Ethernet Access PMDs for Central Office Consolidation (Super-PON)
Call For Interest

Consensus Deck

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- **All IEEE-SA standards meetings shall be conducted in compliance with all applicable laws, including antitrust and competition laws.**

  - **Don't discuss the interpretation, validity, or essentiality of patents/patent claims.**

  - **Don't discuss specific license rates, terms, or conditions.**

    - Relative costs of different technical approaches that include relative costs of patent licensing terms may be discussed in standards development meetings.

      - **Technical considerations remain the primary focus**

  - **Don't discuss or engage in the fixing of product prices, allocation of customers, or division of sales markets.**

  - **Don't discuss the status or substance of ongoing or threatened litigation.**

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- **IEEE 802 Working Group membership is by individual; "Working Group members shall participate in the consensus process in a manner consistent with their professional expert opinion as individuals, and not as organizational representatives". (subclause 4.2.1 "Establishment", of the IEEE 802 LMSC Working Group Policies and Procedures)**

- **Participants have an obligation to act and vote as an individual and not under the direction of any other individual or group. A Participant's obligation to act and vote as an individual applies in all cases, regardless of any external commitments, agreements, contracts, or orders.**

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  - (Latest revision of IEEE 802 LMSC Working Group Policies and Procedures: http://www.ieee802.org/devdocs.shtml)

CFI Objective

- Measure the interest in studying Ethernet subscriber access PMDs for point-to-multipoint operations over an increased-reach optical distribution network leveraging 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 CSD responses
  - Create a standard
- Anyone in the room may vote or speak

Agenda

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

Current 802.3 Support for Access Networks

- Clause 56 defines Ethernet for optical subscriber access networks
  - Aka EFM (Ethernet in the First Mile),
    see [EFM Tutorial](#), [EFM PAR/5C](#), [EFM Objectives](#)

- Point-to-MultiPoint (P2MP) PHYs
  - 1G-EPON, 10/1G-EPON, and 10/10G-EPON (Clauses 60, 64, 65, 75, 76, 77)
  - 802.3ca is defining additional PHYs for P2MP
    - 25/10G-EPON, 25/25G-EPON, 50/10G-EPON, 50/25G-EPON, and 50/50G-EPON

- Single fiber bidirectional Point-to-Point (P2P) PHYs
  - 100BASE-BX and 1000BASE-BX (Clauses 58, 59, 66)
  - The Bidirectional Optical Access PHY Study Group is investigating more PHYs
    - at 10Gb/s and 25Gb/s

Industry Trend

- Consolidation of local and regional offices is an on-going trend for multiple telecommunication operators

- This brings new requirements to the subscriber access infrastructure
  - Support longer distances
 - Support an higher number of subscribers on the optical distribution network (ODN)

Enhancing 802.3 Support for Access Networks

- This study group intends to investigate optical subscriber access PMDs to achieve the following goals:
  - Extend the reach from ~10-20 km to ~40-50 km *
  - Increase the number of subscribers per fiber strand from ~64 to ~1024 * leveraging wavelength division multiplexing
  - Keep active equipment inside Central Offices (COs)

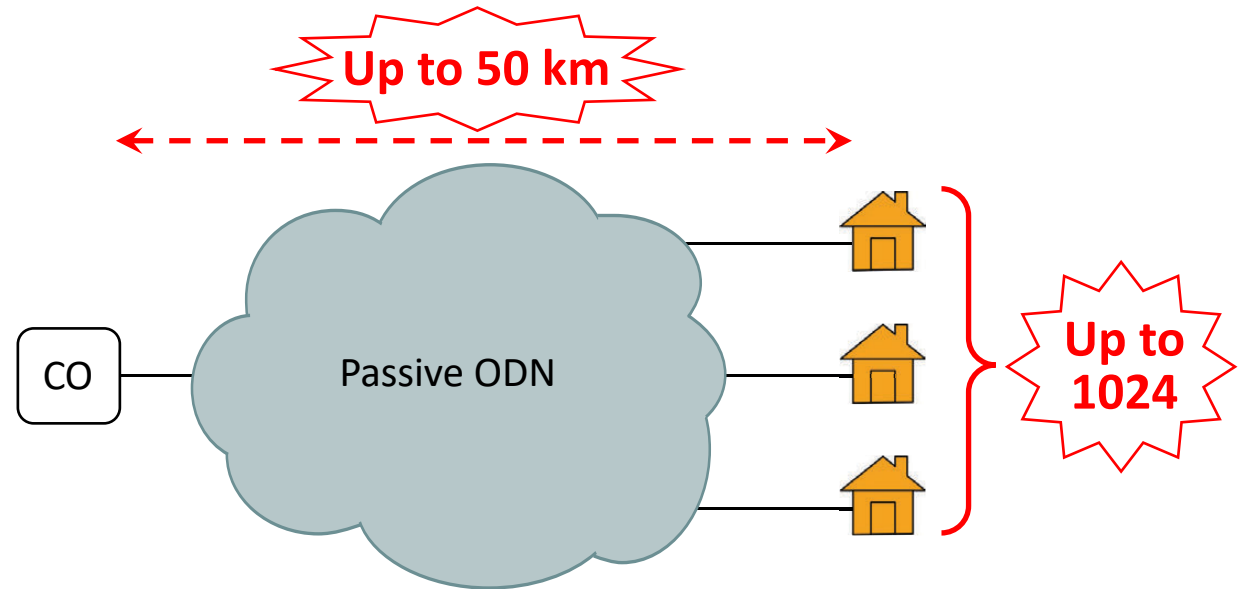- Independent from the higher speed definitions of 802.3ca

* The reach and number of subscribers come from link power budget limits and can be traded off against each other
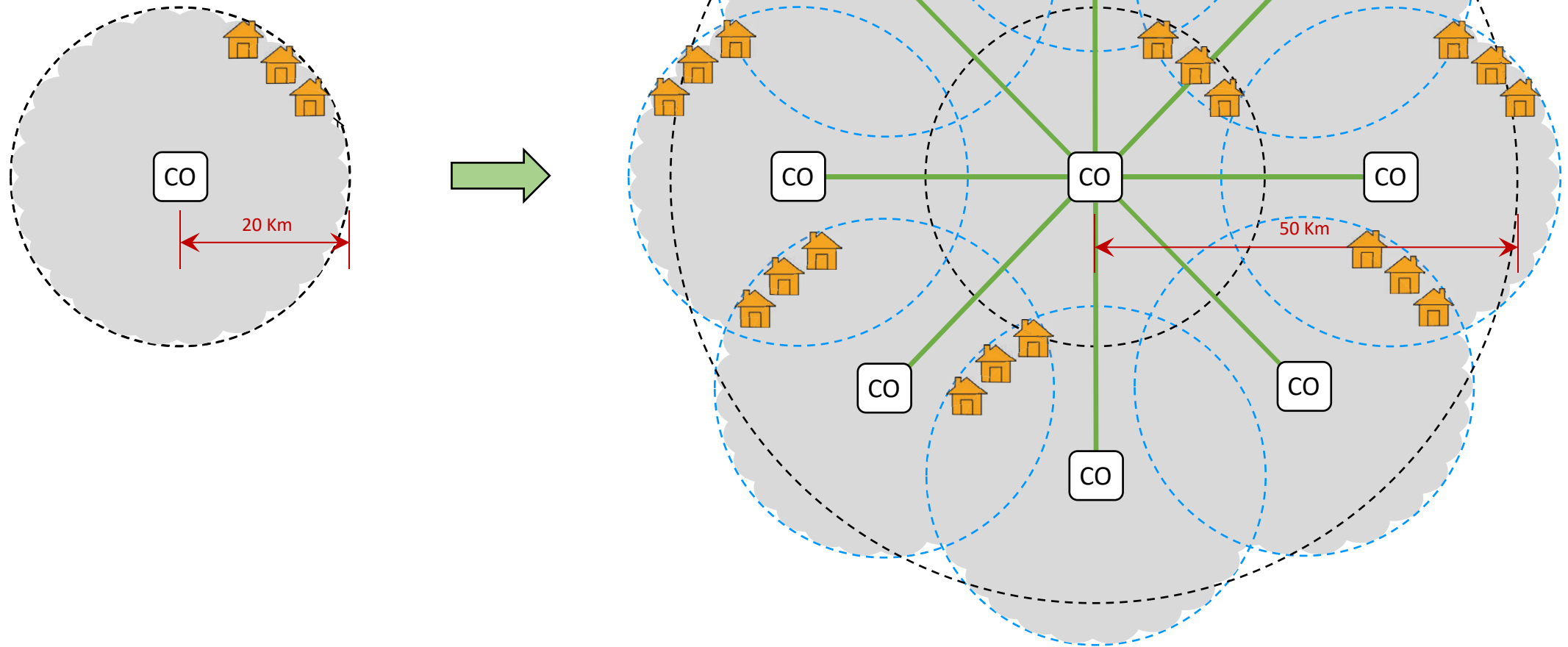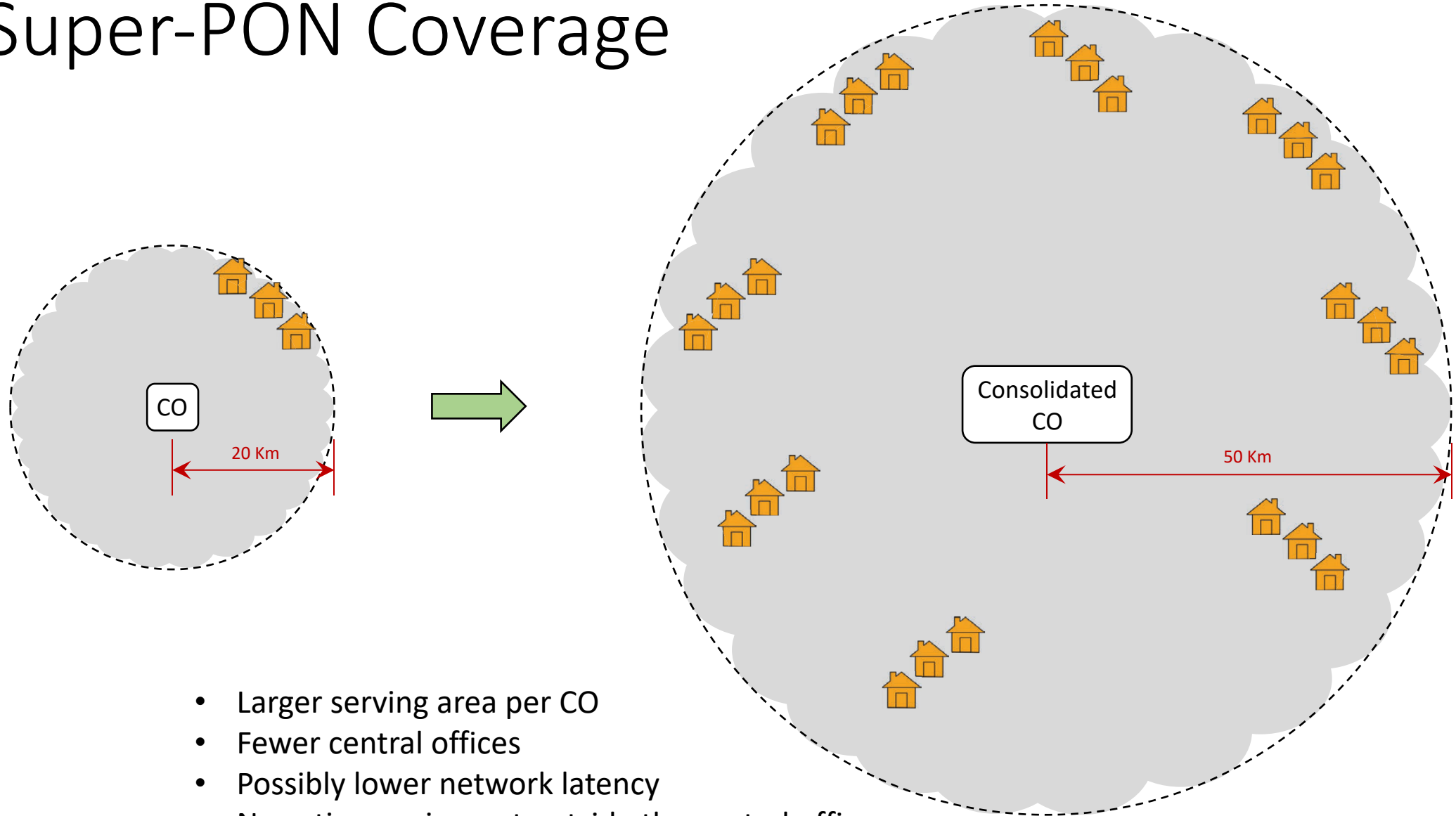
Study Group Goal

From here… …to here

Up to 20 km

Up to 64

Up to 50 km

Passive ODN

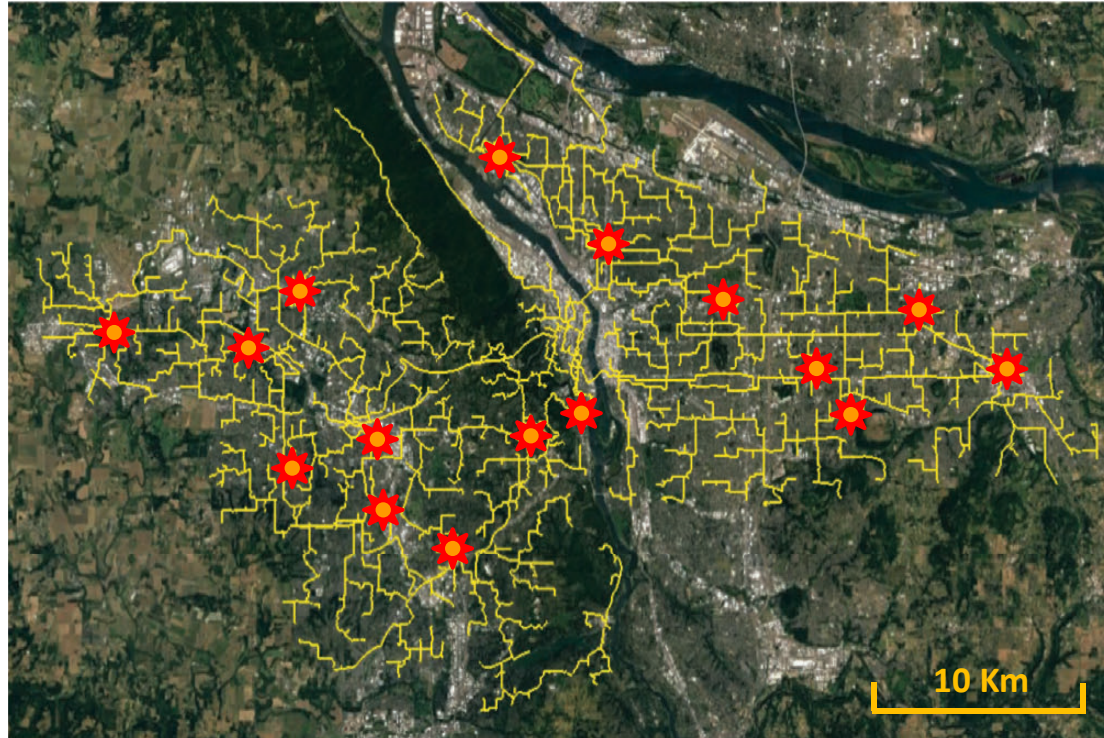Up to 1024

CO

CO
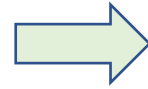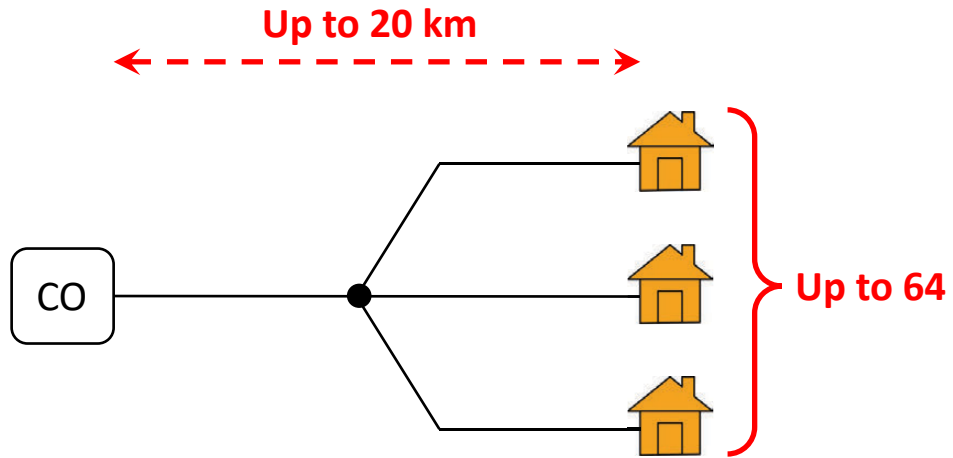
Current Access Coverage

Super-PON Coverage

- Larger serving area per CO
- Fewer central offices
- Possibly lower network latency
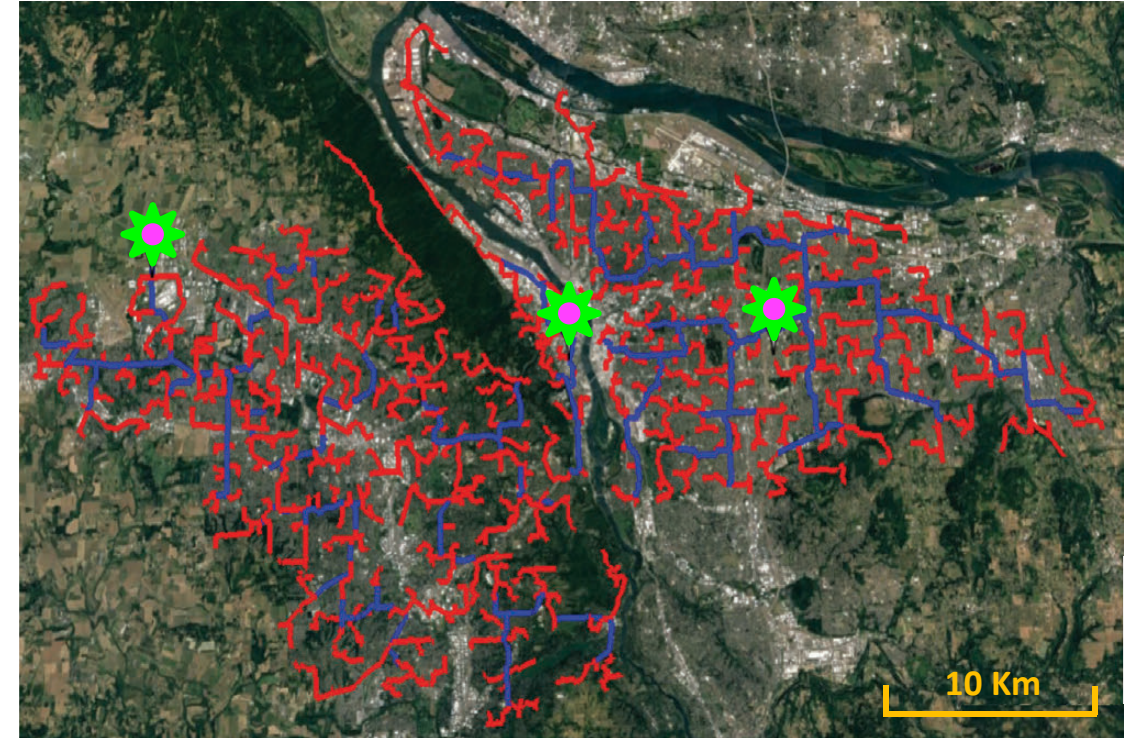- No active equipment outside the central office

Example of Medium Sized US Metropolitan Area

Current PON: 16 COs

Super-PON: 3 COs

— Feeder fiber

Wavelength splitter feeder fiber —
Power splitter feeder fiber —

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

Reducing Cables Size

Traditional Trenching

Directional Boring

Micro Trenching

Market Opportunity (1)

- PMDs for new ODN builds for countries building new infrastructure
  - 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 (i.e., towns)
    - 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
  - E.g., new US residential developments
  - Avoid active equipment between CO and customer premises
- PMDs for ODN expansion to suburban/rural areas
 - These areas are difficult to serve not just in developing countries
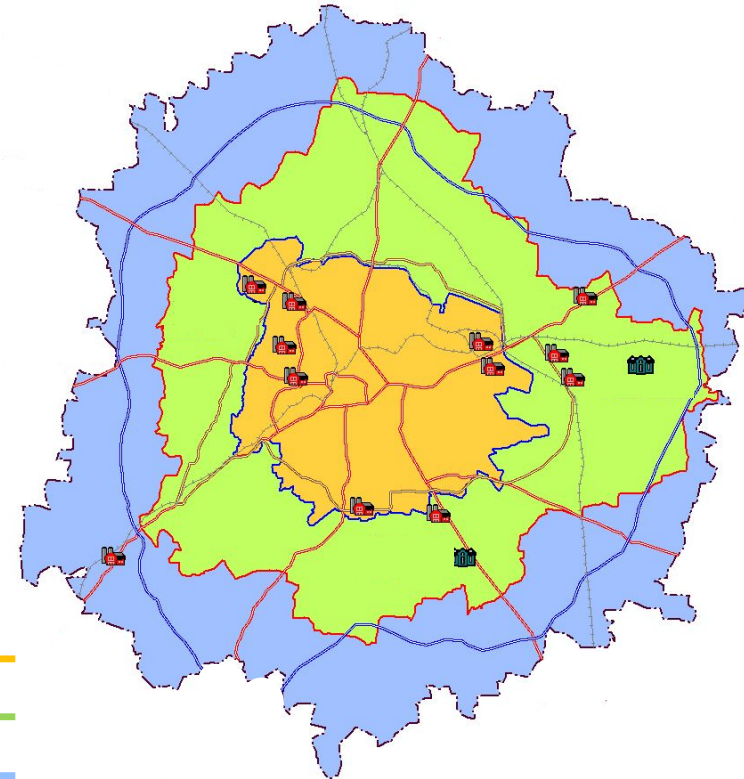
Central urban area ———
Outer urban area ———
Suburban area ———

Market Opportunity (3)

- PMDs for ODN optimization for central office redesign as data center
- Multiple efforts are on-going to re-implement the central office functionalities as a data center
  - Not cost effective with many COs
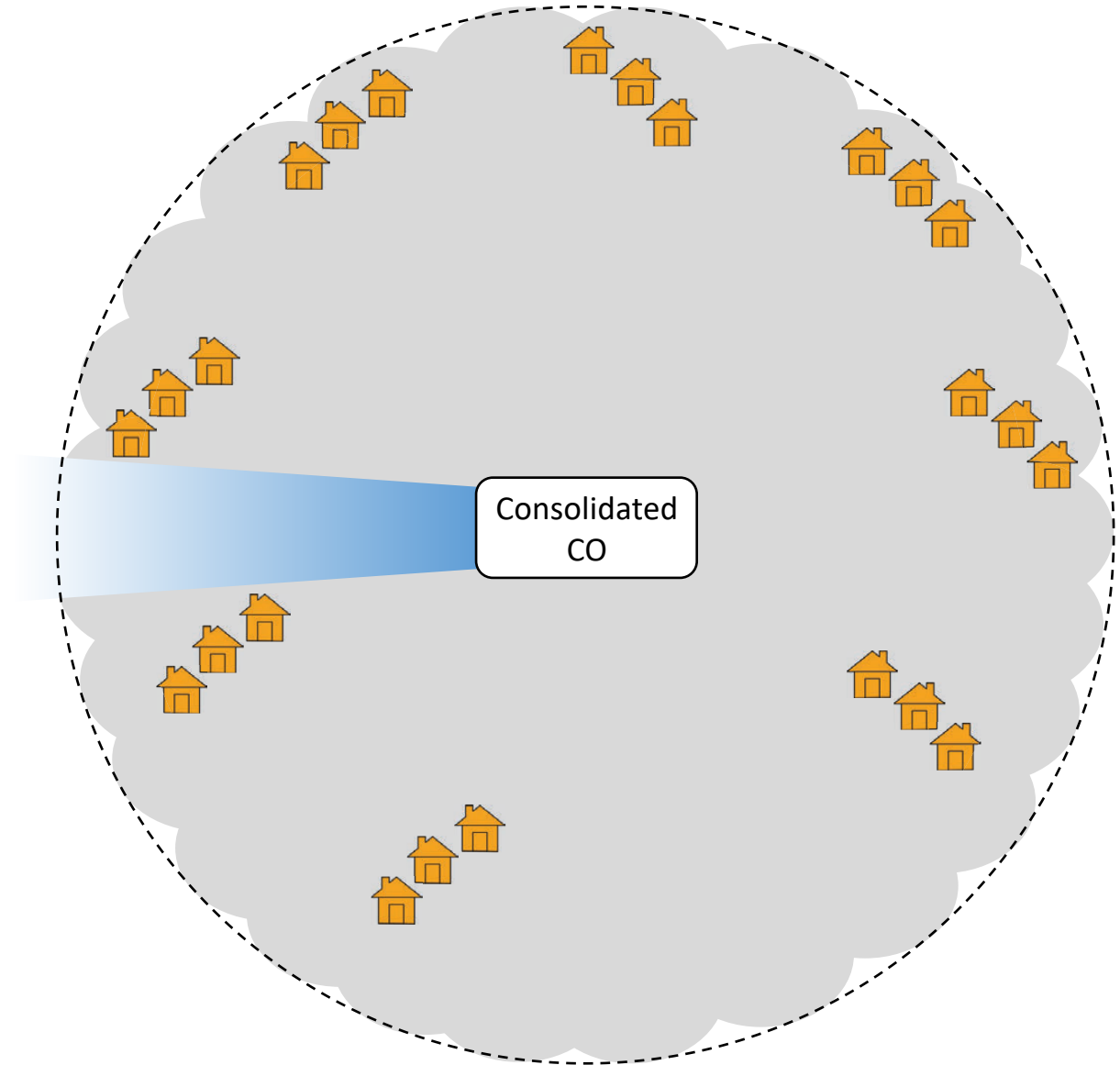 - More viable by consolidating COs or by building ODNs with fewer COs
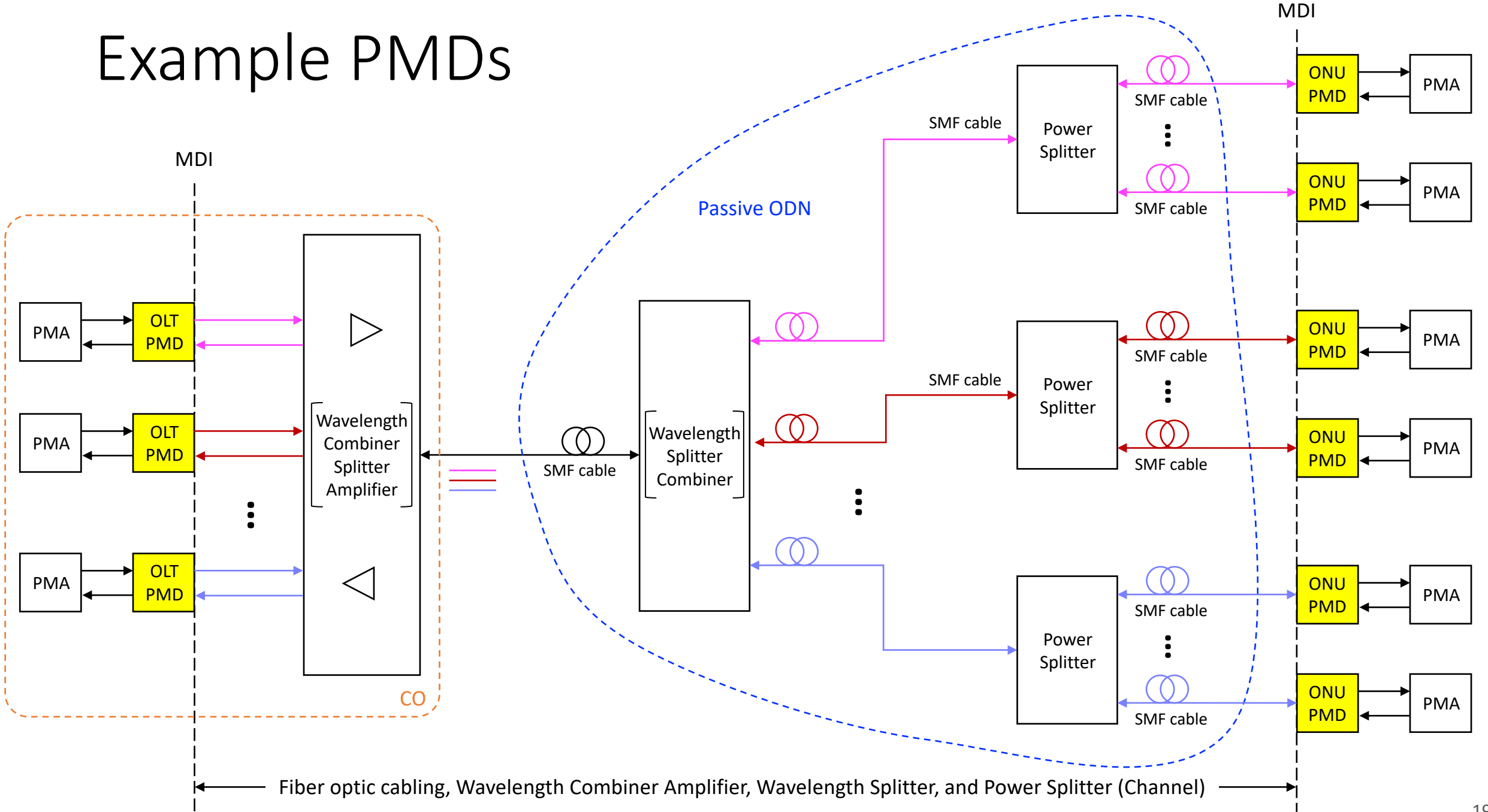
Central Offices as Data Centers

Many COs → many data centers
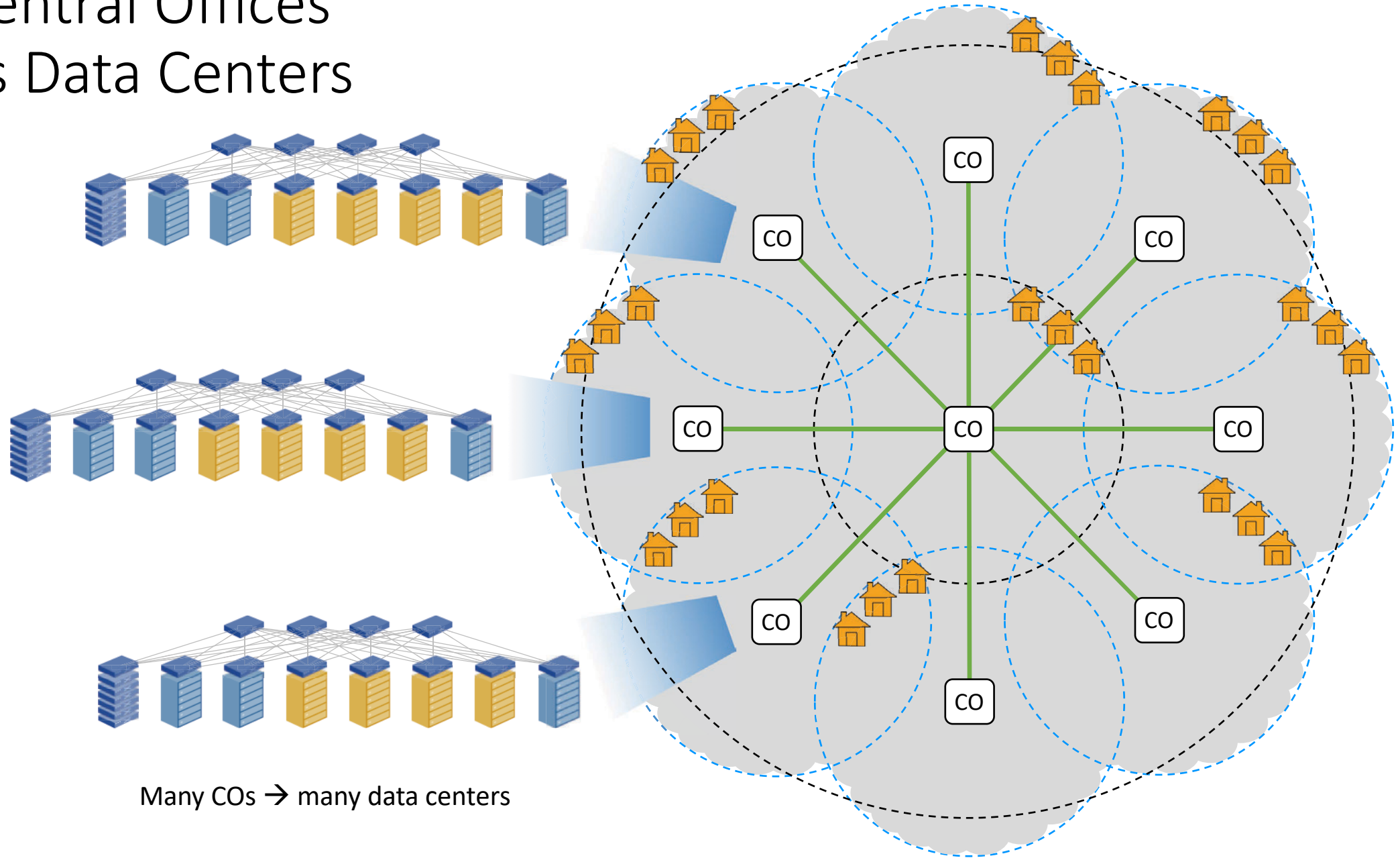
Data Center in Consolidated CO
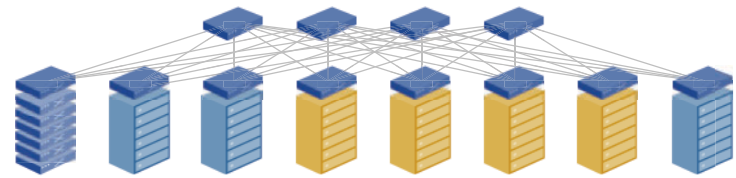
Consolidated CO data center

Consolidated CO

Example PMDs

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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
  - To increase reach
  - Shared amplifiers for all channels to reduce the cost

- Feasible with current technologies
  - A proof-of-concept has been deployed

Speed Support

- Goal: leverage the already defined PCS and PMA sublayers
  - 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 (upstream and downstream)
- Investigate upstream speeds of 2.5Gb/s and 5Gb/s for P2MP
  - For example, a 10G/2.5G asymmetric ONU may be very cost effective for residential use
  - A downclock of already defined higher speed PCS and PMA

Why Now?

- Subscriber access infrastructure is growing significantly in developing countries
  - A window of opportunity for Ethernet of several millions PMDs
  - See lightwaveonline and futuremarketinsights
- The need for broadband requires ODN expansion and optimization for emerging applications
  - New residential developments need to be served
  - Suburban areas are still underserved
  - Central offices are beginning to migrate to data center architectures, increasing the desire for CO consolidation
- Existing standardized subscriber access interfaces do not provide enough reach/split margin for central office consolidation
  - E.g., 802.3: 1G-EPON, 10G-EPON
  - E.g., ITU-T: XG(S)-PON, NG-PON2

Supporters

Alexander Umnov (Corning)

Ali Ghiasi (Ghiasi Quantum)

Bo Wang (China Telecom)

Curtis Knittle (CableLabs)

Daisuke Umeda (Sumitomo)

David Chan (AOI)

David Lewis (Lumentum)

David Li (Hisense)

Duane Remein (Huawei)

Feng Tian (GoFoton)

Frank Effenberger (Huawei)

Glen Kramer (Broadcom)

Guangquan Wang (China Unicom)

Hanhyub Lee (ETRI)

Henk Bulthuis (Kaiam)

James Wang (Hisense)

John D'Ambrosia (Futureway)

Jun-ichi Kani (NTT)

Jun Shan Wey (ZTE)

Karen Liu (Kaiam)

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)

Zhigang Gong (O-Net)

Questions?

Straw Poll 1

- Should a Physical Layer for increased-reach Ethernet optical subscriber access study group be formed?
  - Y:
  - N:
  - Abs:

  - Room count:

Straw Poll 2

- Would I participate in a Physical Layer for increased-reach Ethernet optical subscriber access study group?
  - Tally:

Straw Poll 3

- I believe my company would sponsor one or more individuals to participate in a Physical Layer for increased-reach Ethernet optical subscriber access study group
  - Tally (1 per company):

Thank you