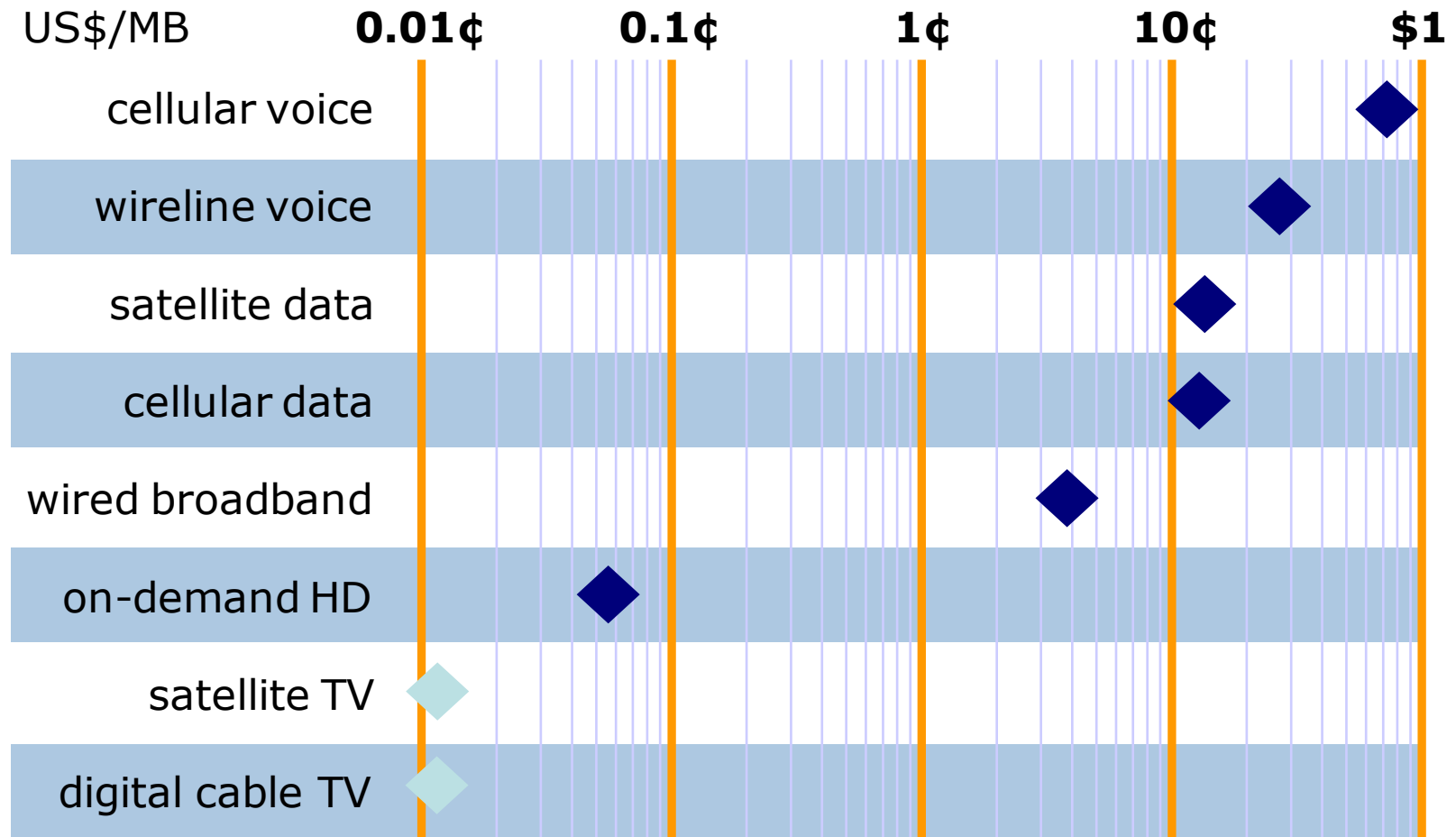
Rate/Reach for Current Cu-based Broadband Access Technologies



Sources: DSL Forum; Zhone testing

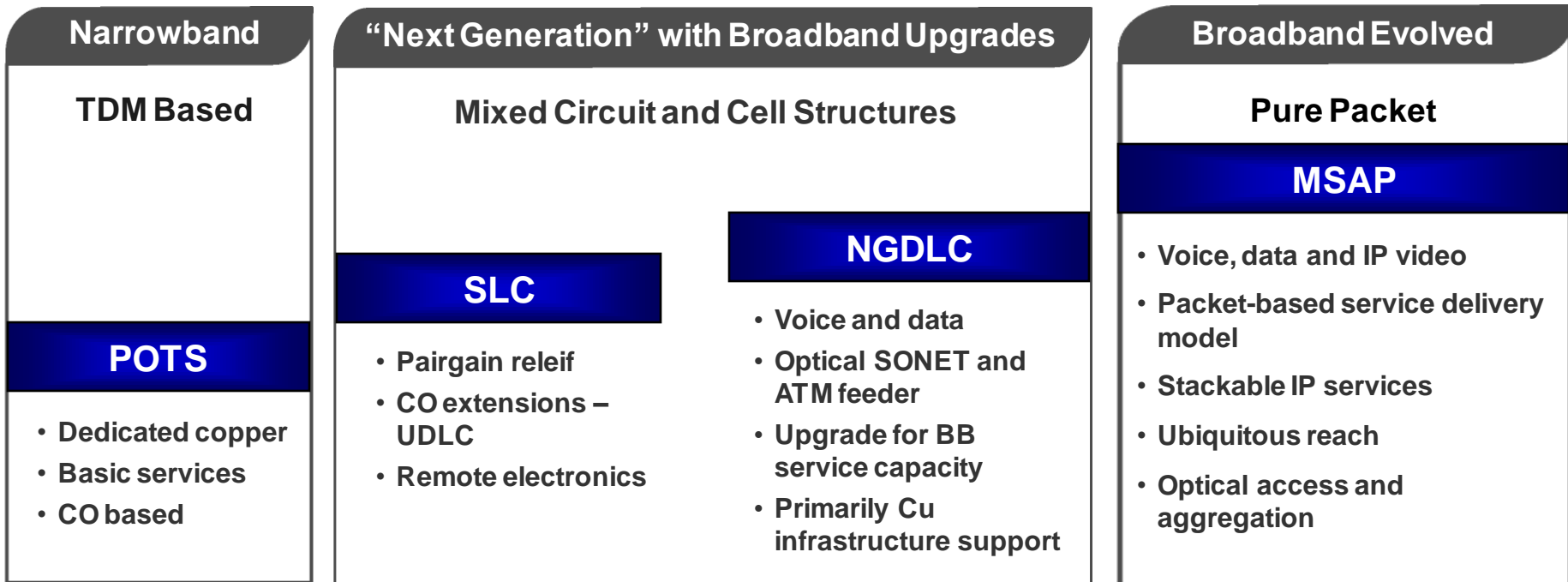
ARPU vs. Bandwidth: Pipe Economics Are Critical

Willingness to Pay per Unit of Capacity Consumed



Sources: US commercial network offers circa January, 2008; Zhone analysis

Evolution of Last Mile Access



1950s



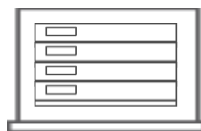
1980s



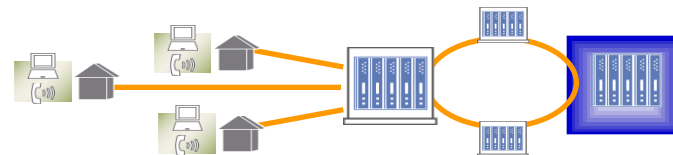
2007+



CO



RT



FTTH/B, FTTC, FTTN

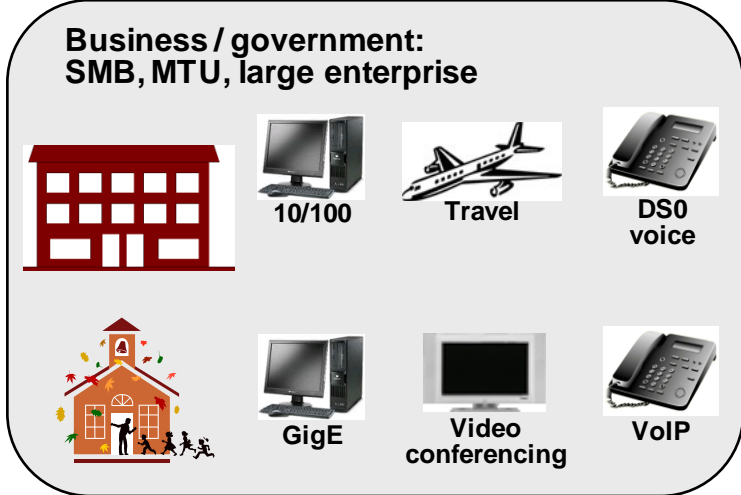
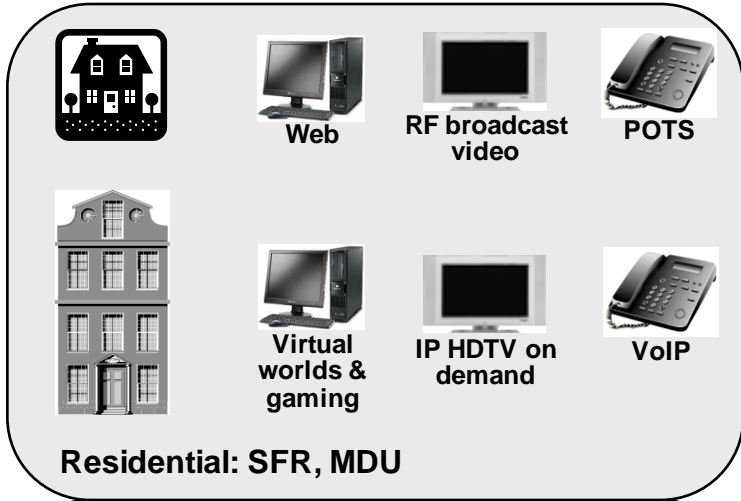
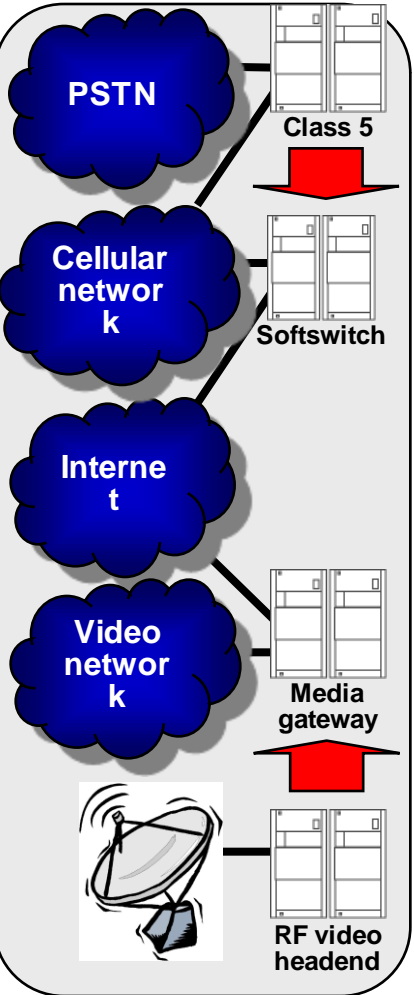
Aggregation and Last Mile Decisions

Network services

Aggregation

Last mile

Subscriber premises

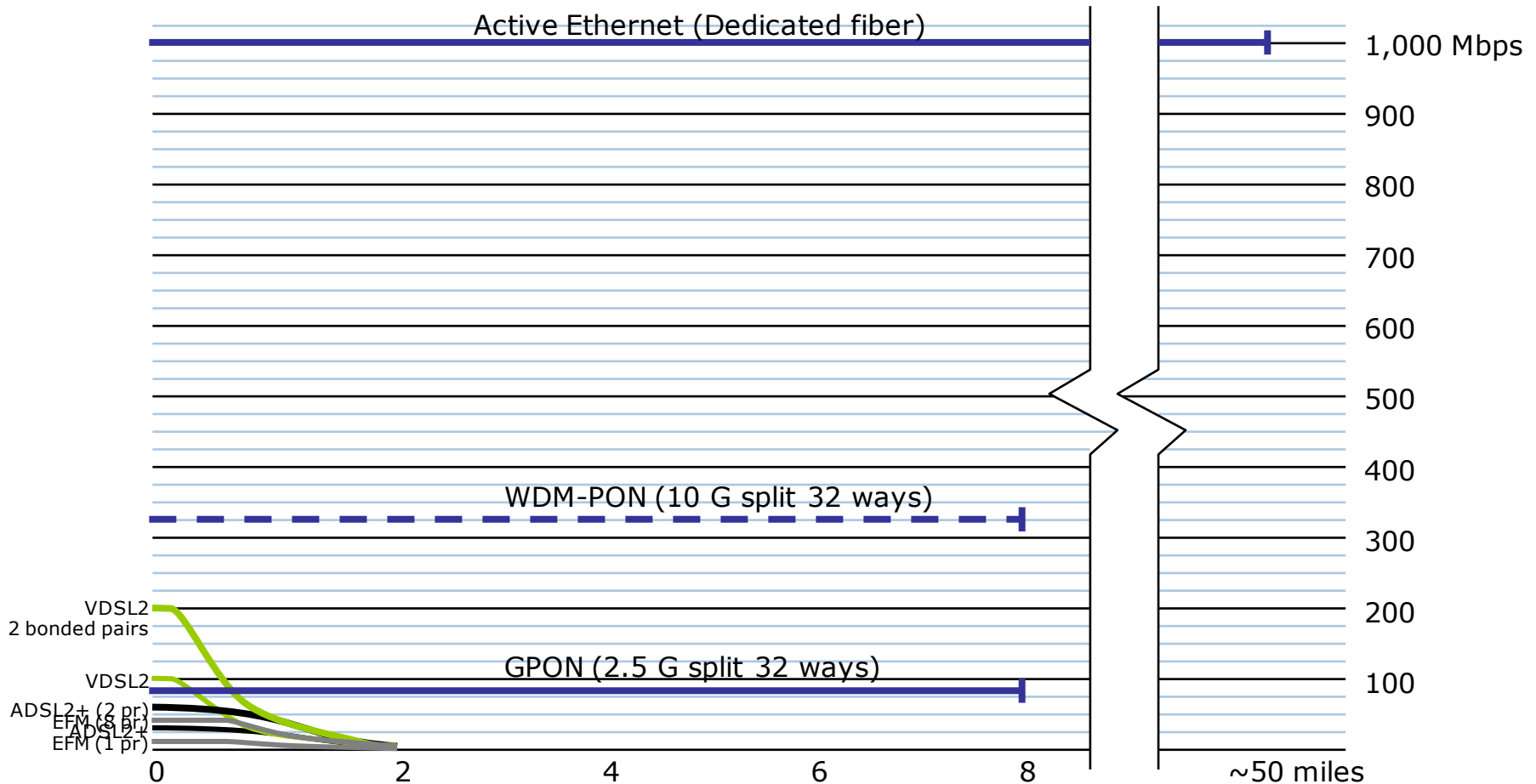


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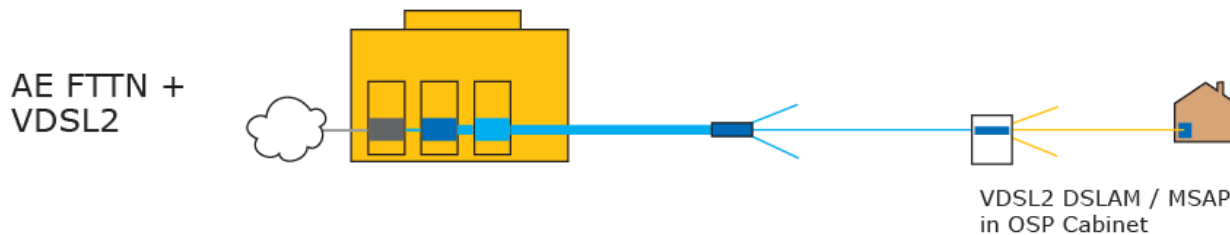
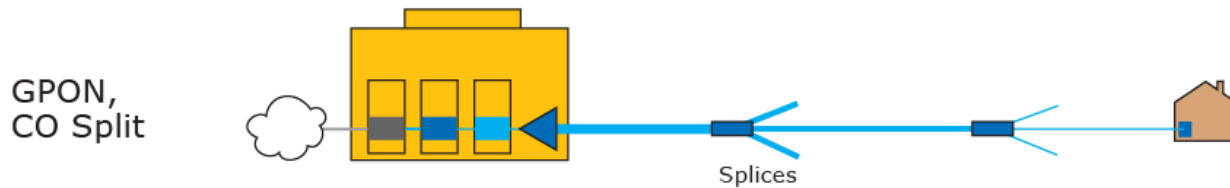
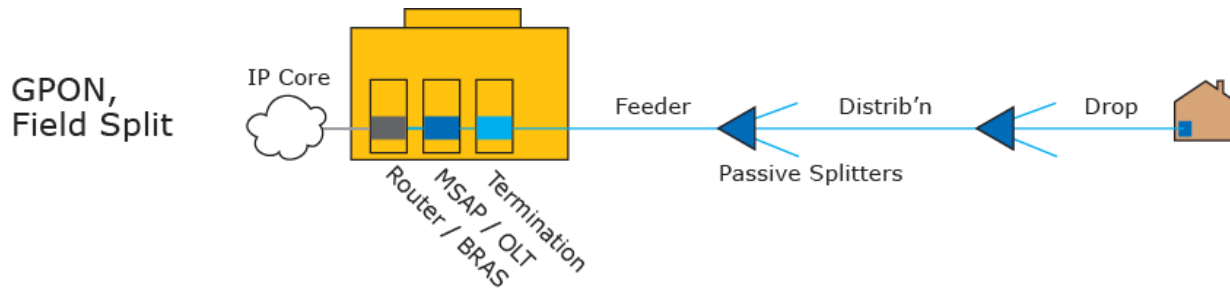
Fiber Provides a Path Forward

Rate/Reach for Fiber-based Broadband Access Technologies

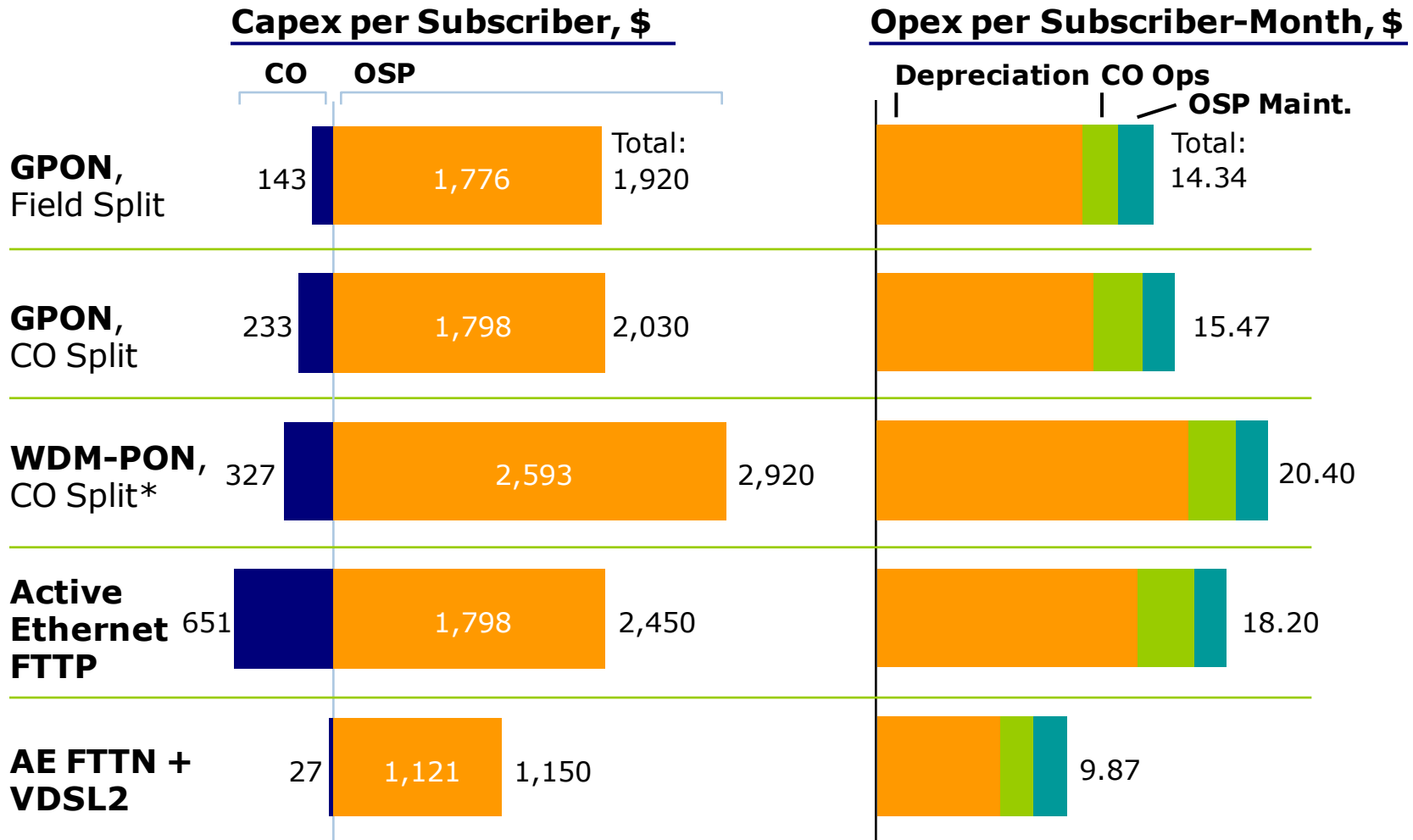


Sources: DSL Forum; Zhone testing.

Four Common Fiber Access Scenarios to Assess



FTTx Cost Comparison

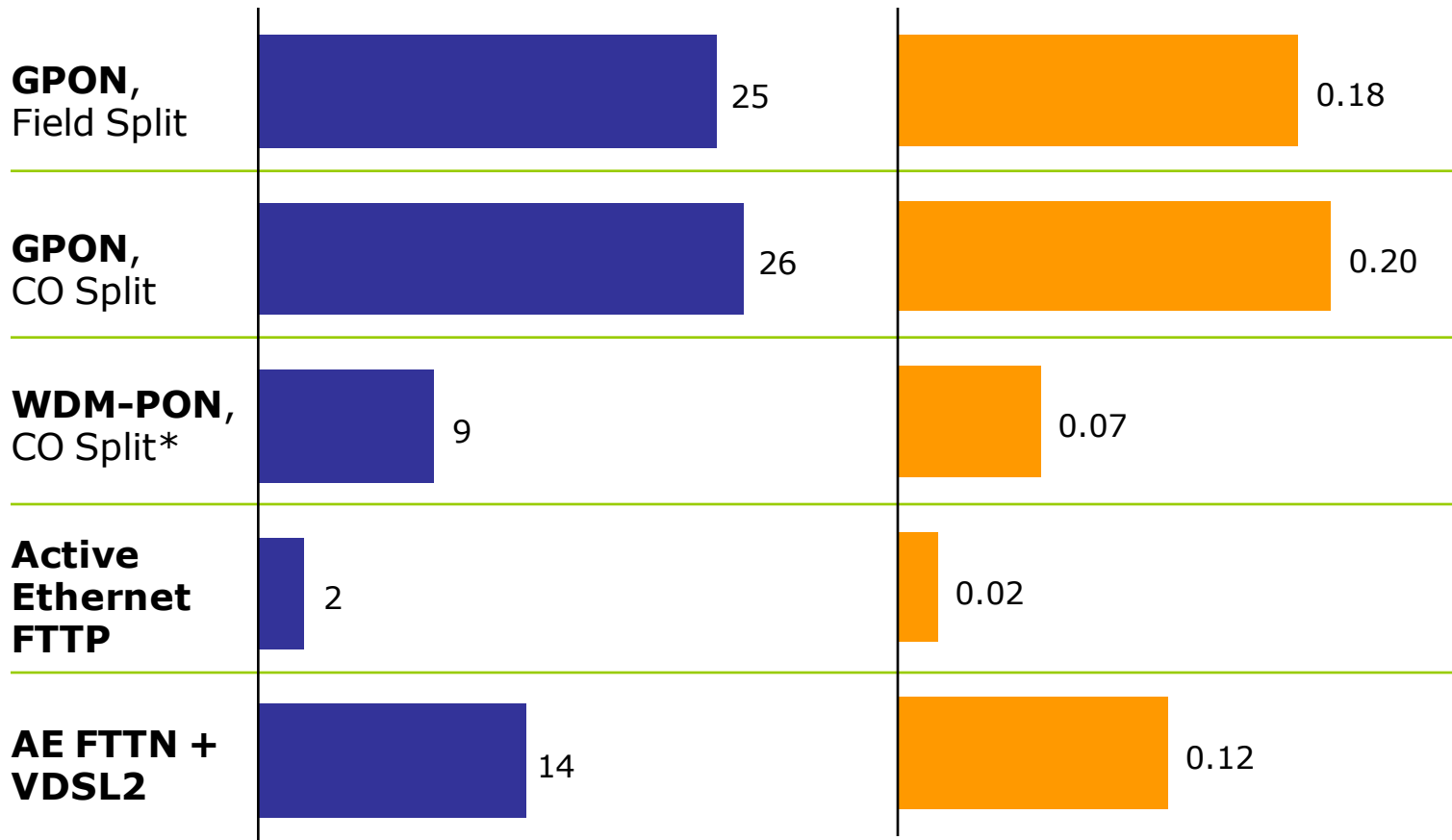


*Rough estimates!

Sources: Various industry/customer benchmarks; Zhone analysis

FTTx Costs vs. Data Rate

Capex per Subscriber, \$/Mbps Opex per Subscriber-Month, \$/Mbps



*Rough estimates!

Sources: Various industry/customer benchmarks; Zhone analysis

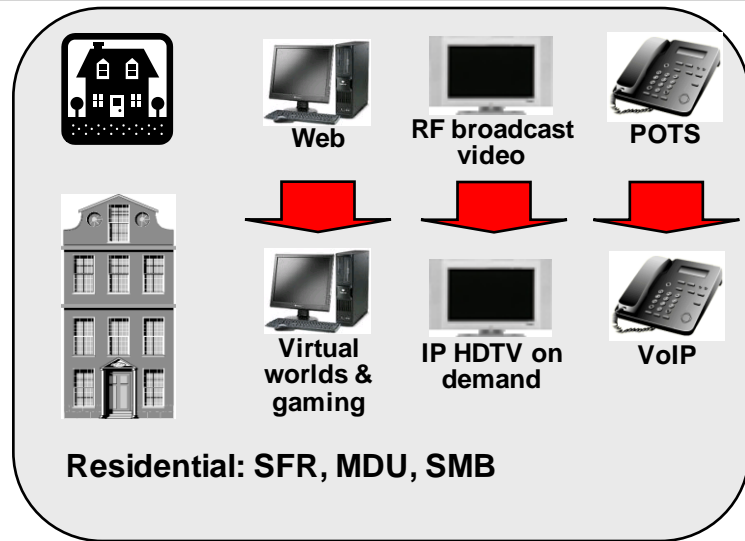
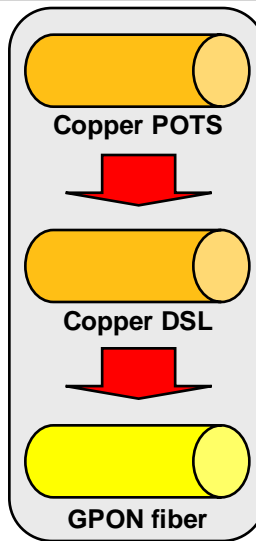
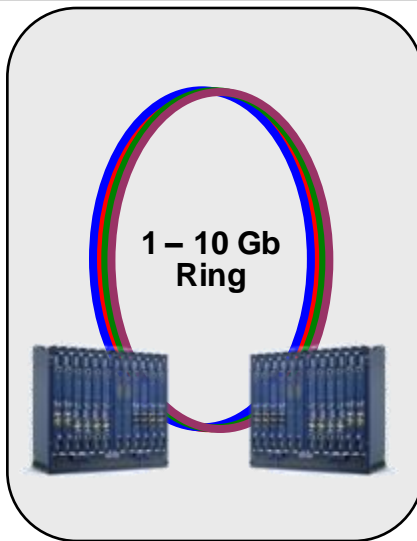
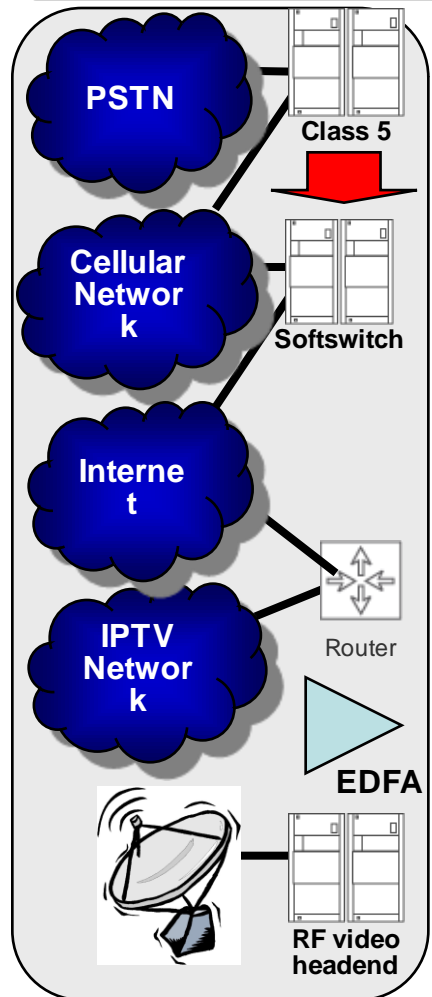
GPON Benefits

Network services

Aggregation

Last mile

Subscriber premises



- RF Overlay
- Residential MDU
- Dense Urban Distribution
- Predictable BW Requirements
- Natural Option for Planned Growth

P2P Benefits

Bandwidth

- From 1M to 1000Mbps
- Granular BW Management
- Complements GPON for 'Super Users'

Network Location

- CO/POP
- OSP Terminals
- Equipment Closets
- Pole/Pedestal
- Customer Premise

Applications

- IPTV
- MEF Services
- VoIP, POTS
- Media Conversion
- TLS / VPNs
- Extended Reach

- Residential Overbuilds and Business Ethernet
- Media Distribution for MDU/MTU
- Slow or Incremental Growth Rates
- *Unpredictable* BW Requirements
- Natural Option for Unexpected Growth

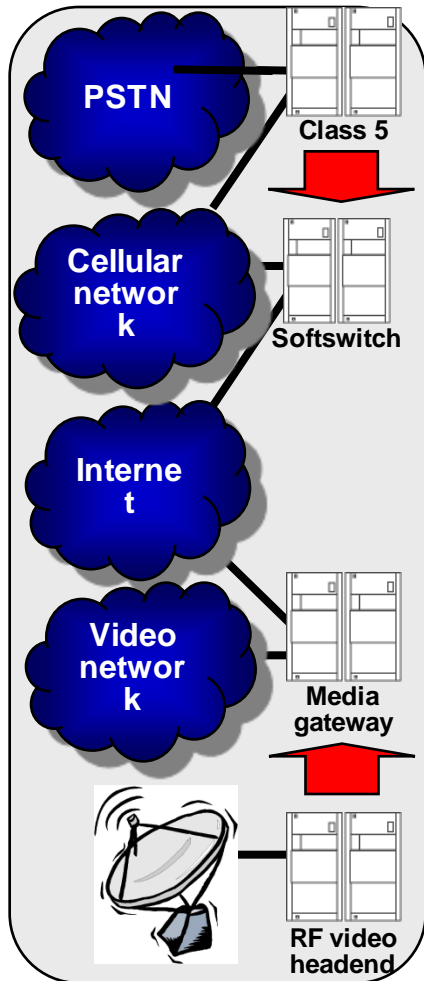
Simplified Service Management

Network services

Aggregation

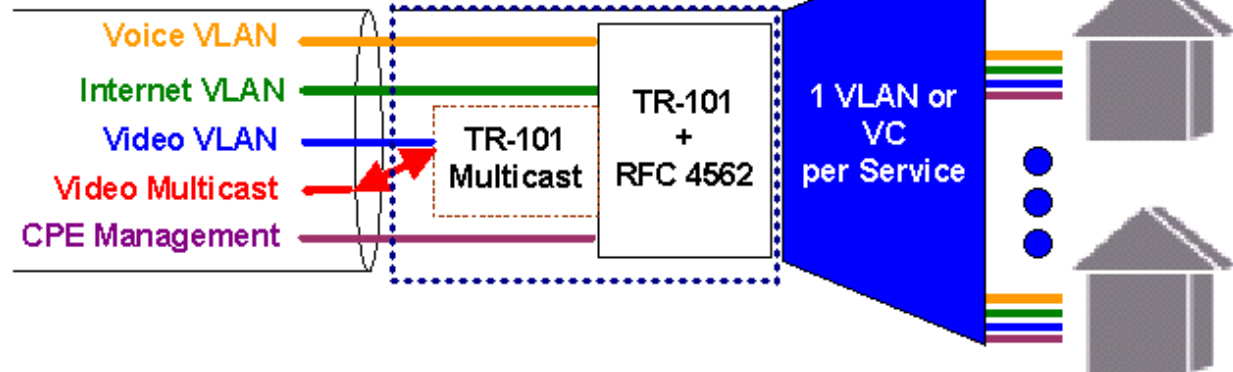
Last mile

Subscriber premises



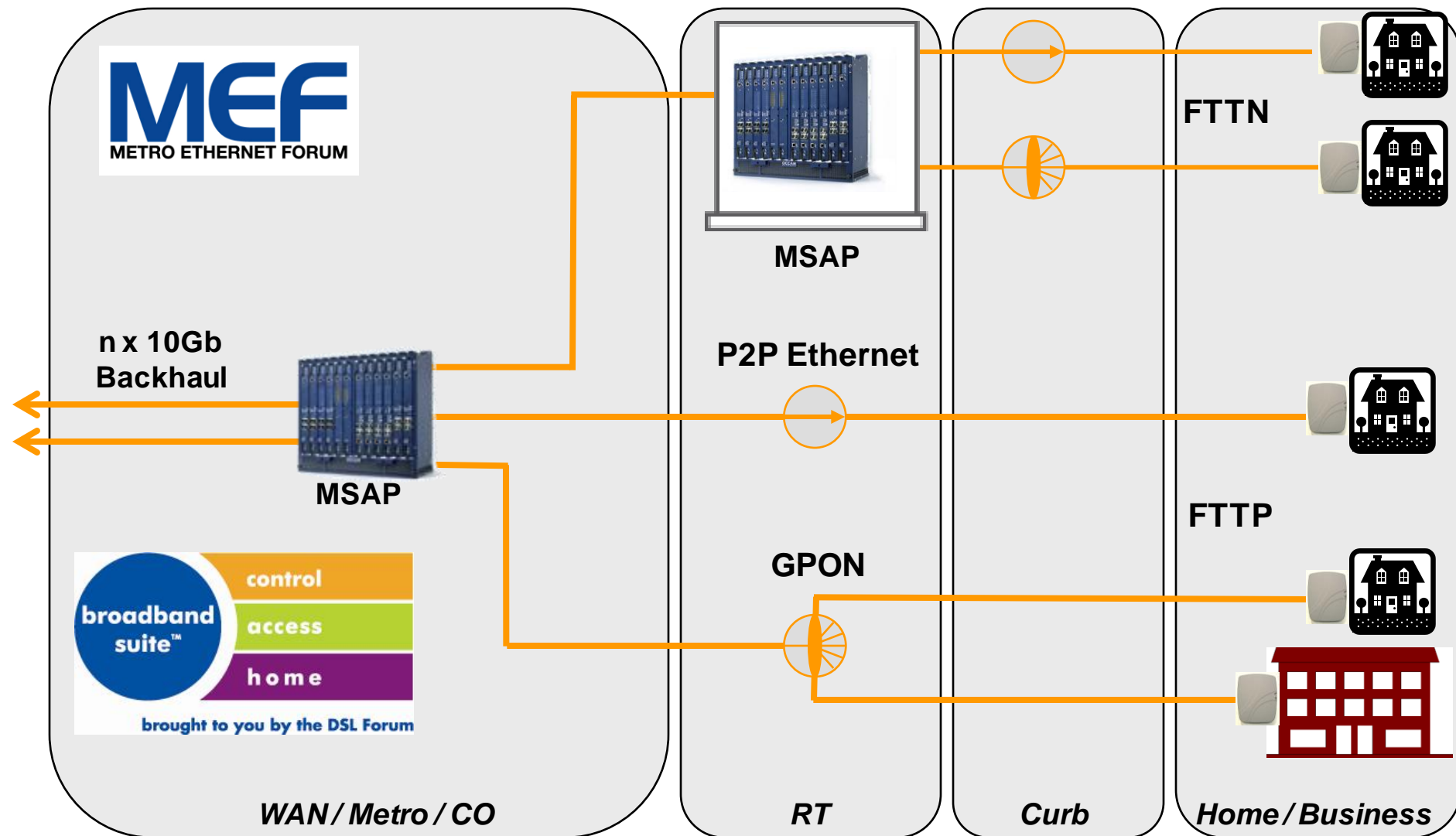
Media Independence

N:1 Service Model



brought to you by the DSL Forum

Complementary Deployment Options

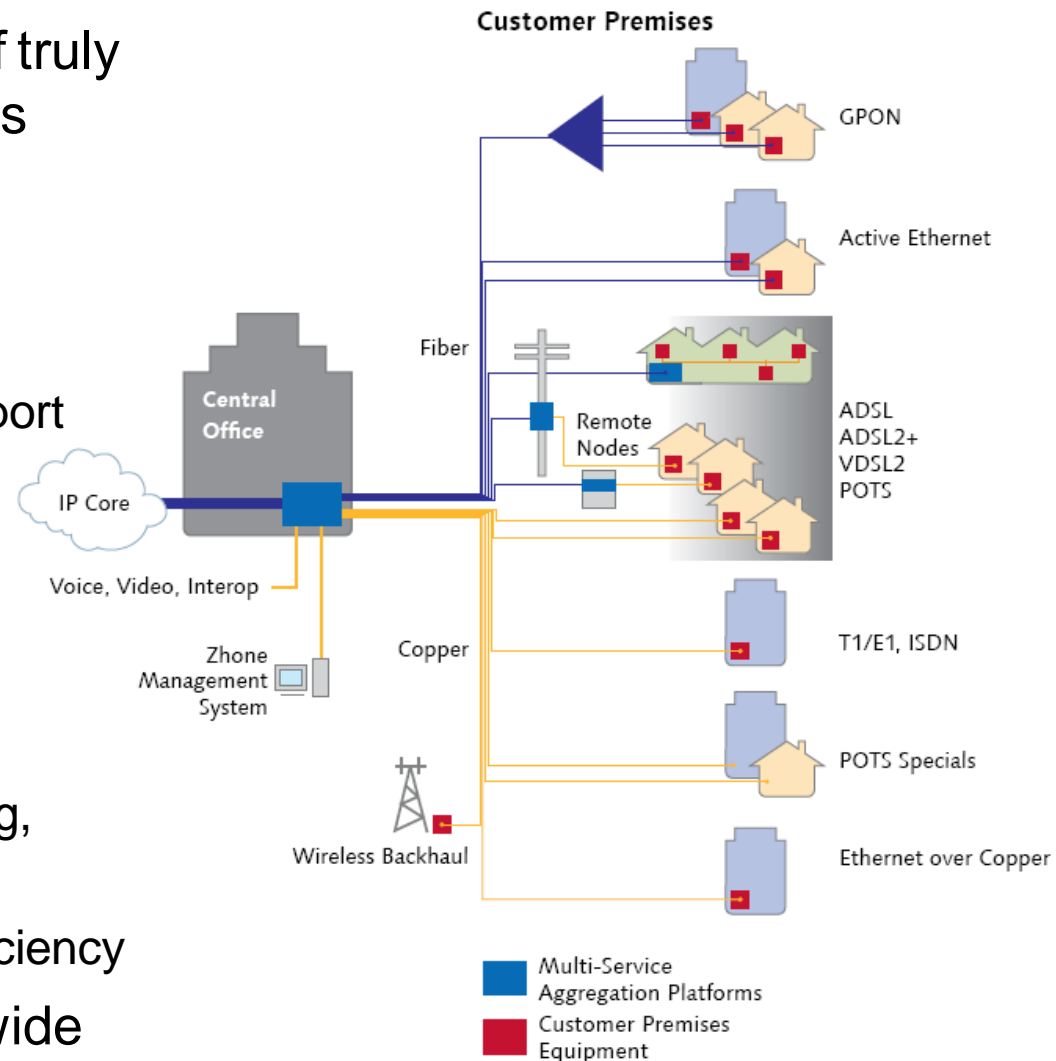


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Zhone Access Solutions

- Industry's broadest portfolio of truly integrated multi-service access solutions
 - All current access technologies
 - Copper, fiber, or both
 - Extensive legacy interface support
 - Scalable to 10G
 - One software architecture, one EMS, one OSS interface
 - Sophisticated access service enablement features (e.g., QoS, IP SLA, rate shaping, IGMP snooping)
 - Higher versatility, flexibility, efficiency
- 600+ service providers worldwide



Zhone Complete FTTx Solutions



- **zNID Intelligent FTTH Gateway for GPON or AE**
 - Radically simplified provisioning and management
 - Advanced QoS — The only gateway to deliver Layer 3 intelligence
 - Remote Management — DSL Forum Standard TR-069 server, OMCI, SNMP or HTTP
 - Resilient thermal enclosure — add electronics on service demand
 - No new wiring HPNAv3 over coax and phone lines
 - Integrated power source via home's phone line
 - Premium voice, video, data
 - Complemented by indoor unit options
- **MALC Integrated Multi-Service GPON and AE Platform**
 - Smooth migration, low-cost entry for MSAP-architecture networks
 - Line card upgrades — rapid deployment for first-to-market services
 - Integrated system approach, streamlines inventories and operations
- **Bitstorm VDSL2 for FTTN**
 - 100 Mbps symmetric performance
 - Cost-effective, temperature-hardened 1U form factor for remote installation



Occam High Definition Access™

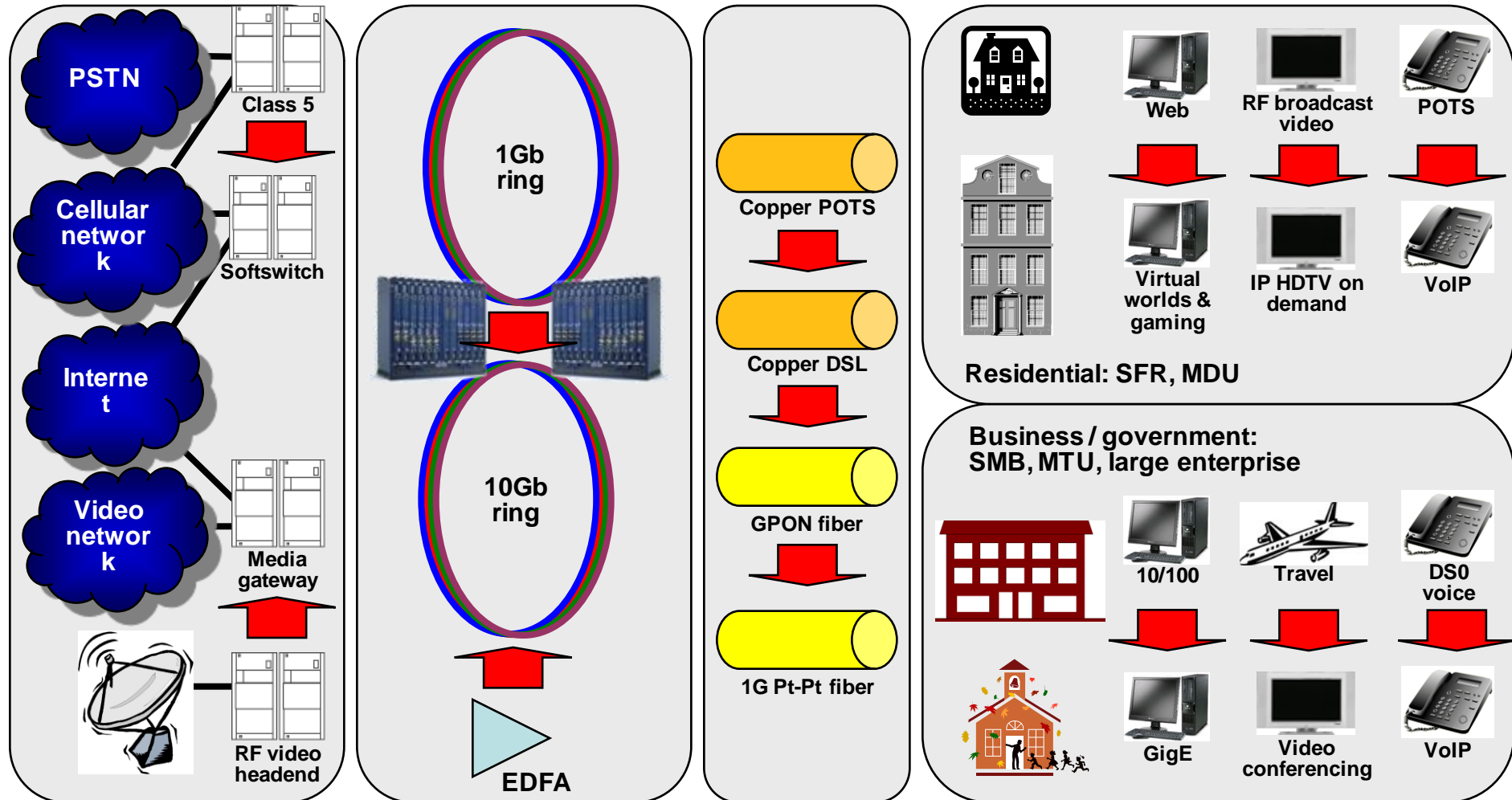
Powerful Access Convergence

Network services

Aggregation

Last mile

Subscriber premises



Occam Networks

Simplifying FTTx Access

- **Residential and Business** service convergence over comprehensive **Carrier Ethernet access** solutions
 - Complementary P2P and GPON FTTx Solutions
 - Common service management models
- Unmatched **flexibility** in **simple, cost competitive** platforms that scale from **64kbps to 10GigE**
- Leverage Ethernet over **Any Media** to deliver **Any Service Anywhere**
- **Standards Simplified....**
 - MEF defined E-LINE and E-LAN services
 - DSL Forum and Broadband Suite defined residential services

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The Right FTTP Choice

Attribute	P2P	GPON	Notes
Bandwidth	✓	75-150M*	P2P most future proof
Deployment Flexibility	✓		P2P scales low to high
RF Overlay		✓	PON best for existing RF
OAM & Maturity	✓		802.3ah widely used
OSP Simplicity	✓		P2P = 1 to 1
Feeder Relief		✓	PON minimizes feeder
Urban Residential		✓	PON built for density
Rural & Business	✓		P2P allows for precision
Economic Cents		✓	PON saves CAPEX
Power and Management		✓	PON minimizes fiber mgmt

The Right Wireline Access

- It all depends...
 - Investment time horizon
 - Service definition
 - Customer segment needs
 - Asset initial conditions

GPON	AE FTTP	AE FTTN + VDSL2	ADSL2+ Bonding
Medium	Long	Medium	Short
Tomorrow	Long-term	Tomorrow	Today
Residential	Res + Biz	Residential	Res + Biz
None	None	Plentiful Cu	Plentiful Cu

- Choosing
 - Equipment flexibility, versatility for network evolution and heterogeneity
 - Do the math, with some good help

Q&A



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