EFM deployment requirements
A practical overview

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Agenda

- Basic scenario
- Service model
  - Service segregation
  - Provisioning and management issues
- EFM deployment strategy
- Alternate models

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Goal

- To present a practical vision of how can EFM be deployed
- To stablish a context where Service Provider requirements can be discussed and understood

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Assumptions

- Focus on issues that affect EFM design
- Keep it simple and practical
  - Better be simple - we’re just too used to the legacy
  - Operational costs are a big concern
  - Customer service is different
- Avoid absolute requirements
  - No obstacle is unsurmountable...
  - But some things are better if avoided
- This is a **service requirements** presentation
  - Focus on ‘what we need & why we need it’
  - Avoid technical details - better left up for vendors

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Basic scenario

- Expected service offer
  - **'Full service' approach: Voice, Data and Video support**
  - **Consistent service offering, independent of media type**
  - **Predictable performance**
- Impact of regulatory framework
  - Few companies can provide all the services
  - Common combinations: voice + data, video + data
- Possible trends
  - Deregulation: voice, data and video from the same SP
  - **Open access: infrastructure provider, unbundling**
    - Provide hooks to transport more services over the network
    - Leverage SP partnerships to provide complementary services

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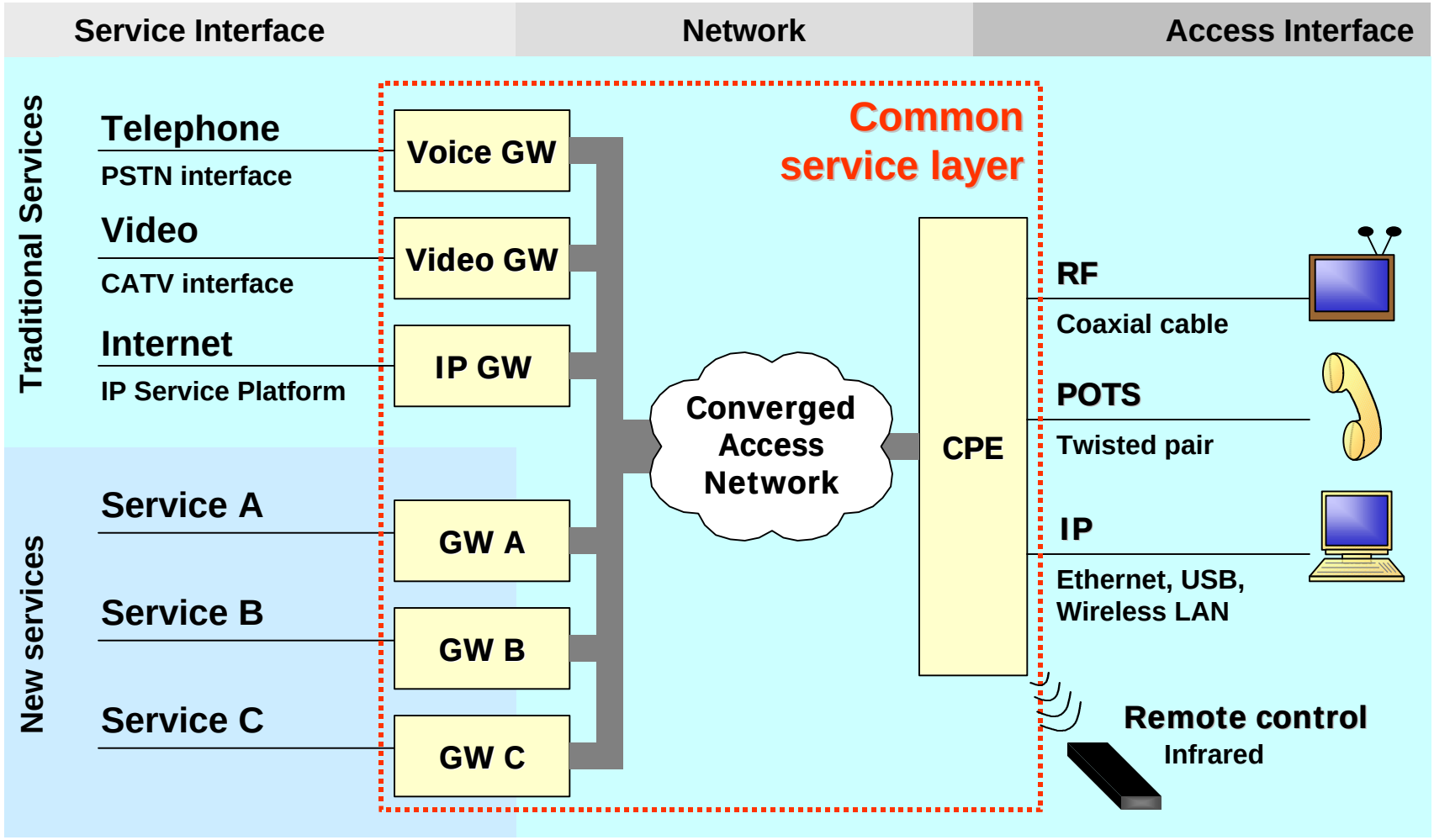
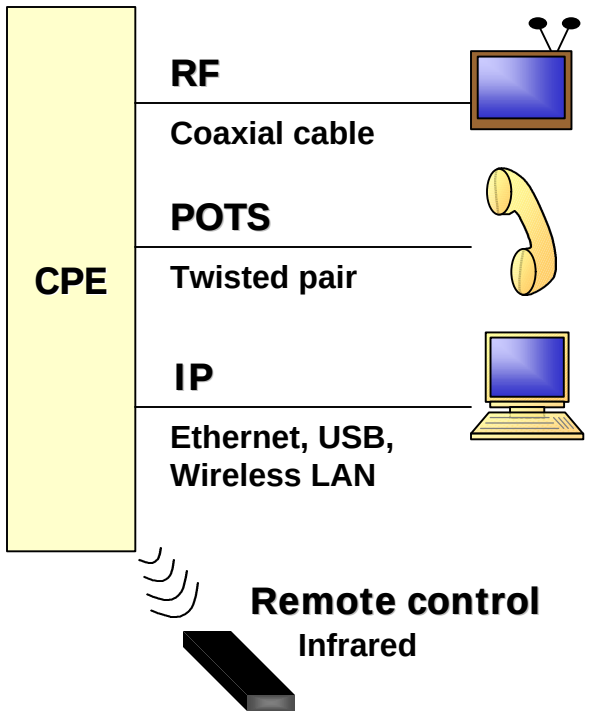
Service reference model

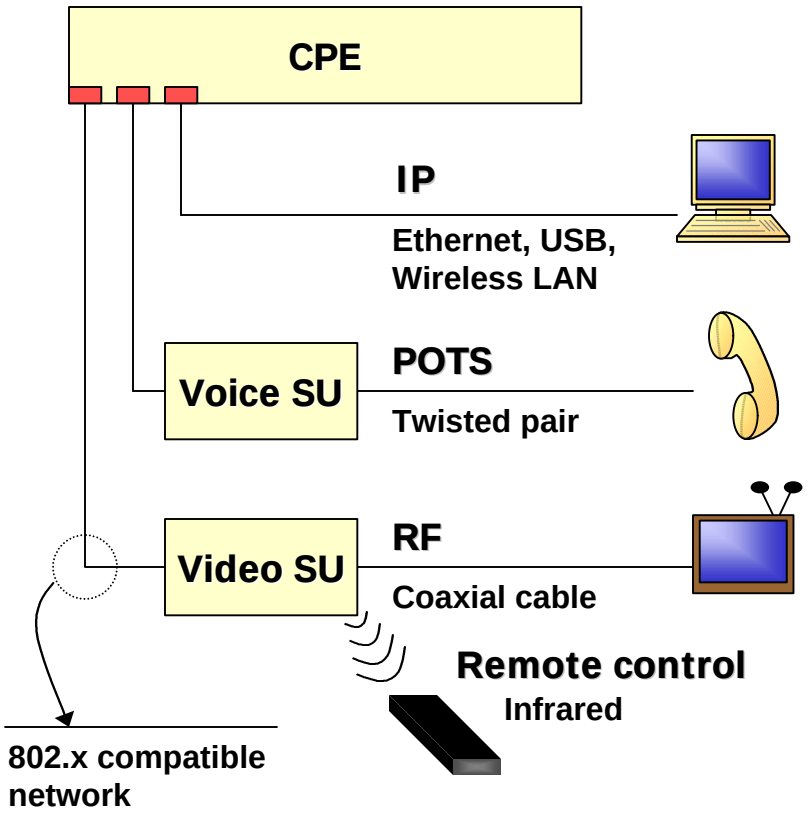


Home network solution

Integrated CPE



Distributed Service Units



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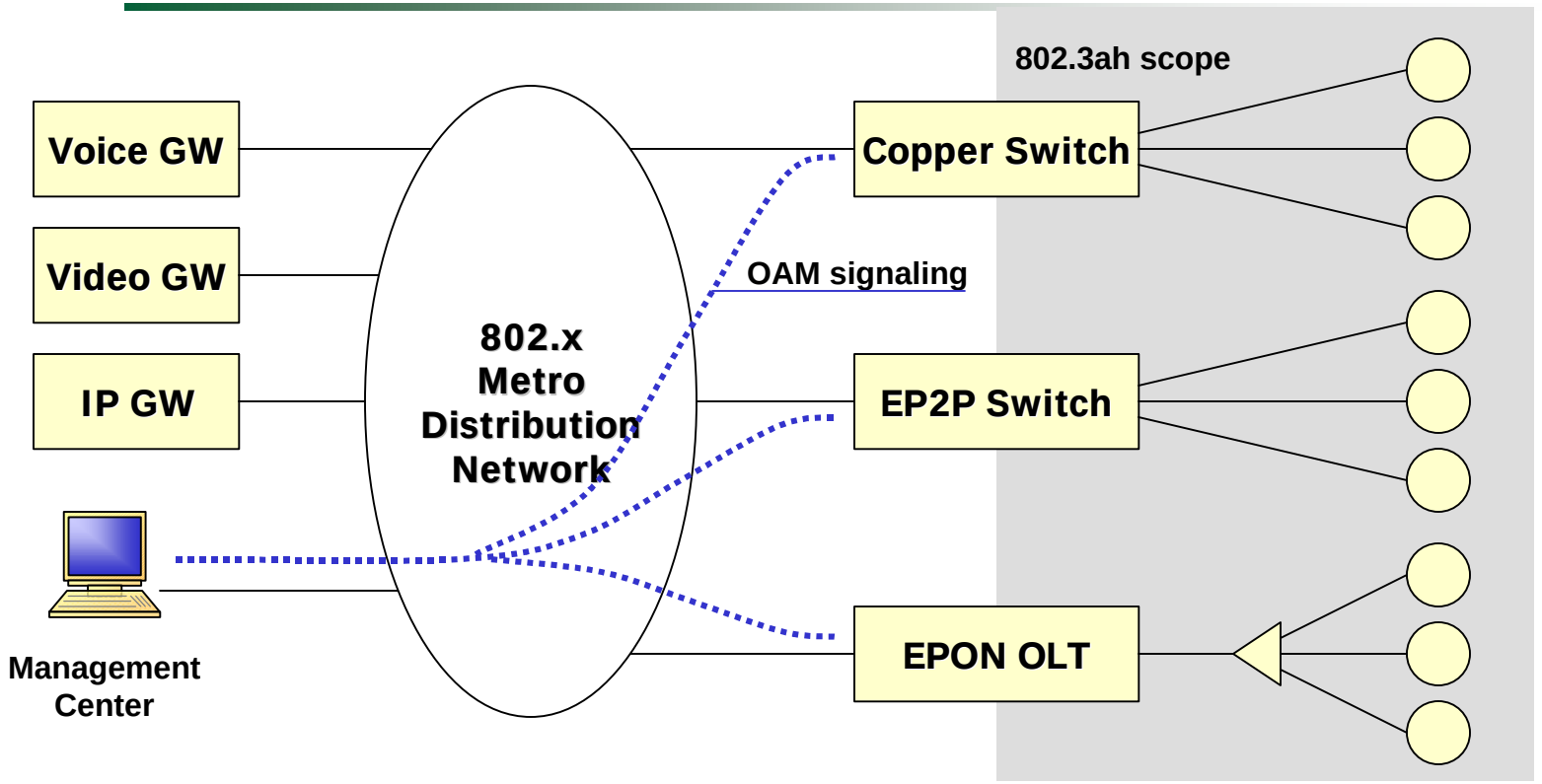
Choice of physical layer



- 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

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Service model

ATM-based × EFM-based

	Existing ATM-based scenario	Proposed EFM-based solution
Segregation	• Dedicated VCs per service (voice, data or video) • PPPoA/PPPoE tunneling for Data/IP service	• Virtual LANs • Virtual MACs • PPPoE tunneling
Provisioning	• Usually rely on PVCs • PPPoA & PPPoE growing in use	• VLAN or VMAC configuration • PPPoE account creation
QoS	• QoS is guaranteed at the VC level	• Map service priority to different queues at the EFM level

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Service model

Topology & provisioning

- ✓ **All links are ‘master-slave’**
  - Direct links between CPEs are **not necessary**
  - Even optical P2P links should follow this rule
    - Back-to-back connection of CPEs should not be possible
  - ✓ **The resulting topology is always a single rooted tree**
- ✓ Provisioning is always controlled by the central node
  - The CPE **never** sends low level provisioning-related requests
    - Improves security of the system
    - Makes it much simpler to implement
  - The CPE can ask for services using IP-based protocols
    - Uses the existing AAA (authentication, authorization, accounting) framework

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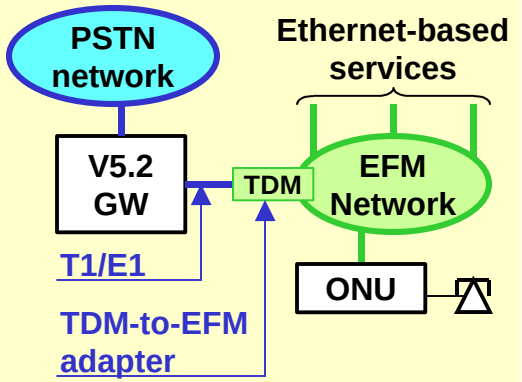
Service model

Voice service

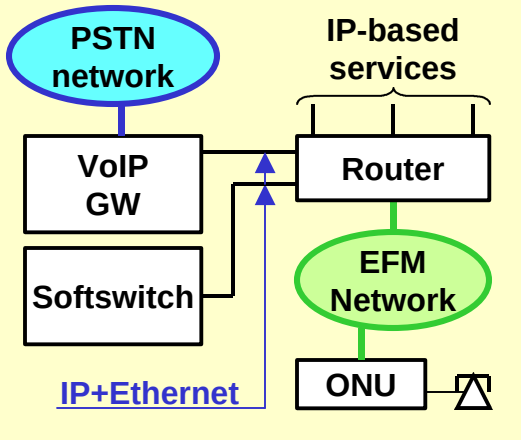
- TDM emulation
  - Access: 64 kbps, circuit emulation, per port
  - Aggregation: V5.2/GR303 interface
  - Uses the installed phone switching base
  - Cost effective approach

Example: TDM emulation



- VoIP - 'Next Generation Network' approach
  - Access: compressed voice, IP-over-Ethernet
  - QoS handled at L3
  - Softswitch-based - easier to deploy new services
  - Still a long way from large scale deployment

Example: Voice over IP



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Service model

Voice service

- Key requirements
  - ✓ **Full segregation of voice services**
  - ✓ **Ability to map voice QoS directly at EFM layer**
  - ✓ **Interoperability between CPEs with voice support**
- Native support for TDM emulation is highly desirable
  - Voice support is a special case for QoS
    - Low bandwidth, bidirectional
    - Native support avoids the need for a generic QoS implementation
  - A frame-based approach can be implemented
    - Works consistently over all media types
  - It makes easier to guarantee interoperability between CPEs

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Service model

Video

- Analog video
  - ✓ ‘Necessary evil’: it’s not possible to rely on digital video only
    - Local content has to be encoded
    - Encoders are way too expensive
- Digital video
  - ✓ MPEG over IP solution
    - MPEG2 and MPEG4 support
    - RTP transport (RFC 2250, RFC 2343, RFC 3016)
  - ✓ Ability to insert video signal received directly from DVB source
  - ✓ Use single copy broadcast to distribute the signal
  - ✓ Keep strict timing on the video transmission

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Service model

The channel selection problem

- **Digital video over the backbone**
  - Transmit all channels simultaneously
- **Digital video inside the home**
  - Main problems
    - Set top boxes are not located close to the ONU
    - Bandwidth is limited inside the home
    - Analog distribution is not an option
      - All channels would need to be decoded at the ONU
  - Possible solutions
    - Use IGMP snooping for channel selection on the home network
    - Map individual video channels to VLANs

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Service model

Working with analog video

- Key requirements
  - ✓ **Reflection can’t be tolerated**
  - ✓ **APC connectors are mandatory**
  - ✓ **Split ratio is limited (practical 1:16)**
- Potential for improvement
  - Minimize the number of analog channels
    - Use only lower channels for analog video
    - Limit bandwidth accordingly
    - May allow use of lower cost lasers for analog video transmission

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Service model

Data services

- ✓ IP-based for all practical purposes
  - Modelled after today's ISP business practices
  - Service offer may include voice and video over IP
- ✓ Key issues
  - Scalable IP address provisioning
    - PPPoE tunneling is the preferred approach
  - Spanning tree protocol is inadequate for large scale networks
    - Interaction with other Ethernet-based networks is a concern
    - Problem may be minimized by tunneling services with PPPoE
  - Service segregation
    - Support for multiple VLANs
    - Virtual MACs + filtering by source, destination, ethertype

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Service model

PPPoE tunneling

- ✓ Advantages
  - Widely deployed, compatible with ISP business practices
  - Easy transition from the dial-up & ADSL model
  - Support authentication and accounting
  - Well defined session setup & tear-up procedures
- ✓ Allow relaxed Ethernet forwarding rules
  - PPPoE-aware ports can filter many packets types
    - Only PPPoE ethertype is accepted
    - Broadcasts: only for PPPoE discovery
    - Unicasts: only between data port and PPPoE terminator
  - Filters can be applied on PPPoE aware ports
    - Improve security, minimize impact of potential loops

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Service model

EFM support for segregation

- Virtual LAN requirements
  - ✓ Already are supported over all media types
  - ✘ Maximum number of VLANs is severely limited
  - ✓ Data services: support for 1q-inside-1q (preserves VLANs for all customers)
- Virtual MAC requirements
  - ✓ Can be combined with filtering to allow segregation
  - ✓ Have to be supported over all media types (Cu, P2P, P2MP)
  - ✓ Dynamic registration: allow ‘on-the-fly’ service provisioning
  - ✓ Map bandwidth requirements to individual VMACs

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Network management

Key requirements

- ✓ Single management framework
  - – Link management
    - • Implementation may depend on the media type
    - • Includes test functionality (loopback, BERT, etc.)
  - – Service management
    - • Should be consistent across all media types
    - • Hints at frame-based approach
- ✓ Classes of messages for service management
  - – Provisioning and service control
    - • Includes filtering (see next slide)
  - – Performance metrics
  - – Alarms and warnings

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Network management

MAC address filtering

✓ **Key requirement for Service Providers**

- Implemented at the ONU (as close to the edge as possible)
- Controlled via OAM (set filter & get filter commands)
- Checks source, destination, ether type

- Applications
  - PPPoE security
  - Voice session protection
  - Broadcast flood prevention
- Open questions
  - Define minimal number of filter entries to be supported

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EFM Deployment Strategy
Copper-based networks

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Requirements for copper operation

- Reach
  - Most brazilian operators have short copper plant
  - Typical loop is under 1 km
  - Old copper (paper isolated) still in use at some locations
- Spectral compatibility
  - ADSL and ISDN deployment
- Low power consumption
  - For use in outdoor equipment
  - Detect inactive units - enter standby mode

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EFM Deployment Strategy
FTTH networks

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EFM Deployment Strategy

Two approaches: Telco × MSO

Telco approach

- Alternatives: ADSL, FSAN
  - Focus on voice and data
- Large installed base of EFM-ready copper wire
- Forgot how to wire the customer home
  - Almost all existing homes are already wired for telephone
  - Operation crew normally works outside of the user home

MSO approach

- Alternative: DOCSIS
  - Video, voice and data
- Know how to wire the customer home
  - It's common to install new coax inside the home
  - Specially true in countries where CATV is newer
- Current network is not EFM ready
  - The fiber part could be leveraged, but the coax is useless

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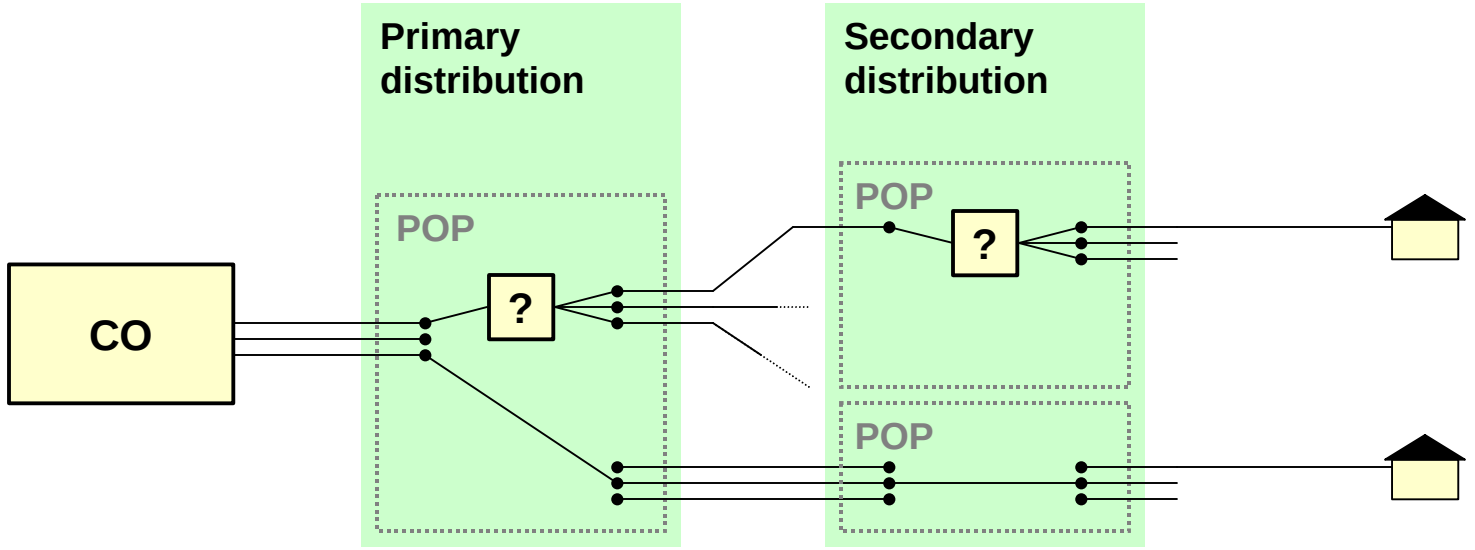
EFM Deployment Strategy

Fiber network architecture



- A fiber-rich architecture allows for flexible deployment
- P2P and P2MP can be supported using the same topology
  - P2P: active nodes on the distribution points
  - P2MP: passive splitters on the distribution points
- Two fibers per home are the safest approach

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P2P & P2MP convergence

Options to be explored

- Physical network topology:
  - Use the same number of fibers
  - Use the same connector type
  - Have similar power budgets, reach, etc
- Common MII implementation:
  - GBIC-like interface
  - Allows for multiple options for the optical components
    - Different MDIs may allow for different reach
  - Makes changing parts easy
- Transceiver module:
  - From optical (P2MP,P2P) to electrical (1000baseTX?)
  - May be installed outside home

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The use of connectors

- Needed at specific points of the plant
  - Test points at the central office and close to the customer
  - Used on internal locations
  - Avoided on external equipment
- Connector requirements
  - Small size, to allow for higher density
  - Mechanical resistance
  - ✓ Good connector design may be one of the decisive factors to make EFM a practical reality

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Inside the customer premises

- Will the fiber go inside the customer premises?
  - ✓ That's the best option: terminate the fiber inside the customer premises, where the ONU can be protected
  - ✘ Practical experience shows that this is highly unlikely, at least for existing buildings
  - ✓ CATV operators have lots of experience with coaxial cable that can be applied
    - The cable is different, but many of the issues are very similar
- Alternative approach
  - Use a 'media converter' interface outside the home
  - Use copper to go inside the home
    - Conventional UTP cable, 1000baseTX

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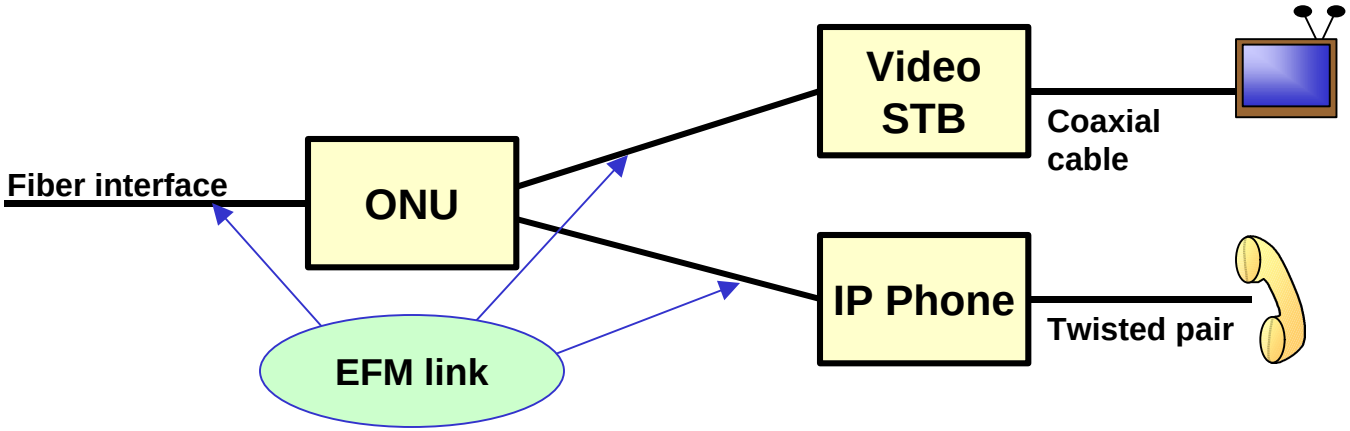
EFM unit cascading



- Current work do not allow for cascading EFM units
- This setup would be useful to allow remote management of all equipment located inside the customer premises
  - OAM frames would need to be forwarded
- Internal wiring can be done using any EFM-compliant media
  - P2P Fiber, VDSL
  - 1000baseTX could be used in this scenario

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Final remarks

Final remarks

- Key requirements
  - **‘Full service’ approach: Voice, Data and Video support**
  - **Consistent service offering, independent of media type**
  - **Predictable performance**
- Other remarks
  - Implement service segregation
    - VLANs, VMACs or tunneling
    - Support for filtering at the MAC layer
  - Master-slave links, even for P2P media
  - Single management framework
  - Evaluate P2P & P2MP convergence options
  - EFM transceivers
  - EFM unit cascading

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