

Ethernet PMDs for
Optical Access Infrastructure Consolidation
(Super-PON)
Call For Interest
Consensus Deck

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(Google)

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CFI Objective

- Measure the interest in studying Ethernet access PMDs for point-to-multipoint and point-to-point operations over a common long-reach optical distribution network leveraging cost effective wavelength division multiplexing techniques
- We do not need to:
 - Fully explore the problem
 - Debate strengths and weaknesses of solutions
 - Choose a solution
 - Create a PAR or 5 Criteria
 - Create a standard
- Anyone in the room may vote or speak

Supporters

Alexander Umnov (Corning)

Bo Wang (China Telecom)

Claudio DeSanti (Google)

Curtis Knittle (CableLabs)

Daisuke Umeda (Sumitomo)

David Lewis (Lumentum)

David Li (Hisense)

Feng Tian (GoFoton)

Frank Effenberger (Huawei)

Glen Kramer (Broadcom)

Guangquan Wang (China Unicom)

Hanhyub Lee (ETRI)

Henk Bulthuis (Kaiaam)

James Wang (Hisense)

Jun Shan Wey (ZTE)

Karen Liu (Kaiaam)

Leo Lin (Finisar)

Liang Du (Google)

Mark Laubach (Broadcom)

Maurizio Valvo (Telecom Italia)

Paul Nikolich (IEEE 802 LMSC Chairman)

Phil Miguelez (Comcast)

Richard Zhou (Charter)

Shikui Shen (China Unicom)

Simin Cai (GoFoton)

Tom Palkert (Macom)

Vince Ferretti (Corning)

Vipul Bhatt (Finisar)

Wanhui He (Accelink)

Weiqing Zhang (Accelink)

Agenda

- Background Information
- Market Need
- Technical Approaches
- Why Now

Current 802.3 Support for Access Networks

- Clause 56 defines Ethernet for subscriber access networks
- Supports Point-to-MultiPoint (P2MP) and Point-to-Point (P2P) PHYs
 - P2MP: 1G-EPON, 10/1G-EPON, and 10/10G-EPON (Clauses 60, 64, 65, 75, 76, 77)
 - P2P: 100BASE-X and 1000BASE-X (Clauses 58, 59, 66)
 - 802.3ca is defining additional PHYs for P2MP
 - 25/10G-EPON, 25/25G-EPON, 50/10G-EPON, 50/25G-EPON, and 50/50G-EPON
 - The Bidirectional Optical Access PHY Study Group is studying additional PHYs for P2P
 - at 10Gb/s and 25Gb/s
- P2MP and P2P operations are defined for different optical distribution networks (ODNs)
 - i.e., current P2MP and P2P access PHYs cannot be connected to the same ODN

Industry Trend

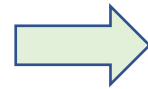
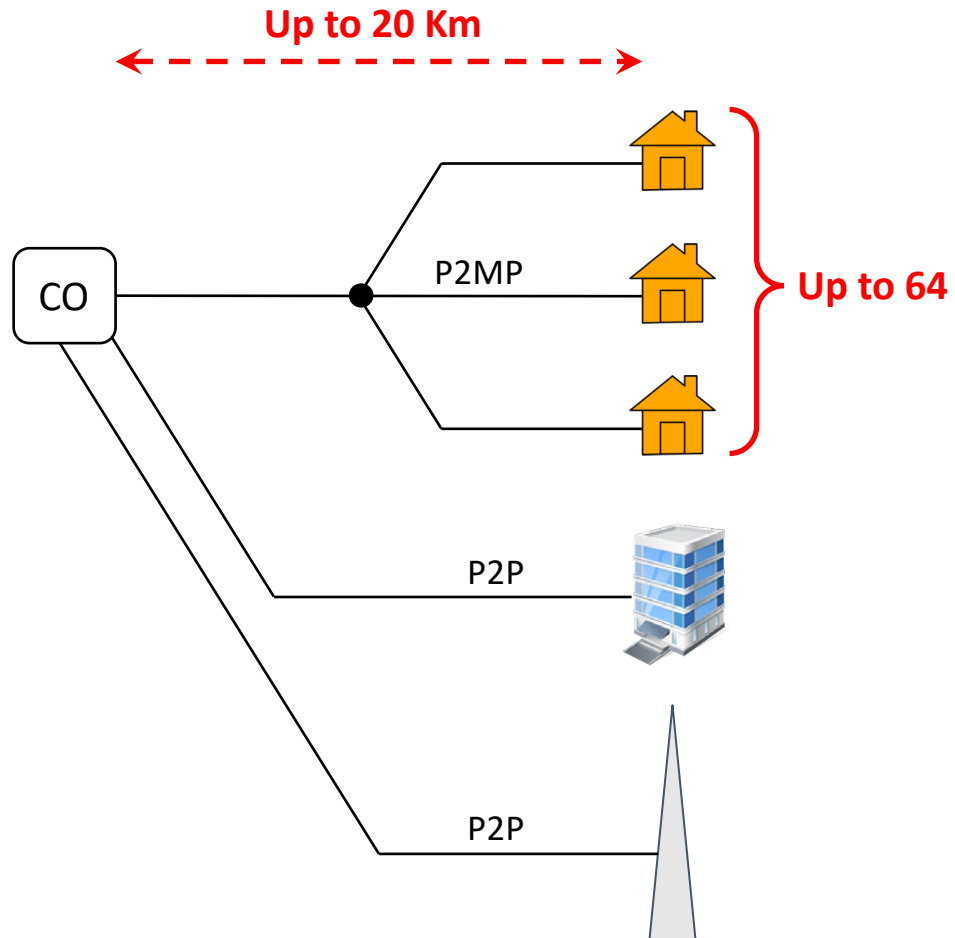
- Consolidation of local and regional offices and infrastructures is an on-going trend for multiple telecommunication operators
- This brings new requirements to the network infrastructure
 - Support longer distances
 - Support multiple channels on the same optical distribution network through wavelength division multiplexing
 - Support multiple P2MP and P2P operations over the same ODN

Enhancing 802.3 Support for Access Networks

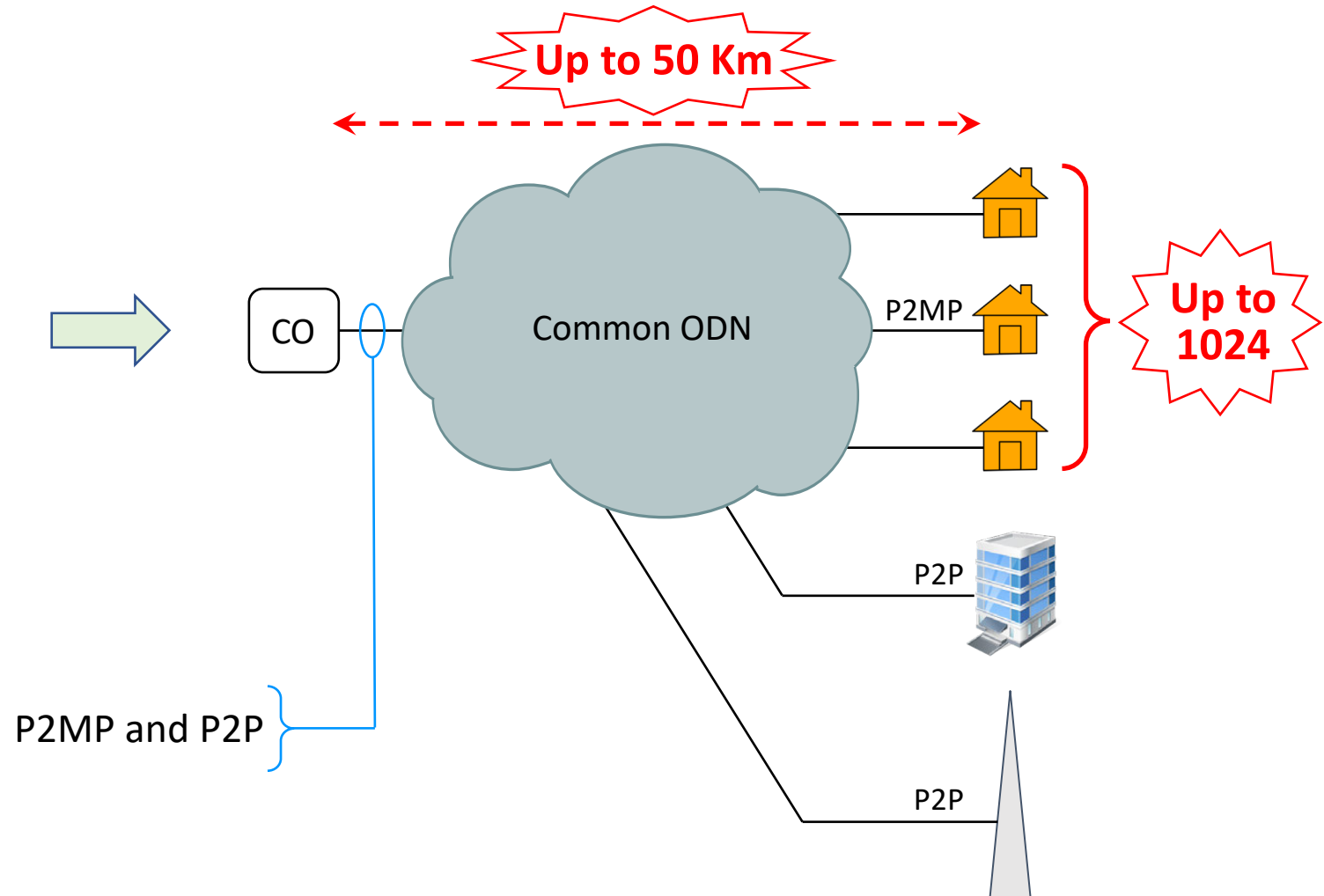
- This study group intends to investigate optical access PMDs to satisfy the optical access network infrastructure consolidation requirements
 - Enable P2MP and P2P operations over a common passive ODN
 - Extend the reach from ~10-20Km to ~40-50Km
 - Increase the number of subscribers per fiber strand from ~64 to ~1024
- Independent from the higher speed definitions of 802.3ca

Super-PON Goal

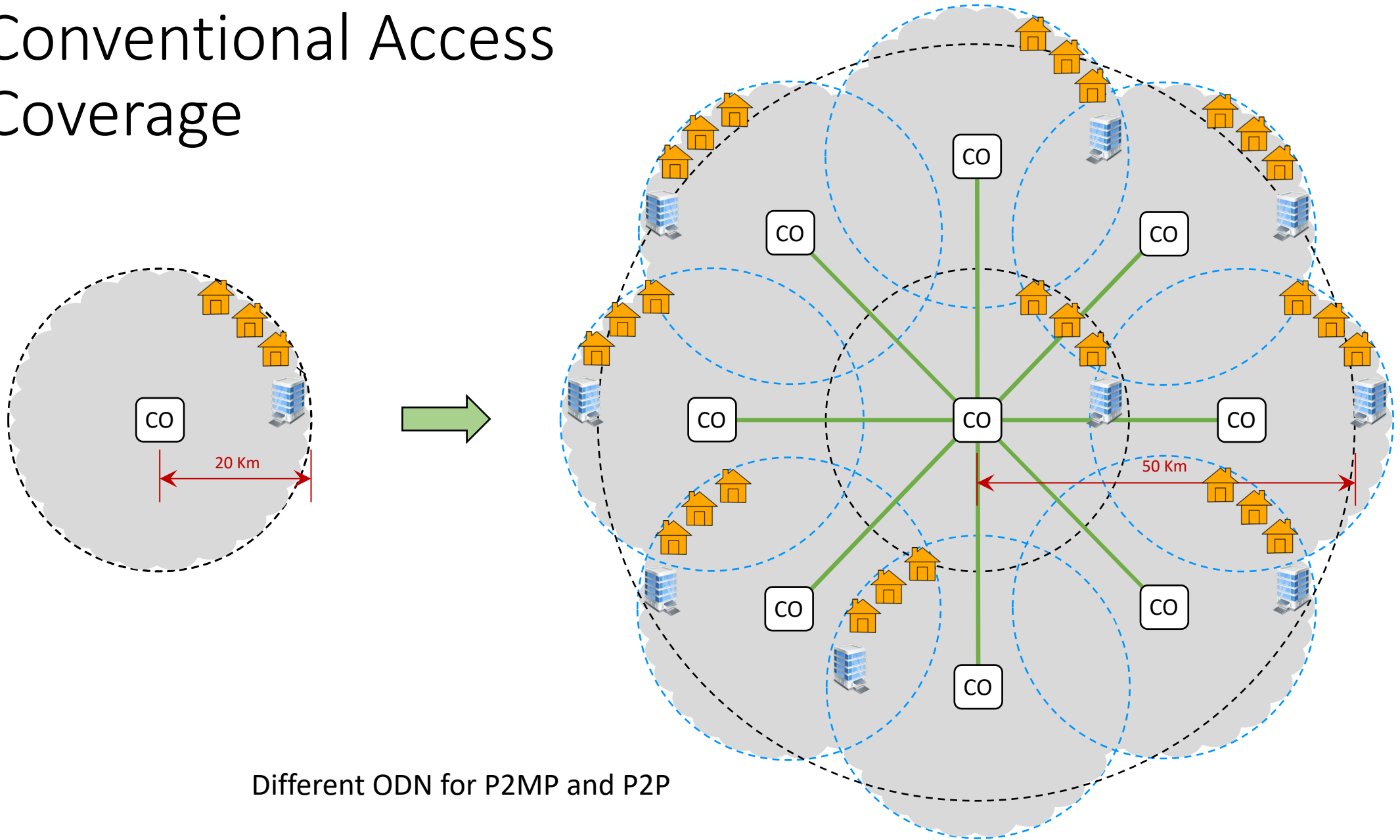
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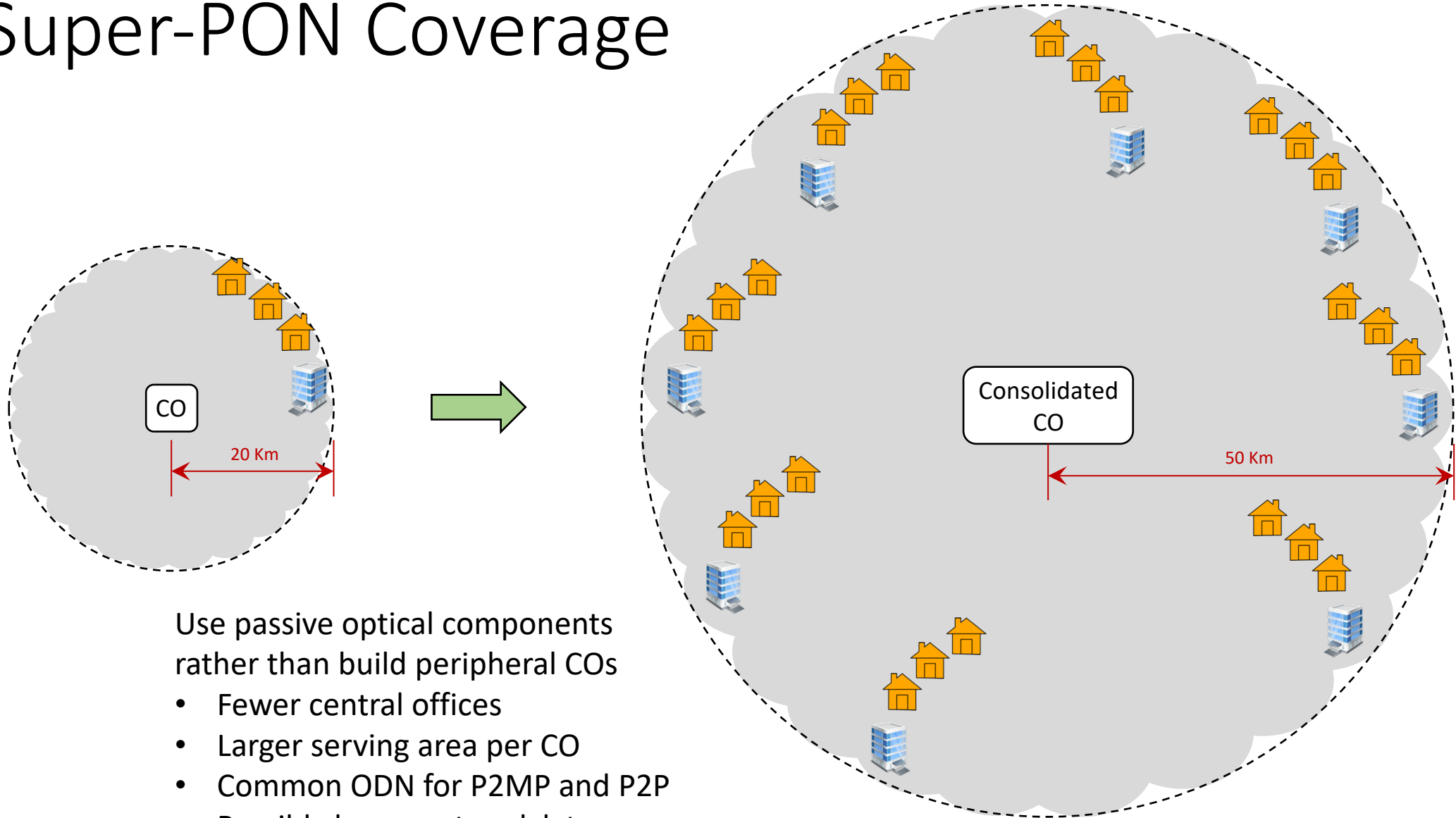
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Conventional Access Coverage



Super-PON Coverage

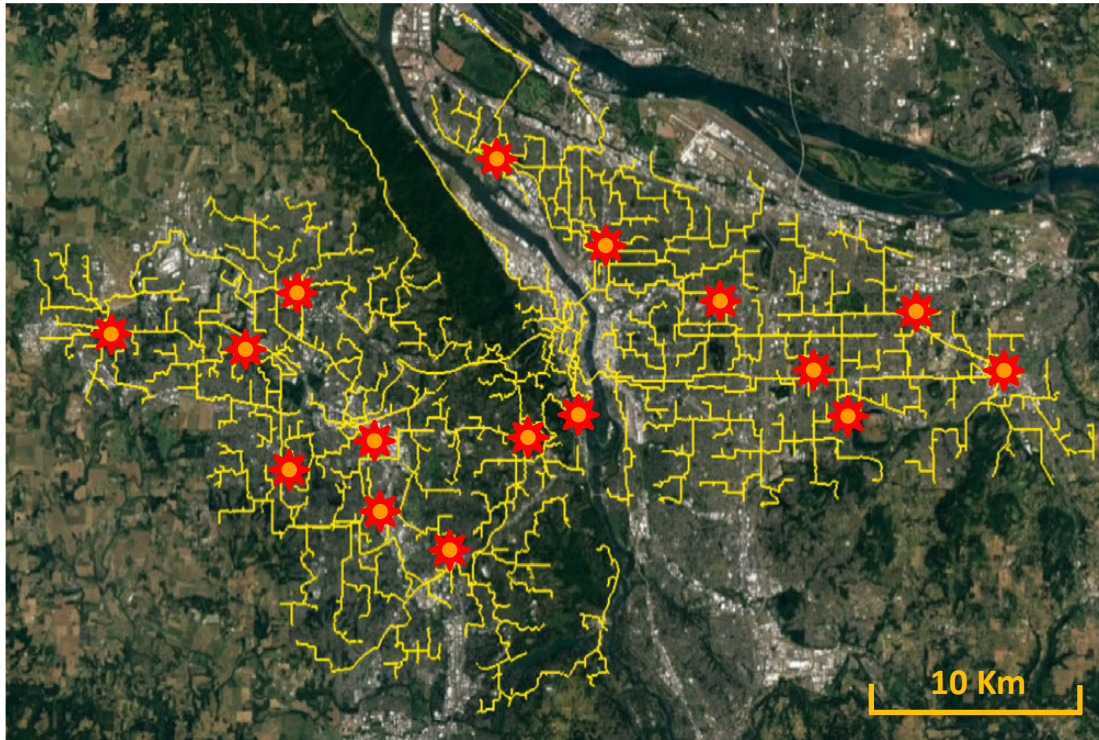


Use passive optical components rather than build peripheral COs

- Fewer central offices
- Larger serving area per CO
- Common ODN for P2MP and P2P
- Possibly lower network latency
- Lower cost by reducing active electronics in the field

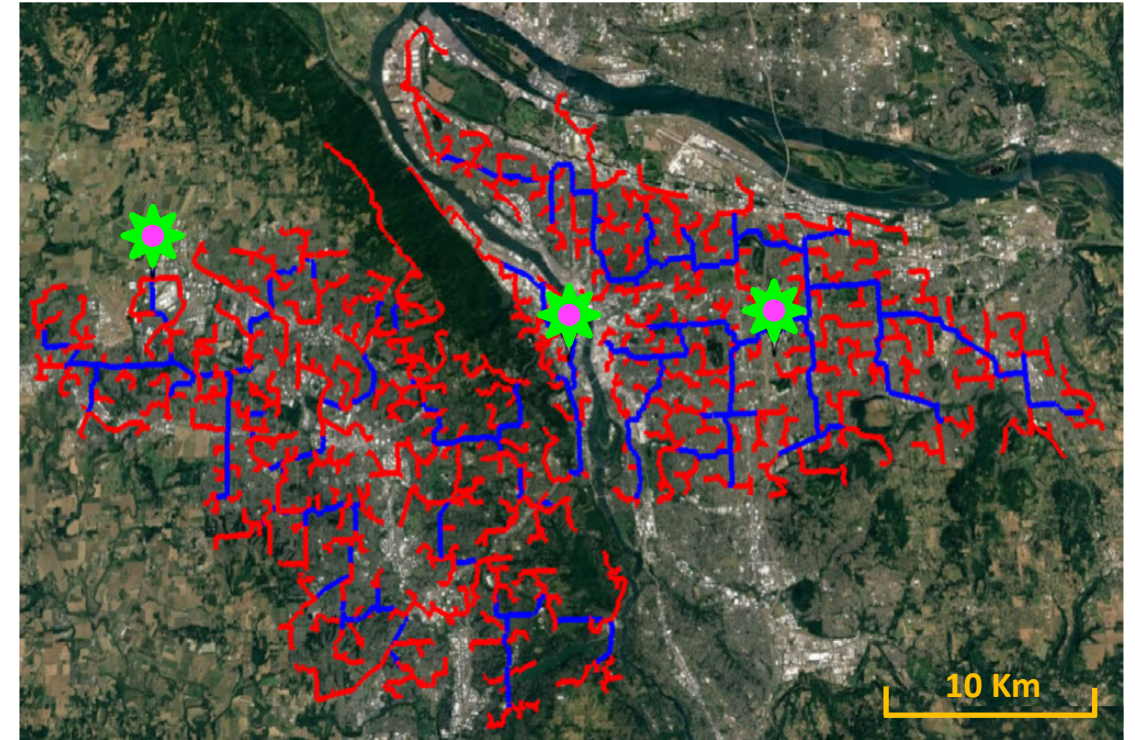
ODN Build Example

Conventional PON: 16 COs



— Feeder fiber

Super-PON: 3 COs



CAWG feeder fiber —
Splitter feeder fiber —

- Fewer central offices
- Lower-count fiber cables
- Less backbone and feeder fiber
- Lower ODN building cost

Reducing Cables Size

Traditional Trenching



Directional Boring



Micro Trenching



Market Opportunity (1)

- PMDs for new ODN builds for developing countries
 - Long reach for rural areas
 - Many countries have government sponsored/funded projects aimed at developing large scale broadband connectivity
 - E.g., Brazil, Indonesia, Thailand, Vietnam, South Africa, Morocco, Kenia, Philippines
 - Example: India's BharatNet project (<http://bbnl.nic.in/>)
 - Aims to provide broadband connectivity to 250,000 Gram Panchayats
 - Goal: increase India's Internet connectivity to 600 million broadband subscribers
 - Specifically tailored to improve telecom services in rural and remote areas of the country
 - E.g., fiber-to-the-home in Telangana (<http://it.telangana.gov.in/telangana-fiber-grid-t-fiber/>)
 - ~ 8M households to connect
- A window of opportunity for Ethernet of several millions PMDs

Market Opportunity (2)

- PMDs for ODN expansion for new residential developments
 - Long reach and broad coverage enable reducing active electronics in the field
- PMDs for ODN expansion to peripheral/rural areas
 - Peripheral areas are difficult to serve not just in developing countries

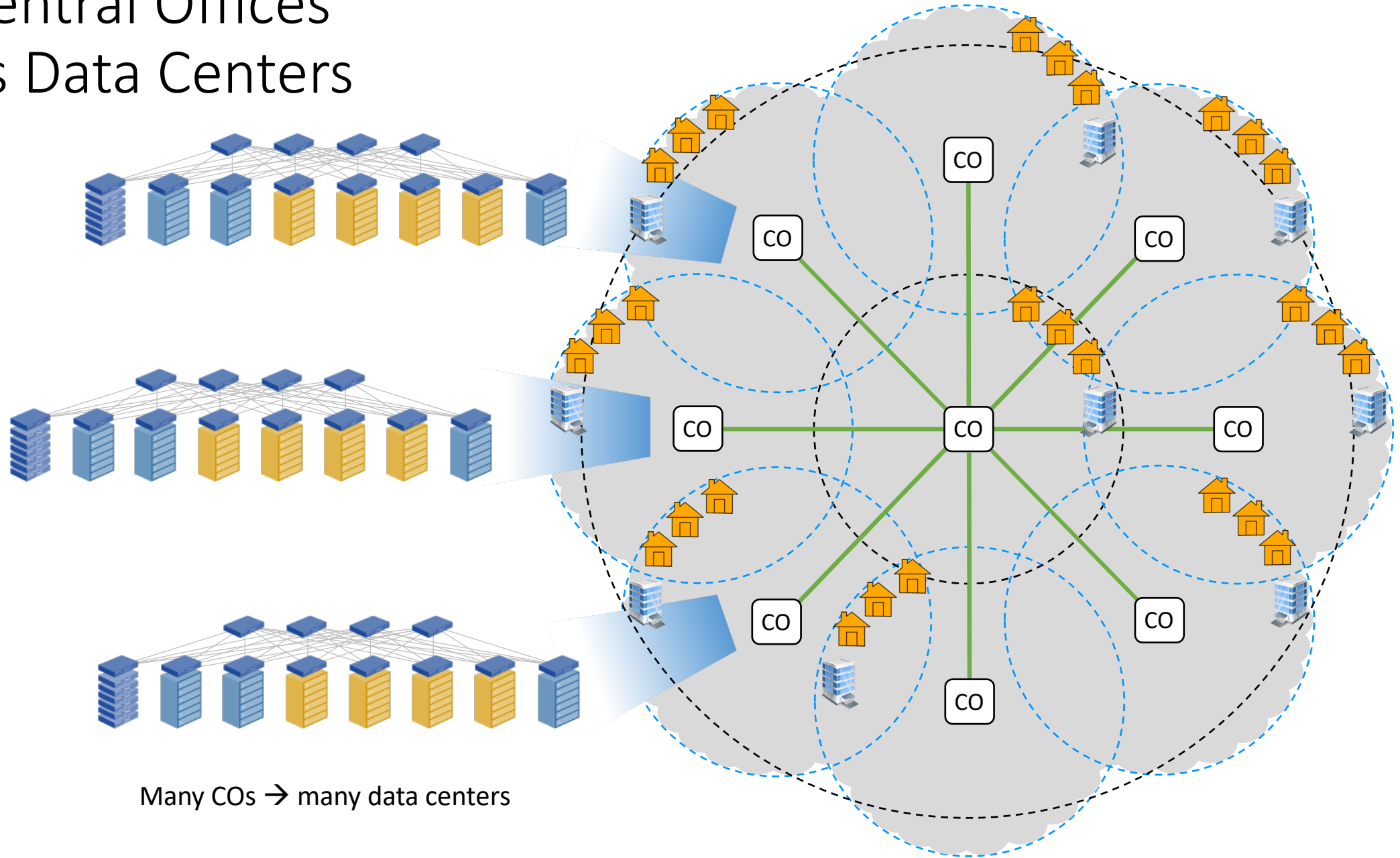
Market Opportunity (3)

- PMDs for ODN optimization for cellular deployments
 - Potentially a major application of Super-PON P2P PMDs
- Potential market
 - 3B people / (100 people / RU) / 10 year rollout = 3M P2P PMDs / year
 - Customers willingness to pay is significantly higher for P2P PMDs (i.e., business customers) than for P2MP PMDs (i.e., residential customers)

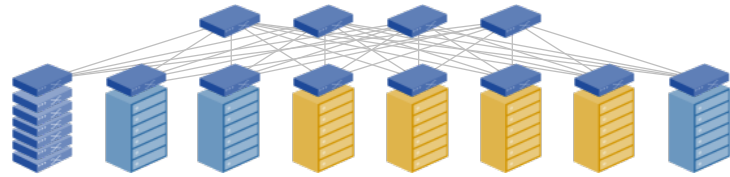
Market Opportunity (4)

- PMDs for ODN optimization for central office redesign as data center
 - Consolidation of local and regional offices
- Multiple efforts are on-going to re-implement the central office functionalities as a data center
 - Not cost effective with many COs
 - More viable by consolidating COs or by building ODNs with fewer COs

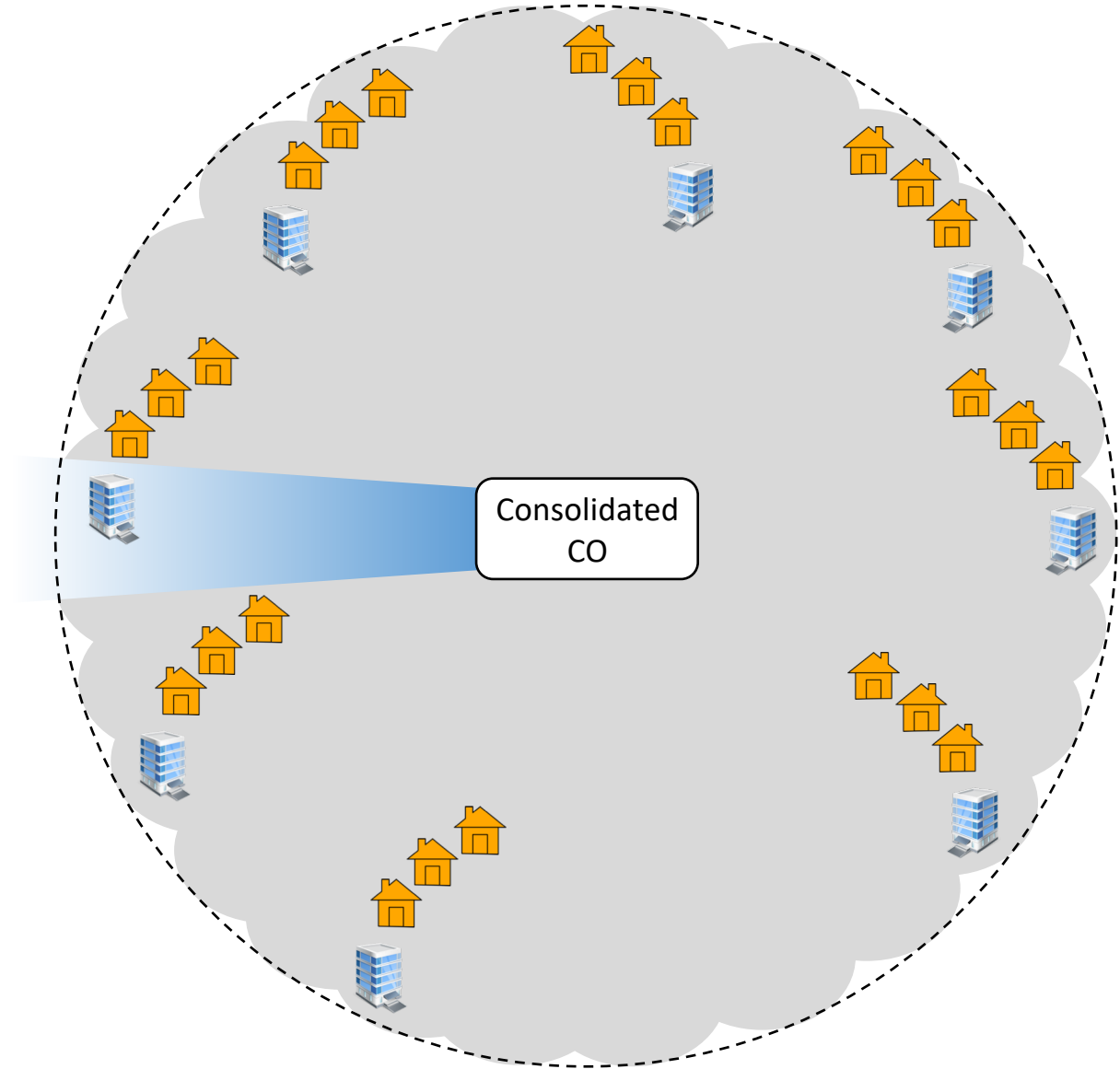
Central Offices as Data Centers



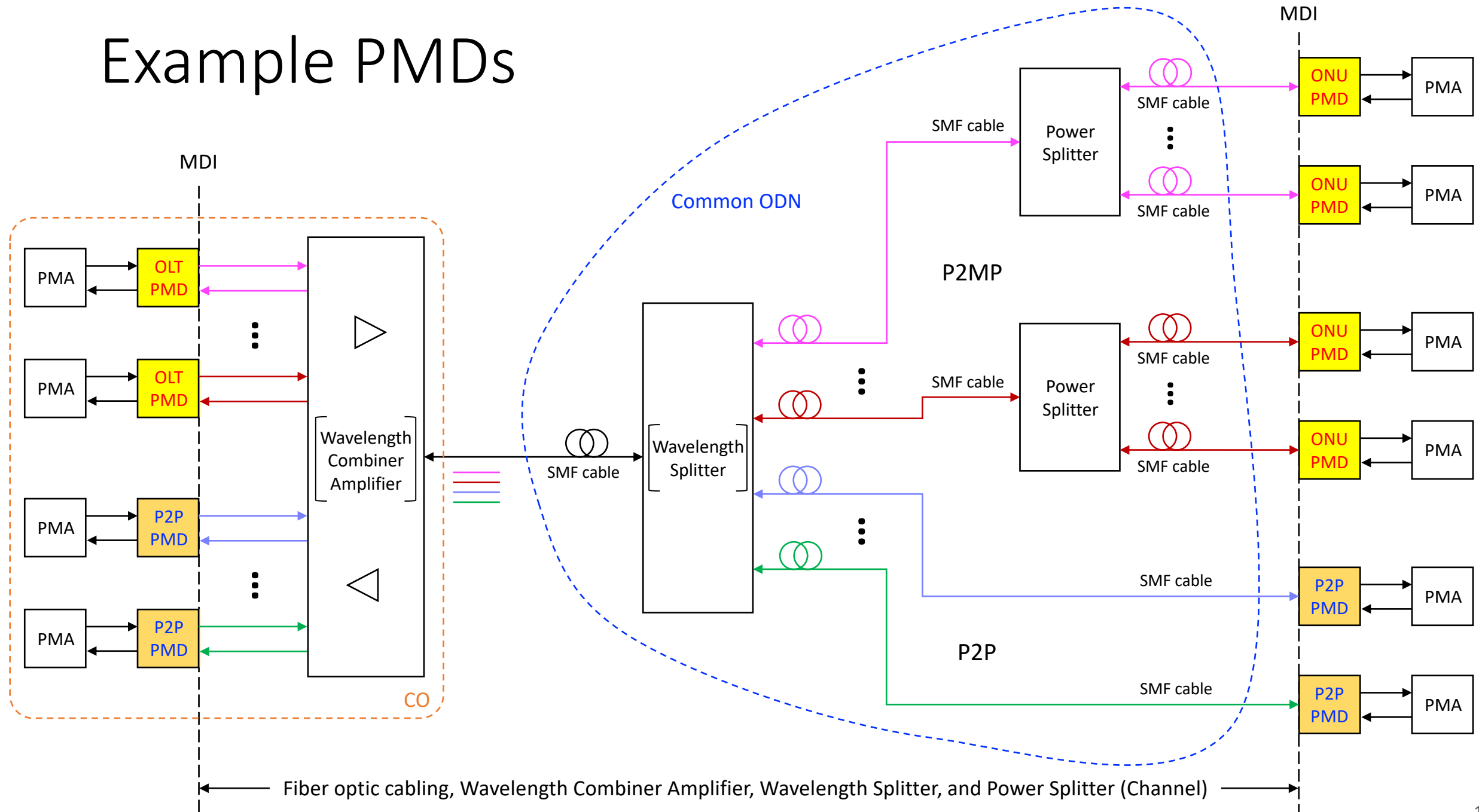
Data Center in Consolidated CO



Consolidated CO data center



Example PMDs



Possible Solution Components

- Wavelength division multiplexing
 - Multiplex multiple channels over a single feeder fiber
 - Separate the channels in the ODN
- Amplification in the central office
 - Long reach
 - Shared amplifiers for all channels to reduce the cost
- Common ODN for P2MP and P2P operations
 - Wavelengths can carry P2MP or P2P channels
- Feasible with current technologies
 - A proof-of-concept has been deployed

Speed Support

- Goal: leverage the already defined PCS and PMA sublayers for both P2MP and P2P applications
 - i.e., DO NOT define new PCS and/or PMA
 - A PMD-only study group (with a possible exception below)
- Support already defined speeds
 - e.g., 10G-EPON for P2MP (upstream and downstream)
 - e.g., 10GBASE-R for P2P
- Possible exception: a 2.5Gb/s upstream EPON speed
 - Because preliminary investigations show a 10G/2.5G asymmetric ONU could be very cost effective for residential use
 - A downclock of already defined higher speed PCS and PMA
 - The study group will decide

Why Now?

- Infrastructure is growing significantly in developing countries
 - A window of opportunity for Ethernet of several millions PMDs
- The need for broadband requires ODN expansion and optimization for emerging applications
 - Next generation cellular field trials are underway
 - Central offices are beginning to migrate to data center architectures
 - New residential developments need to be served
 - Peripheral/rural areas are still underserved
- Existing standard interfaces do not provide the needed reach and aggregation over a common ODN for both P2MP and P2P operations
 - E.g., Ethernet 1G-EPON, 10G-EPON, 100BASE-X, 1000BASE-X
 - E.g., XG(S)-PON, NG-PON2

Thank you

Proposed Motion (1)

- Study Group Name:
Ethernet PMDs for Optical Access Infrastructure Consolidation (Super-PON)
- Move that the IEEE 802.3 Working Group request the formation of a Study Group to develop a Project Authorization Request (PAR) and Criteria for Standards Development (CSD) responses for 'Ethernet PMDs for Optical Access Infrastructure Consolidation (Super-PON)', aimed at investigating PMDs for point-to-multipoint and point-to-point access operations over a common long-reach optical distribution network, leveraging cost effective wavelength division multiplexing techniques and existing PCS and PMA definitions (e.g., 10G-EPON and 10GBASE-R), and possibly defining a 2.5Gb/s EPON PCS and PMA for upstream operations

Proposed Motion (2)

- Study Group Name:
Ethernet PMDs for Optical Access Infrastructure Consolidation (Super-PON)
- Move that the IEEE 802.3 Working Group request the formation of a Study Group to develop a Project Authorization Request (PAR) and Criteria for Standards Development (CSD) responses for ‘Ethernet PMDs for Optical Access Infrastructure Consolidation (Super-PON)’, aimed at investigating Ethernet PMDs for point-to-multipoint and point-to-point access operations over a common long-reach optical distribution network:
 - leveraging cost effective wavelength division multiplexing techniques;
 - re-using existing PCS and PMA definitions (e.g., 10G-EPON and 10GBASE-R); and
 - possibly defining 2.5Gb/s EPON PCS and PMA for upstream operations.

Proposed Motion (3)

- Study Group Name:
P2MP and P2P Ethernet PMDs for Consolidated Long-reach Optical Access Infrastructure (Super-PON)
- Move that the IEEE 802.3 Working Group request the formation of a Study Group to develop a Project Authorization Request (PAR) and Criteria for Standards Development (CSD) responses for 'P2MP and P2P Ethernet PMDs for Consolidated Long-reach Optical Access Infrastructure (Super-PON)',
 - leveraging cost effective wavelength division multiplexing techniques;
 - re-using existing PCS and PMA definitions (e.g., 10G-EPON and 10GBASE-R); and
 - possibly defining 2.5Gb/s EPON PCS and PMA for upstream operations.

Straw Poll (1)

- Should a Study Group be formed?
 - Y:
 - N:
 - Abs:
- Room count:

Straw Poll (2)

- Would I participate in such a Study Group?
 - Y:
 - N:
 - Abs:

Straw Poll (3)

- Would my company support participation in such a Study Group?
 - Y:
 - N:
 - Abs:

Thank you

Call For Interest

The IEEE 802.3 Ethernet Working Group continues to develop standards to scale the speed of Passive Optical Networks (PONs) and point-to-point access networks.

There is a growing need to further scale the coverage and reach of PONs to cover more customers at a greater distance from a Central Office.

There is also an opportunity to define a common optical infrastructure to support both point-to-multipoint (P2MP) and point-to-point (P2P) operations.

This means standardizing new Ethernet Access PMDs for P2MP and P2P operations over a common long reach optical infrastructure through cost effective wavelength division multiplexing techniques.

The Study Group intends to leverage existing PCS and PMA definitions and may consider defining a 2.5Gb/s EPON PCS and PMA for upstream operations.

This Call for Interest is to assess the support for the formation of a Study Group to explore the development of these new Ethernet Access PMDs.