

P12: Local Operator Perspective

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Drivers for EFM

- We foresee strong demand for innovative multimedia services
 - Increased competition
 - There are still some legal issues
 - Regulatory issues, intellectual property
- Converged access networks
 - Based on packet data technology
 - Cost reduction, increased profitability
- Ethernet is a proven, mature standard for packet data networks

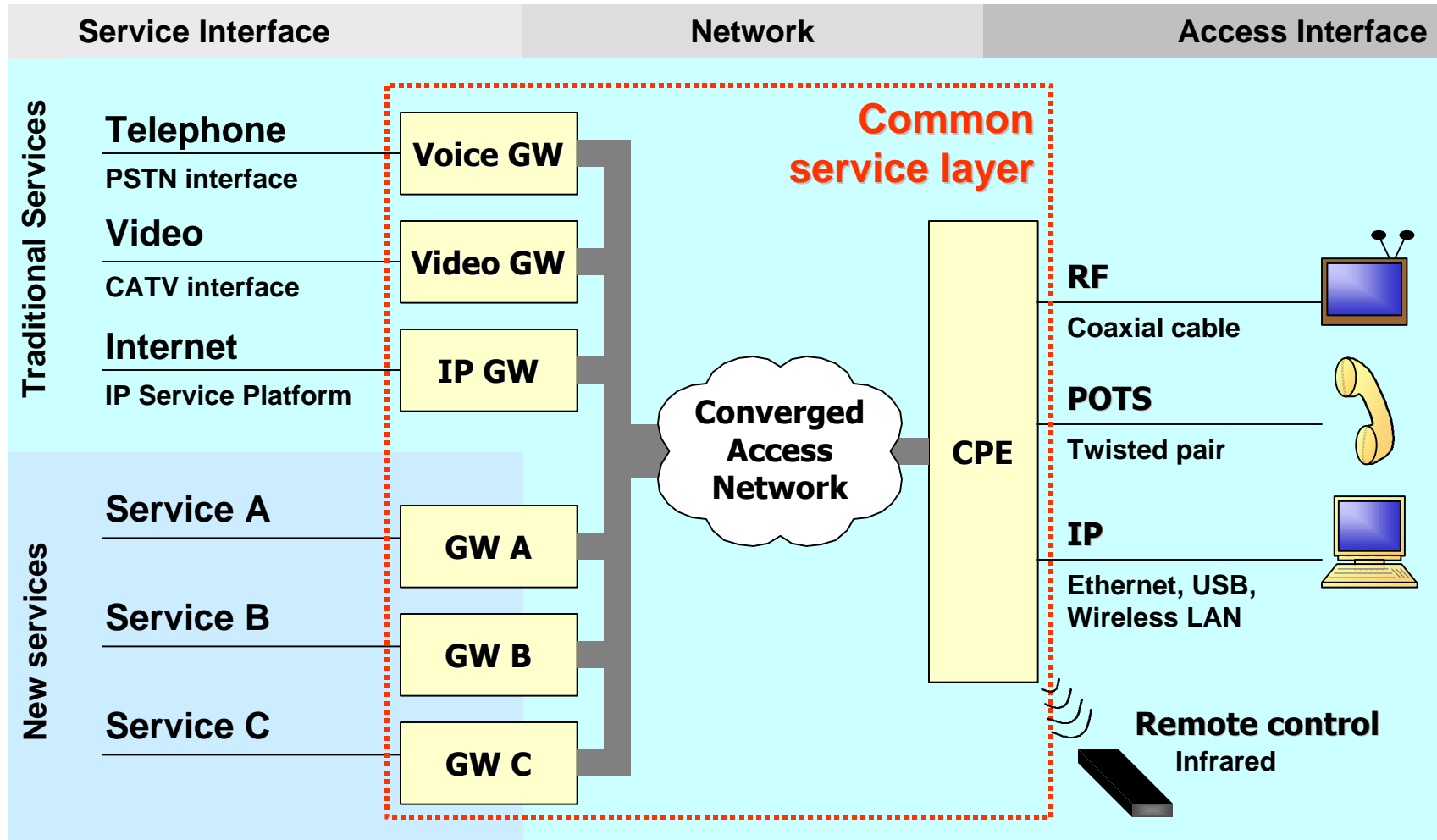
Key points for EFM success

- Availability of choices for the physical layer
- Support for a wide variety of services
- Cost - low cost, in fact
- Flexible L2 topology
- Ease of provisioning
- Security
- Interoperability
- Maintainability
- Scalability

Common architecture

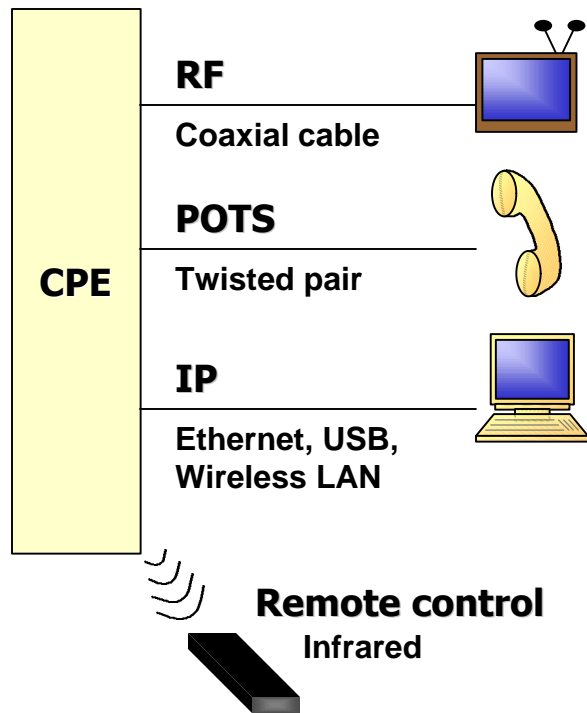
- Single vision
 - Common service layer
 - Common management architecture
- Three different physical layers
 - Copper based
 - Fiber based: EP2P
 - Fiber based: EPON

Service reference model

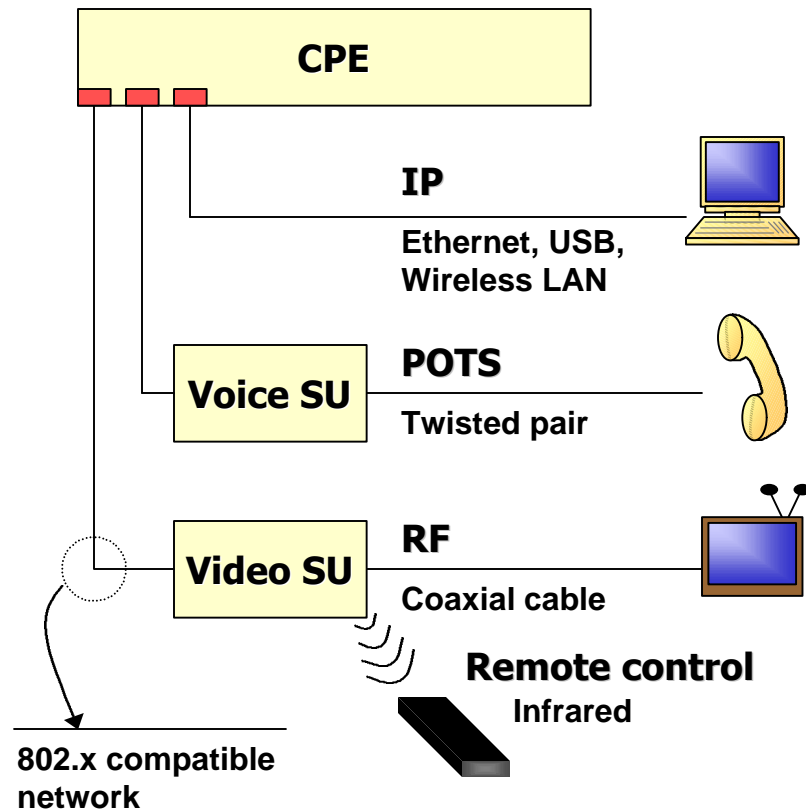


Home network solution

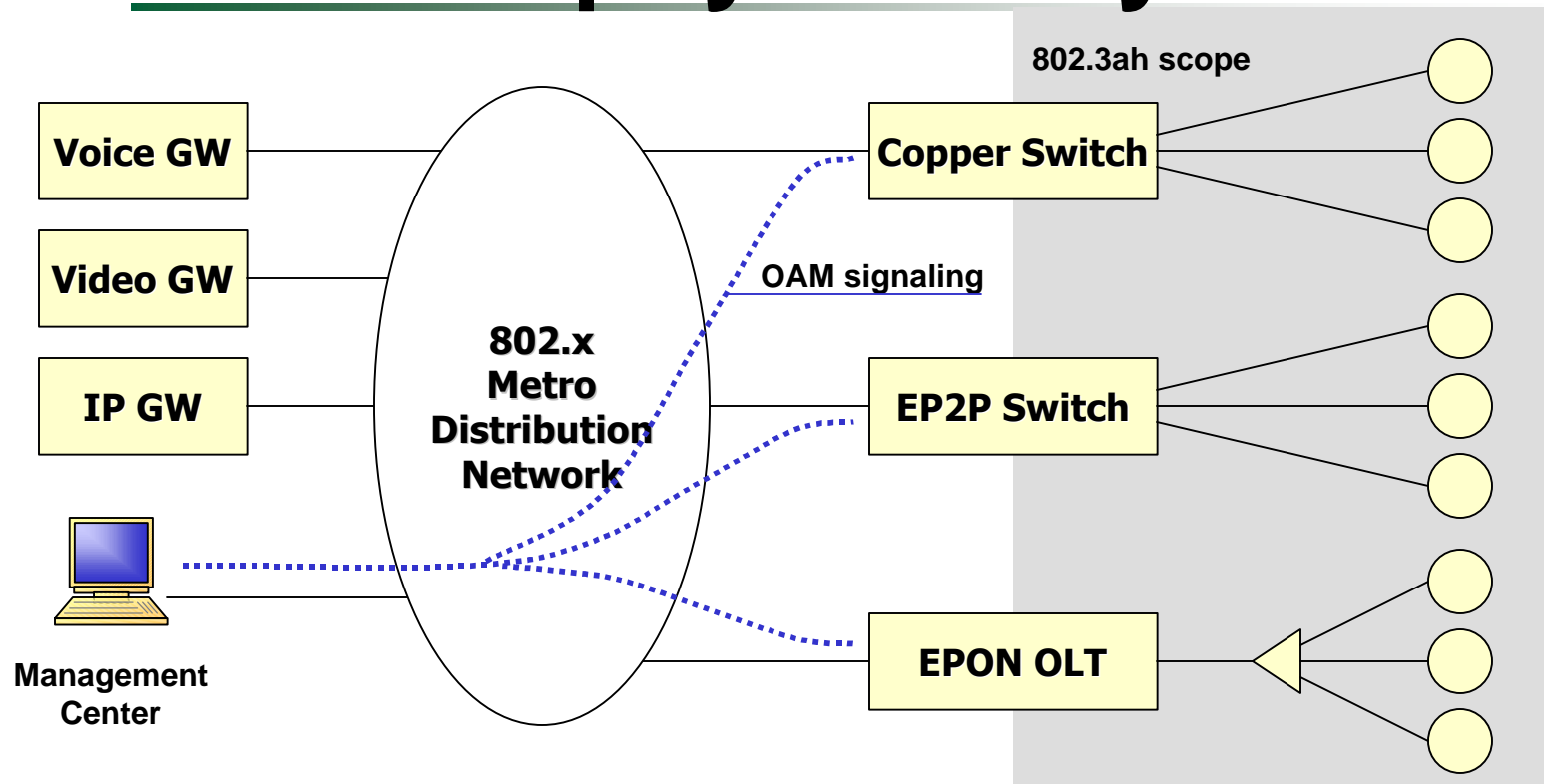
Integrated CPE



Distributed Service Units



Choice of physical layer



- Each kind of access technology is best suited at some particular environment or application
- It should be possible to deploy different technologies while preserving the same service management architecture

Copper based: 'EDSL'

- Leverage the legacy copper
 - Short reach is ok, given the constraints
 - Huge installed based
- Limited applicability
 - Long reach: why not go fiber?
 - FTTB: why not use Cat5 or better?
- Coexistence with other technologies
 - Several different modulations into the same bundle
 - ISDN, HDSL, ADSL...

Copper based: 'EDSL'

- Increased reach is important, but...
- ... the stability of the speed attainable in a given loop is at least as important.
 - We don't want to have services going up and down because of speed variations
 - Video services need guaranteed bandwidth - very little margin for variations
 - We have evidence of degradations in performance related to environmental variations on the plant

Fiber based: EP2P

- Ideal for FTTB
 - Active distribution point can be installed at the basement
- Suitable for FTTH, with some constraints
 - Rugged distribution point for field deployment
 - From 16 to 128 accesses per shelf
 - Management of distribution frame is the limiting factor
 - Need to develop more practical ways to handle lots of fiber connections in less space
- Typical speeds of the access ports
 - 1 Gbps or 100 Mbps
 - Always full duplex

Fiber based: EP2P drops

- Multimode
 - Easier to handle, but limited in performance
- Singlemode
 - Preferred approach
 - Only one type of fiber for the entire network
 - The same splicing equipment for core and drops
 - More room for growth
- and... Cat5 copper
 - Equivalent to fiber for most purposes
 - May share the same service framework

Fiber based: EPON

- Ideal for sparsely populated areas
 - Long reach (up to 5 km), or very long reach (up to 20 km)
- In dense areas,
 - the physical topology converges with EP2P
 - the decision will depend ultimately on cost
- Main concerns
 - Complex bandwidth allocation
 - Needs encryption to guarantee privacy
- Unique advantages
 - Growth to support new services through WDM

EPON Splitter topologies

- Single splitter
 - Dense neighborhoods
- Cascaded splitters
 - Two levels of splitters: 1:4:4, up to 1:8:8
 - Preferred approach for most areas
- Unbalanced splitters (taps)
 - Long reach, scattered customers
 - Hard to balance signal power for all customers
 - May be needed in some areas
- Open issues
 - Management of the physical entity
 - How to connect the drop to the splitter?

EPON WDM

- Adding more services through WDM
 - Analog video overlay
 - New data channels
- Wavelength allocation plan
 - Reserve wavelengths for future growth
 - Focus on the needs of the access network
 - First generation EFM equipment need wider margins; future equipment may use narrower bands, allowing for CWDM (or even DWDM) over PON

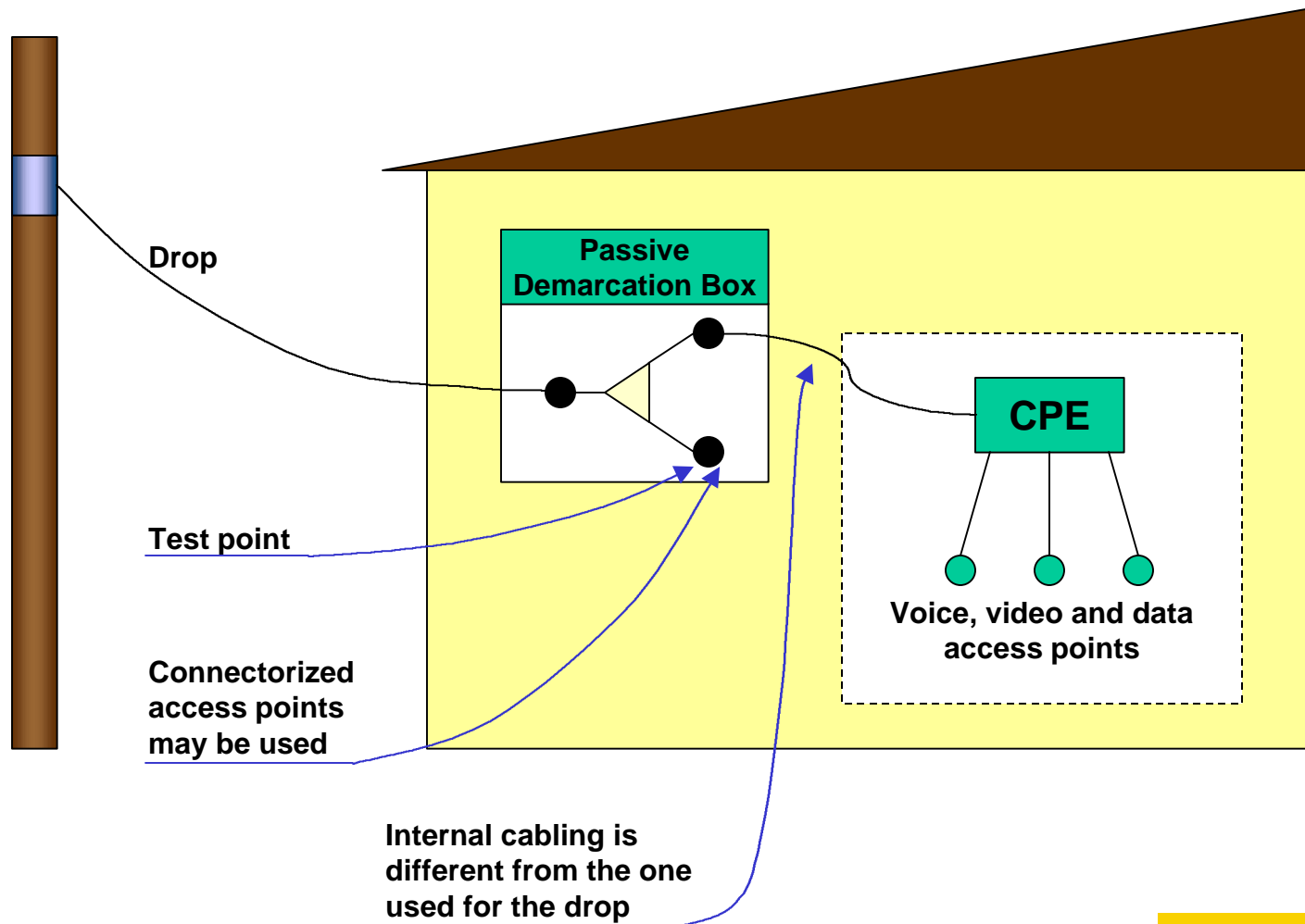
Environmental requirements

- Field equipment
 - Well known requirements
 - Especially important for copper and EP2P
- Home equipment
 - Not as controlled as many people imagine
 - Misplaced units
 - Direct sunlight, lack of ventilation, etc.
 - Biggest concerns
 - Noise, heat and power consumption

Demarcation point

- Passive demarcation point
 - Active equipment can be installed inside the customer premises under his care
 - A passive distribution frame located outside the house is the demarcation point for maintenance
- Active demarcation point
 - Active equipment must be installed outside the customer premises
 - There is no need for a passive distribution frame
- We prefer the passive demarcation point, but other carrier's opinion may (and will) vary
- Regulations may require something different

Passive demarcation point



Flexible L2 topology

- Services offered over IP/L3
- A flexible L2 topology allows for
 - Logical separation of customer traffic via VLANs
 - Good traffic management for multicast/broadcast data
- Requirements
 - Support for large number of VLANs
 - The current limit (4096) may not be enough; this topic deserves more investigation
 - L2 authentication
 - 802.1x
 - PPP-based tunneling

Ease of provisioning

- Plug and play connectivity
 - New units must sync up automatically
 - Service activation may be done later
- Unified management framework
 - Service management is not dependent of physical layer
 - Activation of new services must follow the same basic rules for all PHY options

Security

- Different set of requirements
 - Traditional Ethernet is focused on corporate customers
 - We are public service providers
- We can't fire our customers
- Privacy is key concern for security
 - Isolation of traffic
 - Strong non-intrusive auditing tools
- It's a tradeoff
 - Balance the cost of security risk x implementation
 - Fixing security holes is expensive
 - Do it right

The road for scalability

- **Scalable** means **incremental deployment**
- At the access level
 - Adding new ONUs
- At the backbone level
 - Adding new distributions points
 - Adding new wavelengths in PONs
- At the service level
 - Implementing new service gateways in the core
 - Adding new SU/STB inside the customer premisses

Maintenance issues

- Themes for study
 - Provision of test points
 - Fully optical management systems
 - May be used in PONs
 - To be studied for P2P networks
 - Connectorized drops
- Protection at the access level
 - 1+1, ring - we have to explore the possibilities
 - Don't **overestimate** the importance of protection
 - It's important, but...
 - Conventional access networks are not protected
 - Lots of care to keep the cost low

Business model for CPEs

- Focus on the residential market
 - Customer buys the CPE
 - Free choice of standard CPEs
 - Standard provisioning protocols for new unit activation
- Advantages
 - Customer chooses the one that fits better their needs
 - More competition between vendors
 - Focus on ease to use
 - Faster improvement of the technology
- Interoperability is of utmost importance

Final remarks

- It's Ethernet - keep it simple
- Keep every user connection completely isolated from the other users
- Make it easy to scale to tens of thousands of access points, or more
- Study specific technical solutions for each target application
 - Long reach, scattered customers
 - Short reach, dense neighborhoods
 - Don't force both to use the same technology if it's not clearly better