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IEEE P802.3
ETHERNET IN THE FIRST MILE
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Threshold moment for Ethernet

- Ethernet is emerging as an end-to-end standard
- FSAN/ITU PON standard is 10 yrs old, ATM based, only 622Mbps, needs to be renovated
- Copper infrastructure giving ground to fiber
- Companies will start providing fiber-based Ethernet to the home, market penetration will be hampered by fragmentary approaches

Goals: *what are we looking for?*

- Provide standard for a fiber-to-the-home and fiber-to-the-curb based delivery mechanism
- Use the simplest protocol that meets flexibility/upgrade needs
- Allow for simplest CPE equipment that meets the need
- Allow for initial deployment with existing technology
- Right now need copper-terminated variants
- FTTH/FTTC will be much closer by the time a standard is ratified

A broad scope is required

- Many different industries involved (CATV, large carriers, CLECs, etc.)
- Delivery mechanism, format of data on the medium
- Provide for non-VOIP (legacy) telecom service
- Codify the philosophy behind the decisions made on the protocol, the equipment, and the features as seen by the service provider and the end user.
- Standardize the methodology behind upgrading provided services via scalability requirements
- Provide for future delivery of all basic services on the fiber.

End-User Objectives

- Pay for guaranteed bandwidth with always-on service
- Symmetric bandwidth
- Bandwidth to users scaleable in small increments
- Quick turn-around on bandwidth adjustment requests.

Service Provider Objectives

- Ease of management
  - Ability to bill by usage (by-the-bit)
  - Flexible subnet granularity
  - Control and feedback about latency, statistics, security
  - Add new users without service interruption
- Fault isolation capabilities
  - Limit how many homes can be affected by a CPE fault
  - Allow problem source detection while faulted
- Flexibility of configuration
  - Multi-Dwelling-Unit uses same components
  - Same system for homes, businesses, “power users”

Protocol Objectives (1)

- Stop using the same hammer (SONET/ATM) for every problem that comes up
- Simple TDM and TDMA structures provide simple and adequate method for transporting Ethernet and legacy voice
- No transport of control information via the encoded Ethernet packets
  - Fewer SNMP agents than subscribers: Headend equipment is SNMP agent for connected field equipment
  - CPE requires no MAC, IP address
  - Enhances security
  - More robust

Protocol Objectives (2)

- Simple scheme with more security than one based on VLAN tags
- QoS via bandwidth: total of subscriber guaranteed bandwidth does not exceed WAN capabilities.
- Protocol independent transport of the Ethernet data so future protocols can be transported without upgrade
- Forward path data destination fully determined at the headend equipment
- Minimum bandwidth guaranteed, full 10 or 100Mb service given on the fly if available
- 64kbps telephony provisions

Equipment Objectives (1)

- Initial install supports many low data-rate subscribers, then headend equipment is added to increase data rate to each subscriber
- Concentration of hi-end services in the headend
- Customer-premises equipment as simple as possible
- Specify the required subset of switching rules
- DWDM not required at outset
  - DWDM can be transparently added to network later
  - Use and non-use of 1310/1550 WDM part of standard

Equipment Objectives (2)

- Components essentially the same for different targets
  - Equipment suitable for use in Multi-Tenant-Unit applications
  - Same equipment used for home and business subscribers
- CPE has generic plug-in components
  - Ethernet plug-in as CAT-5 copper, fiber, Bluetooth, HPNA
  - Basic telecom
  - Video
- Multiple standard interconnects at the headend (Gigabit Ethernet, 10Gig Ethernet , SONET)

Equipment Objectives (3)

- Ethernet based connections to WAN support 802.3 LACP
- WAN connection equipment required to place data into standard format (sorting) but can do it in different ways (L2, L3, VLAN Tag)
- Standardize pre-aggregated return path data rate at 0.622GHz, 1.2GHz, 2.5GHz, to allow inexpensive initial deployments

Compatibility

- EFM transport is transparent to 802.3 features
  - IEEE standard Virtual Lans (VLANs)
  - Spanning-Tree
  - Link Aggregation Control Protocol

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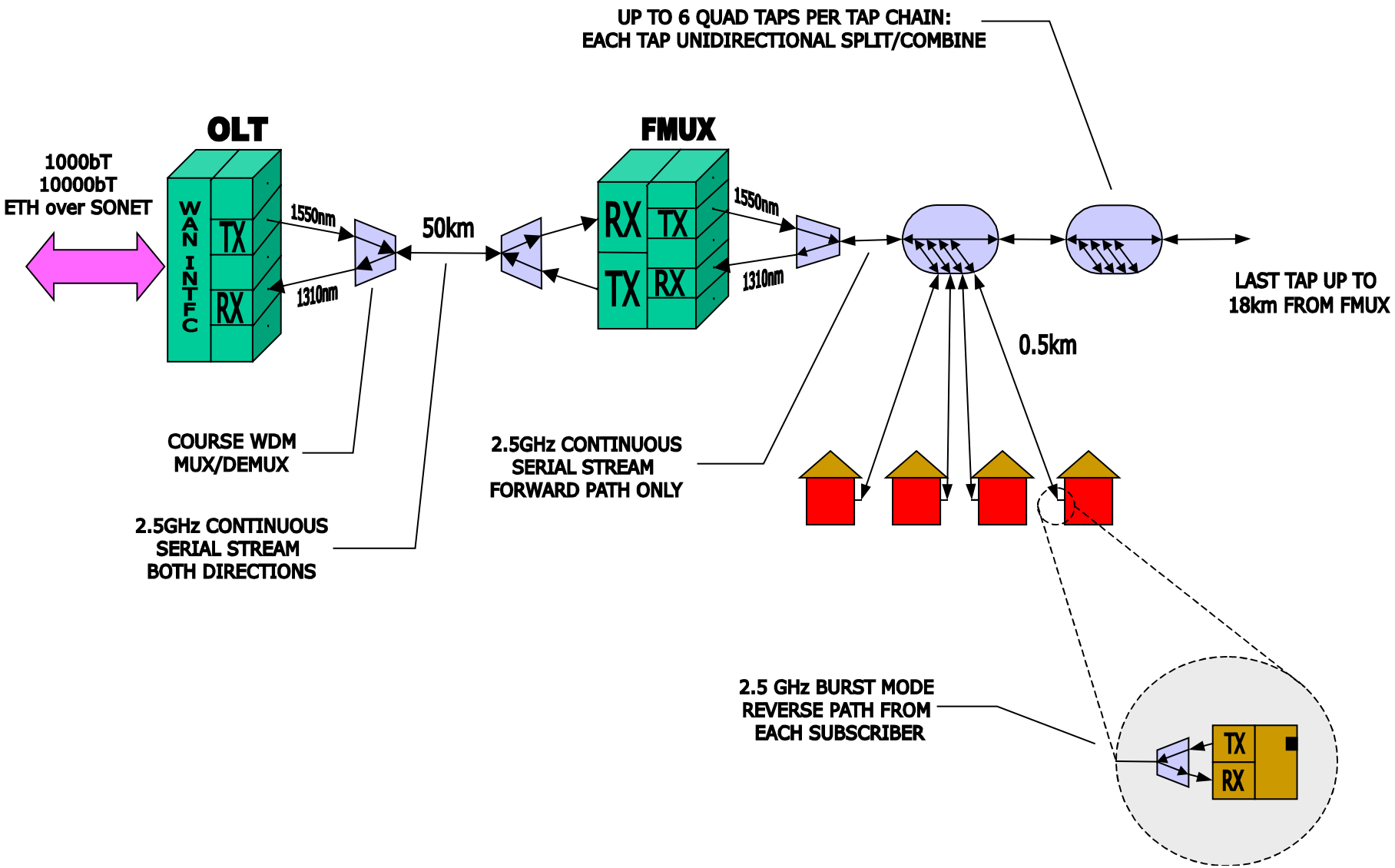
A Sample Architecture

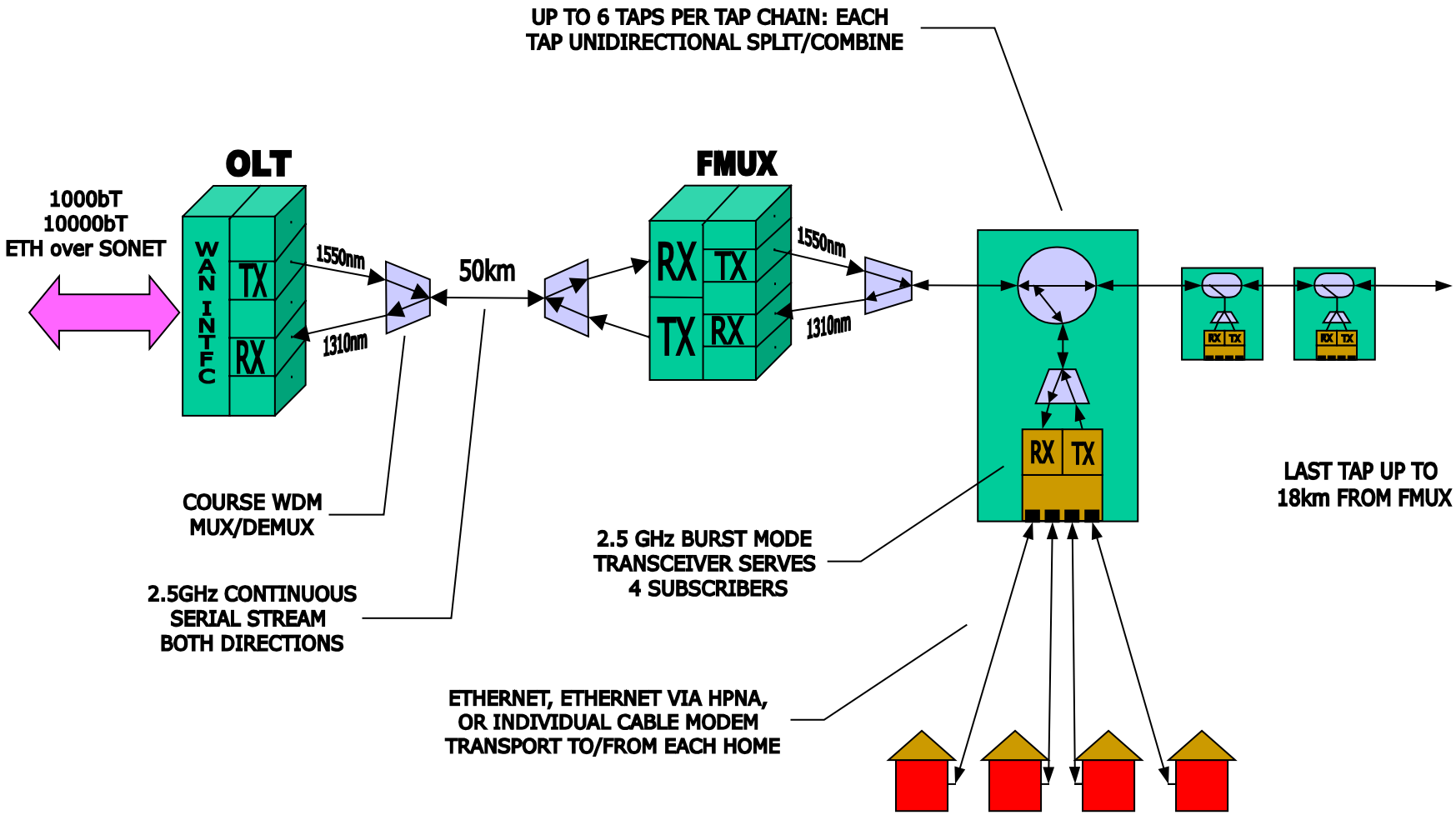
Some Preliminary Data

for Your Consideration

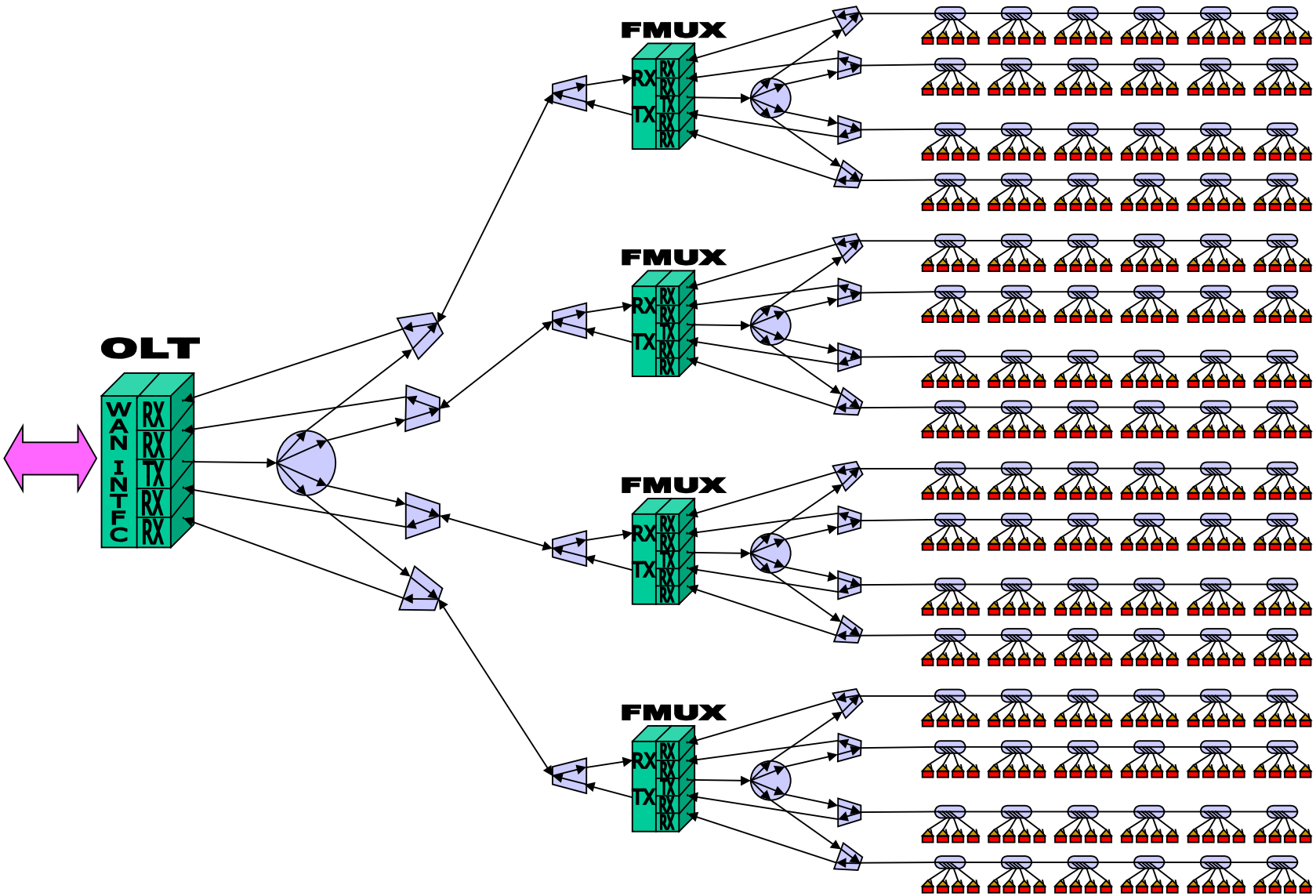
24 homes, 10/100 service mix



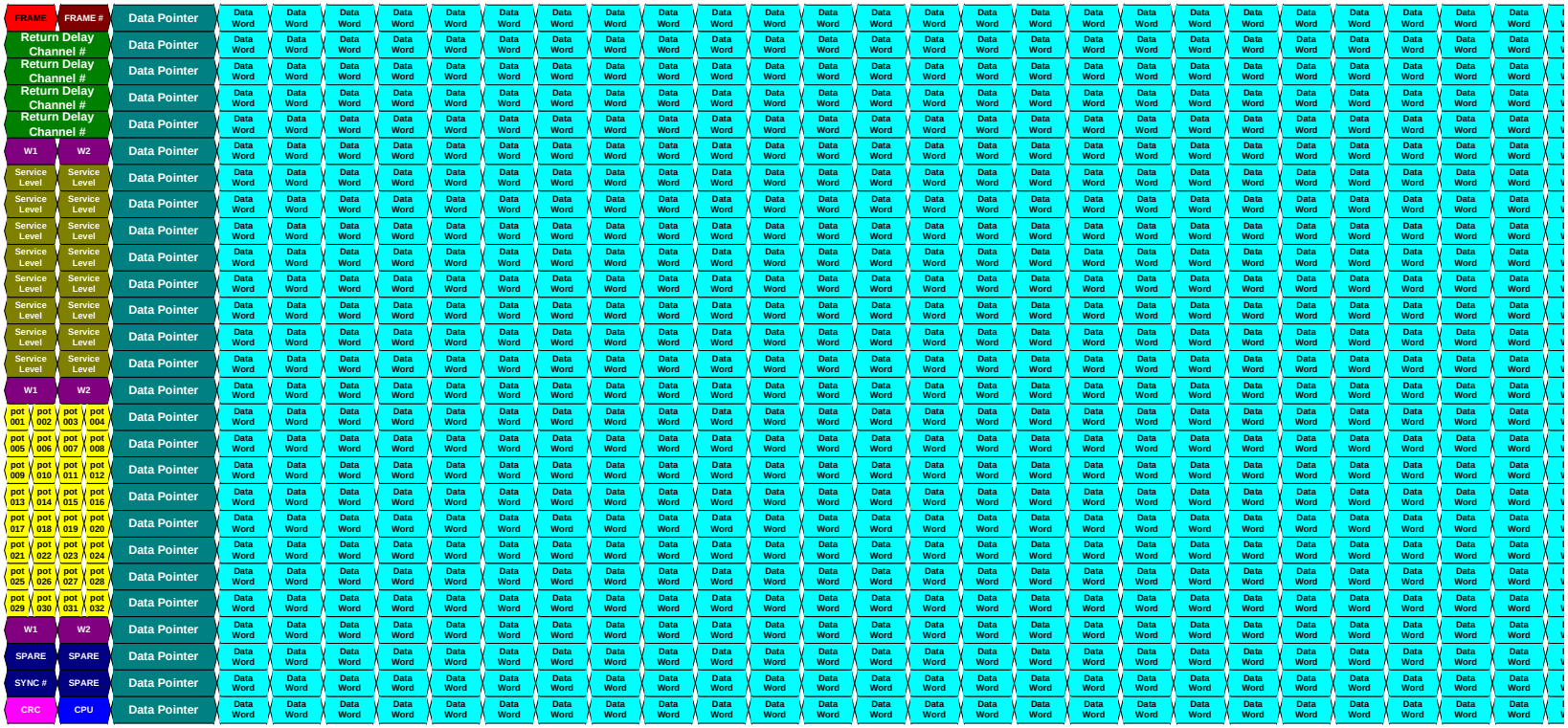
FTTC using curb / pole electronics to serve 4 homes



Single OLT, Quad FMUX, Quad TAP chains, 384 homes served



FRAMING SCHEME



FRAME — Framing "WORD" repeated at 192 kHz '0100 0101 1010 1101'

FRAME # — Framing "COUNT" repeated and advanced at 192 kHz; when "24" reached (8 kHz) rolls over and advances Super Frame Counter

Return Delay Channel # — Callculated Value for return path from TAP

Data Pointer — First 10 Bits Indicate 'Owner' via MAC address pointer, next 3 bits Indicate 'Type', next 5 bits are 'Start Pointer' on word boundry, last 12 bits are 'End Pointer' on byte boundry.

Data Word — Actual Data to be 'Drop Shipped' to User/Costomer

W1 — Data Words sampled at 576 khz (2)

Service Level — Word for Controlling Service's at a Customer Premisses

pot 001 — Byte of POTS designated to user via Service Level Word.

SYNC # — Time Stamp for reference to regenerate 10 Mhz or 100 Mhz as needed.

CRC — Cycle Redundancy Check Word for entire frame for measurment of quality of conn

CPU — Word to be used for CPUs to link up with each other.

Closing Remarks

- Fiber to the home will be here soon
- Aim to provide as many services as possible
- Remember the broad mix of infrastructure providers that will be installing equipment based on this standard