Super-PON CFI

(consensus deck)

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CFI Objective

- Measure the interest in studying Ethernet Access (P2MP and P2P) PMDs leveraging wavelength division multiplexing over a common long reach optical distribution network (ODN)
- 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

- …

Introduction

- 802.3 recognizes the need for different speeds for different markets/applications
  - E.g., 40Gb/s, 25Gb/s, 50Gb/s, 2.5Gb/s, 5Gb/s, 200Gb/s, 400Gb/s
- Super-PON intends to extend Ethernet Access to address different/additional markets/applications
  - Unify the ODN for Point-to-MultiPoint (P2MP) and Point-to-Point (P2P) operations
  - Extend the reach from ~10-20Km to ~40-50Km
  - Enlarge the number of subscribers per fiber strand from ~64 to ~1024
  - Independent from the higher speed definitions of 802.3ca
    - Possibly leverage them

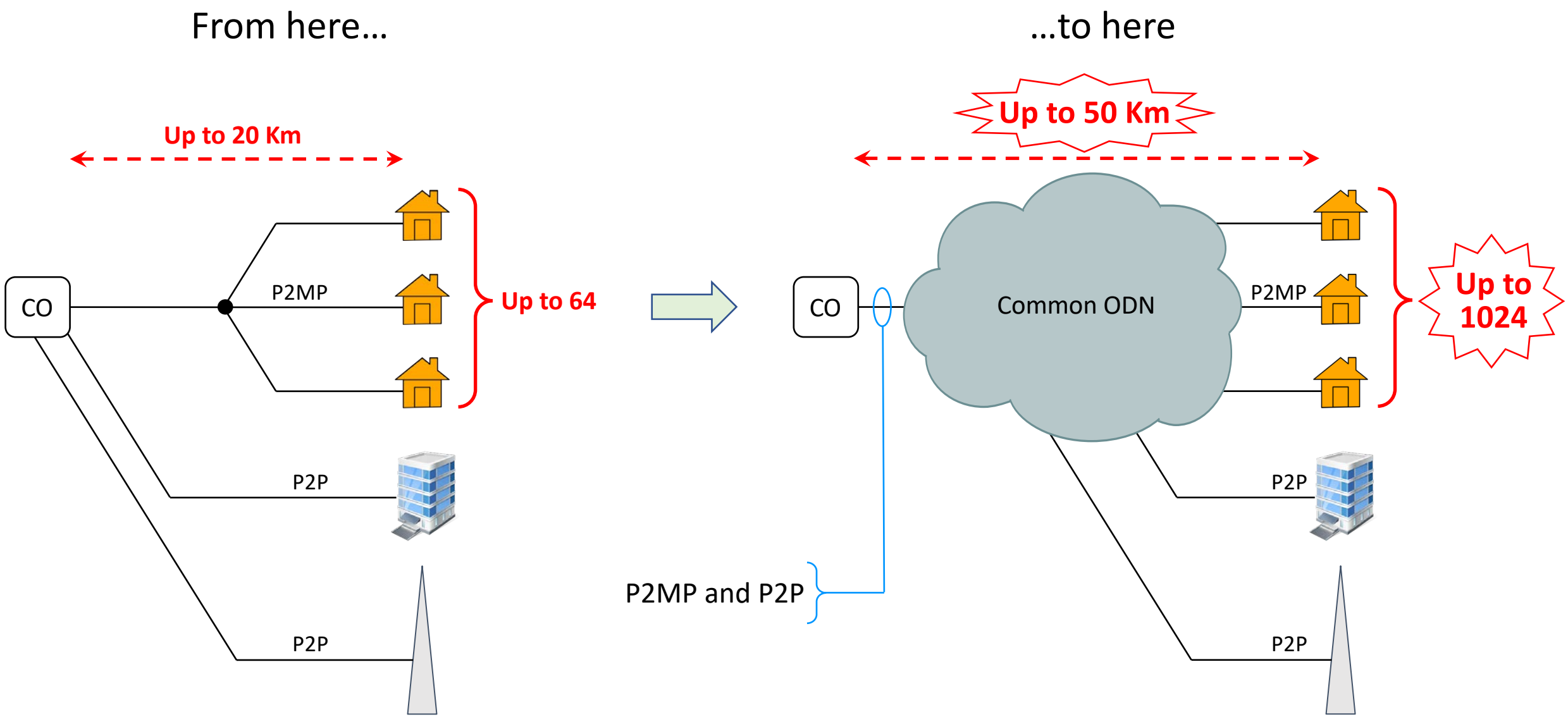
Industry Trend

- Consolidation of local and regional offices and infrastructures is an on-going trend for telecommunication operators
- This brings new requirements to the network infrastructure
  - Support longer distances
  - Support multiple channels on the same ODN through wavelength division multiplexing
  - Support multiple P2MP and P2P operations over the same ODN
- Super-PON intends to satisfy these new requirements with a passive ODN
  - Advantageous for new ODN builds

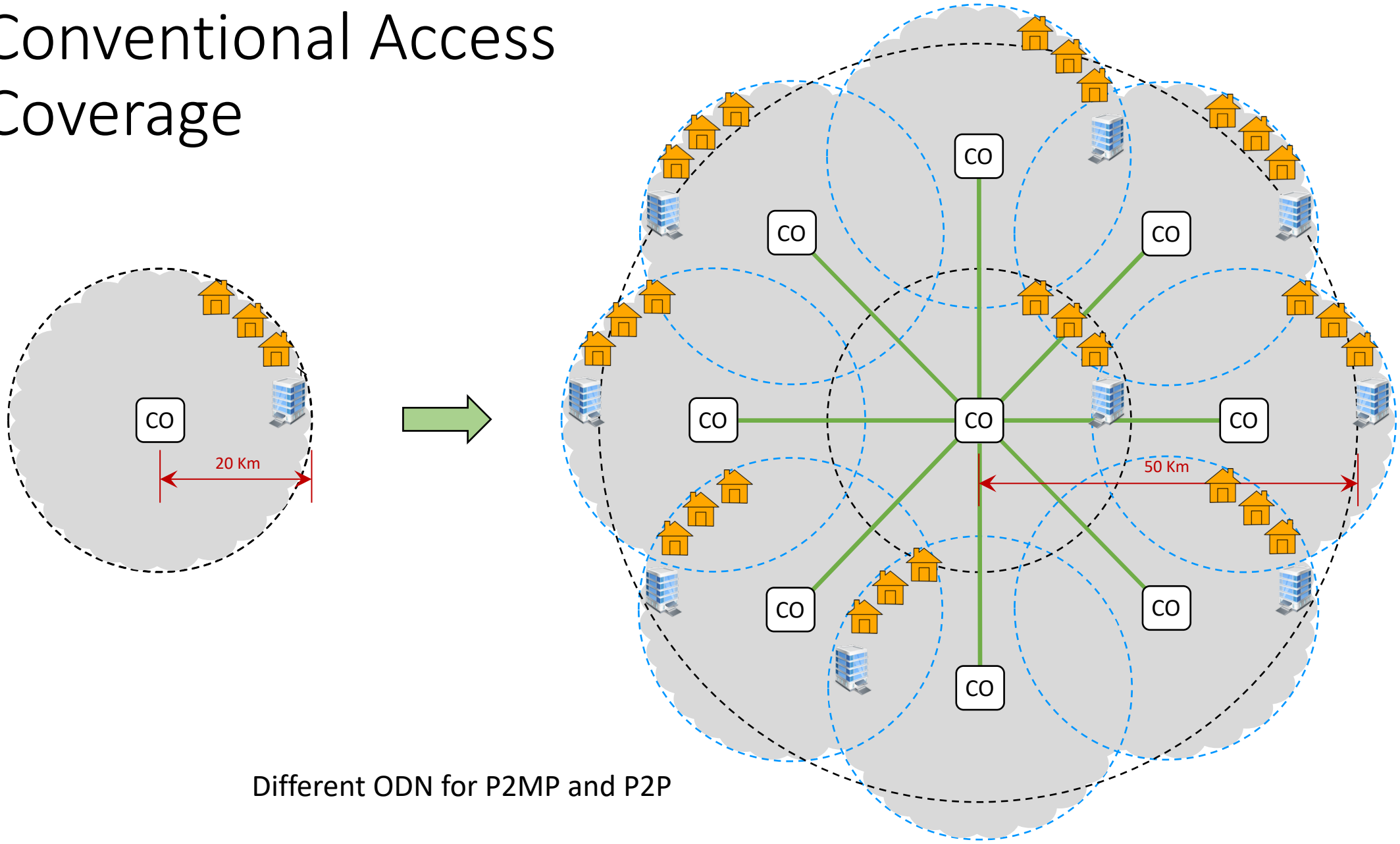
Common ODN for Access Networks

- Clause 56 defines Ethernet for subscriber access networks
  - Or Ethernet in the First Mile (EFM)
- Supports Point-to-Point (P2P) and Point-to-MultiPoint (P2MP)
  - 1G-EPON, 10/1G-EPON, and 10/10G-EPON P2MP (Clauses 60, 64, 65, 75, 76, 77)
  - 100BASE-X and 1000BASE-X P2P (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
- Assumes different ODNs for P2MP and P2P operations
- Super-PON intends to define P2MP and P2P operations over a common ODN

Super-PON Goal

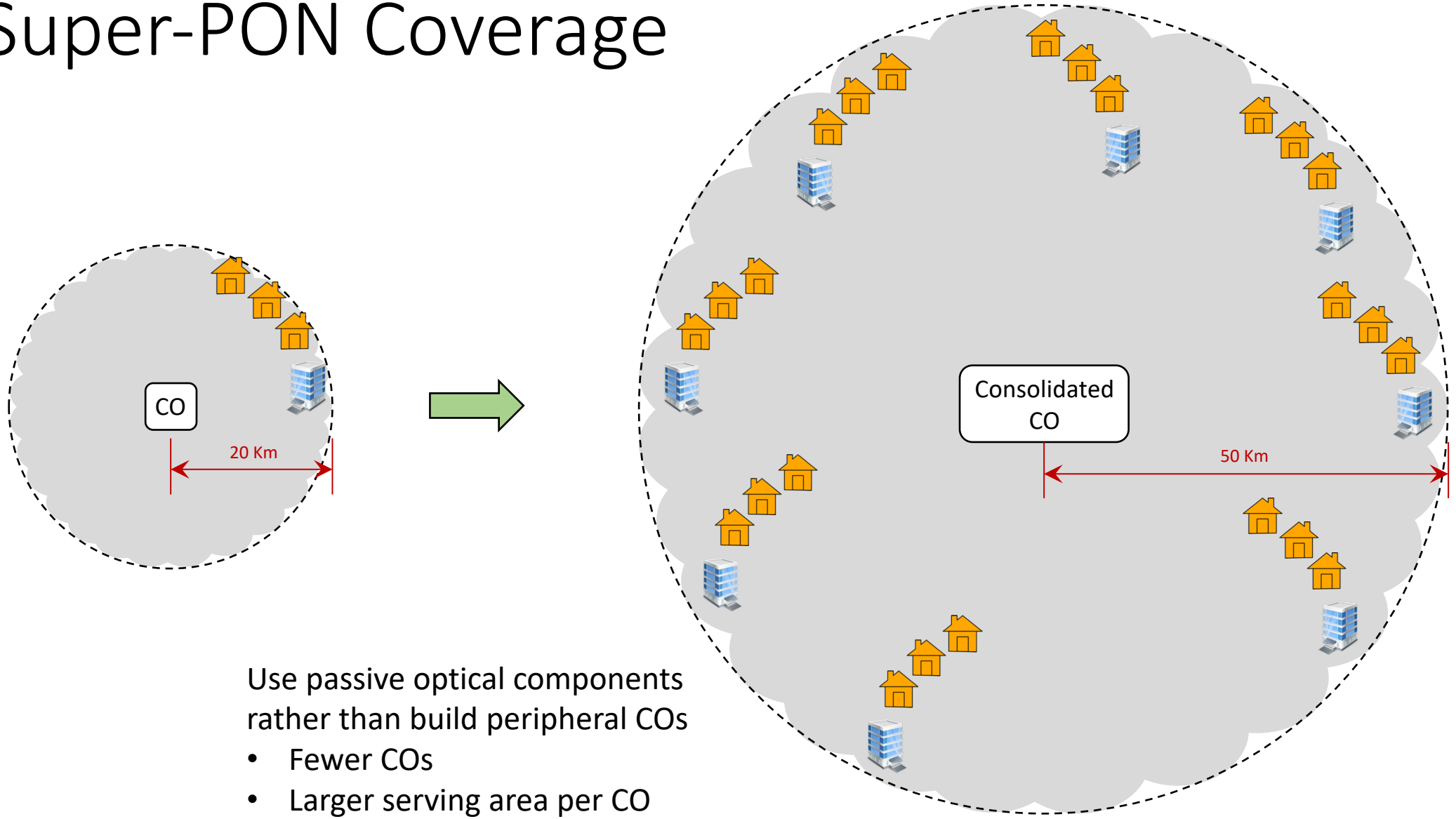


Conventional Access Coverage



Different ODN for P2MP and P2P

Super-PON Coverage

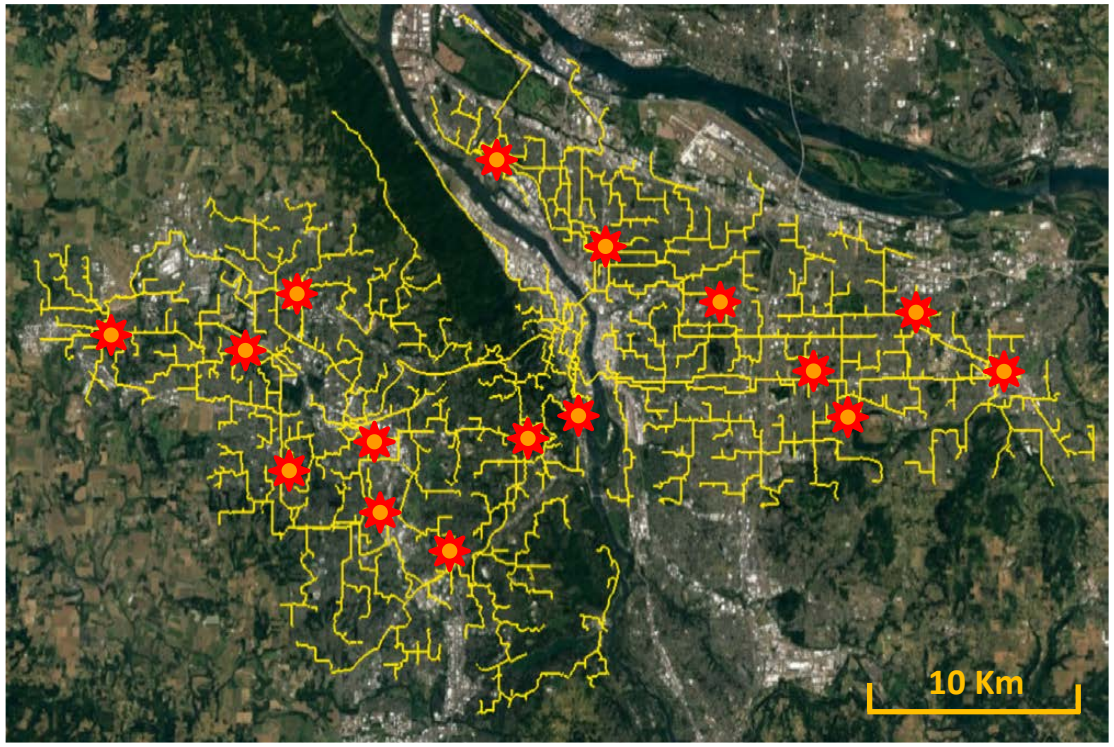


Use passive optical components rather than build peripheral COs

- Fewer COs
- Larger serving area per CO
- Common ODN for P2MP and P2P

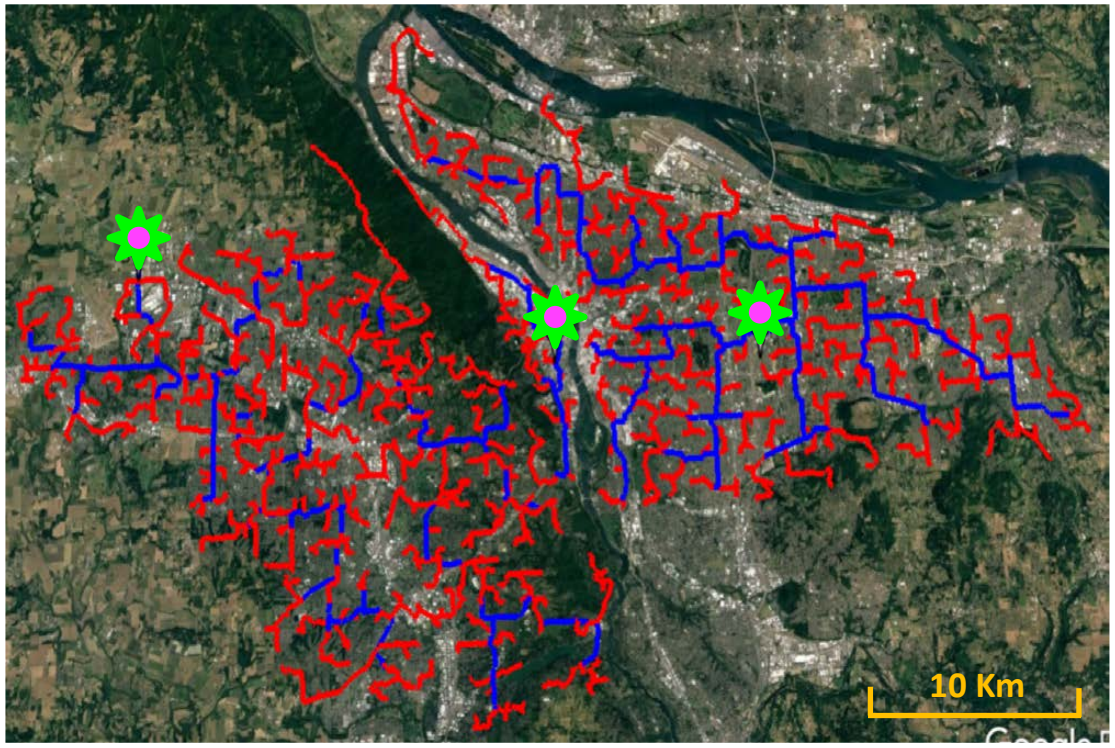
ODN Build Example

Conventional PON: 16 COs



Feeder fiber

Super-PON: 3 COs



CAWG feeder fiber

Splitter feeder fiber

- Fewer COs
- 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
  - Example: India's BharatNet project (http://bbnl.nic.in/)
    - Aims to provide broadband connectivity to 250,000 Gram Panchayats
    - To increase India's Internet connectivity to 600 million broadband subscribers
    - Tailored to improve telecom services in rural and remote areas of the country
    - Potential market several millions PMDs
      - E.g., fiber-to-the-home plans of Telangana state (http://it.telangana.gov.in/telangana-fiber-grid-t-fiber/)
      - ~ 8M households to be connected just in Telangana

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 rural areas
  - Rural areas are difficult to serve not just in developing countries

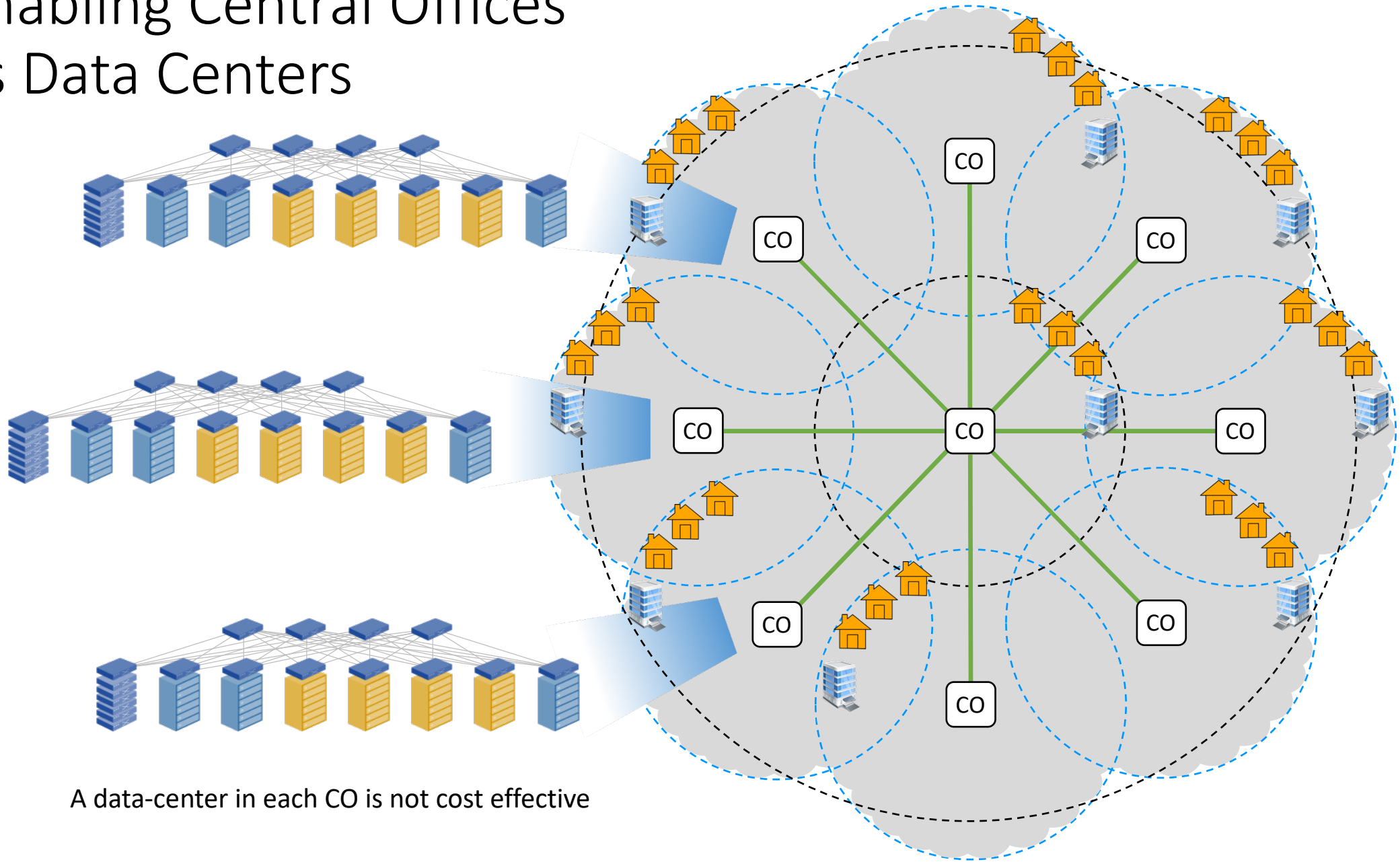
Market Opportunity (3)

- PMDs for ODN optimization for (5G) cellular deployments
  - Potentially a major application of Super-PON P2P PMDs
- Potential market volume
  - 3B people / (100 people / RU) / 10 year rollout = 3M PMDs / year
- Symmetric P2P PMDs may command higher prices than P2MP PMDs

Market Opportunity (4)

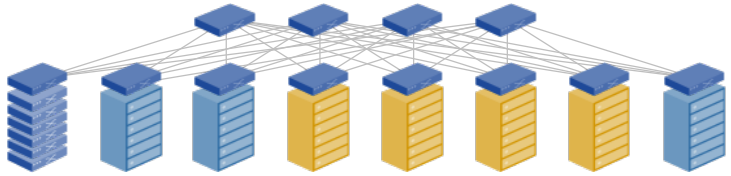
- PMDs for ODN optimization for CO re-implementation as data center
  - Consolidation of local and regional offices
- Multiple efforts are on-going to re-implement the central office functionalities as a data center
  - Not cost effective with many COs
  - More viable by consolidating COs or by building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

Enabling Central Offices as Data Centers

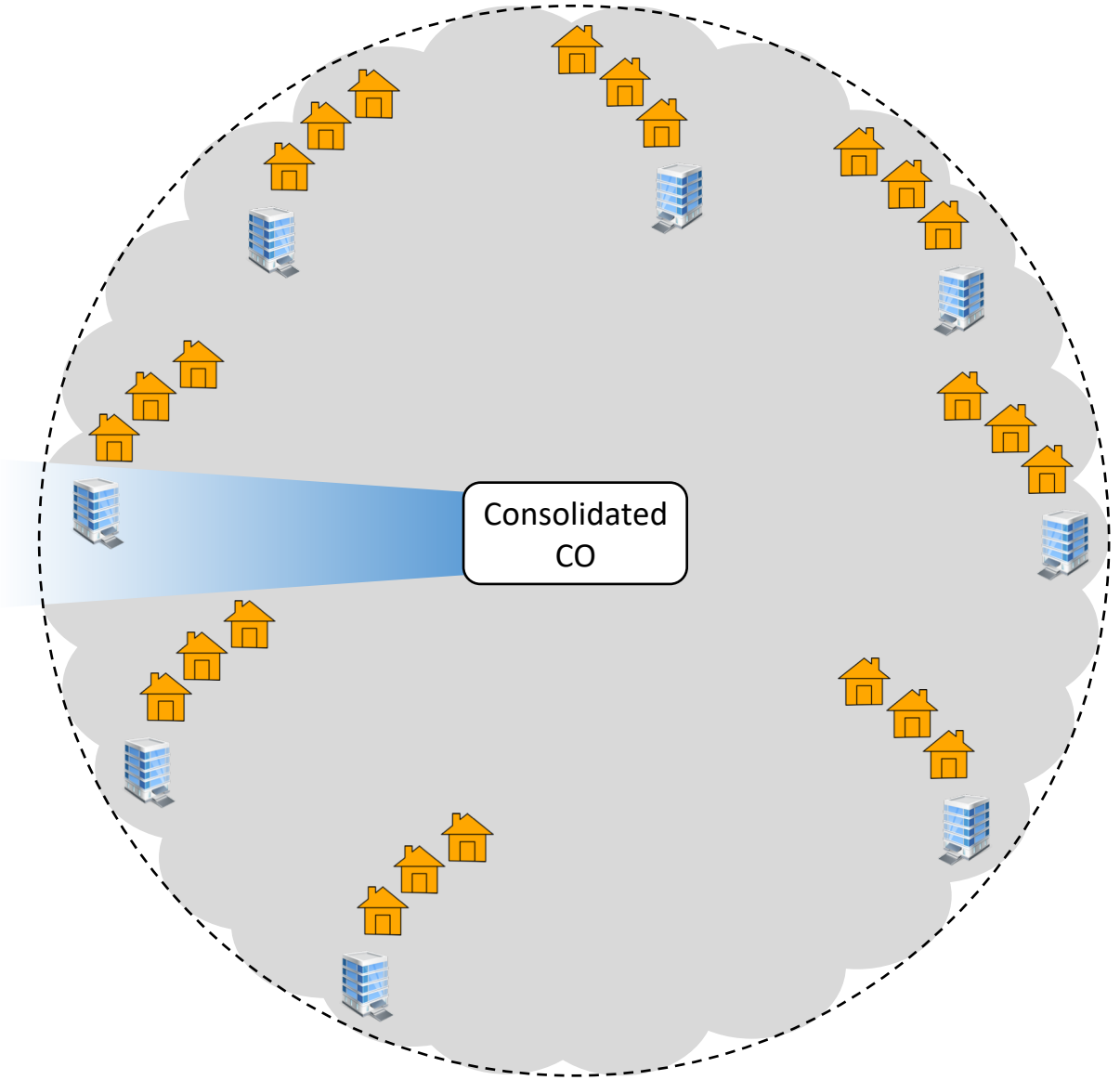


A data-center in each CO is not cost effective

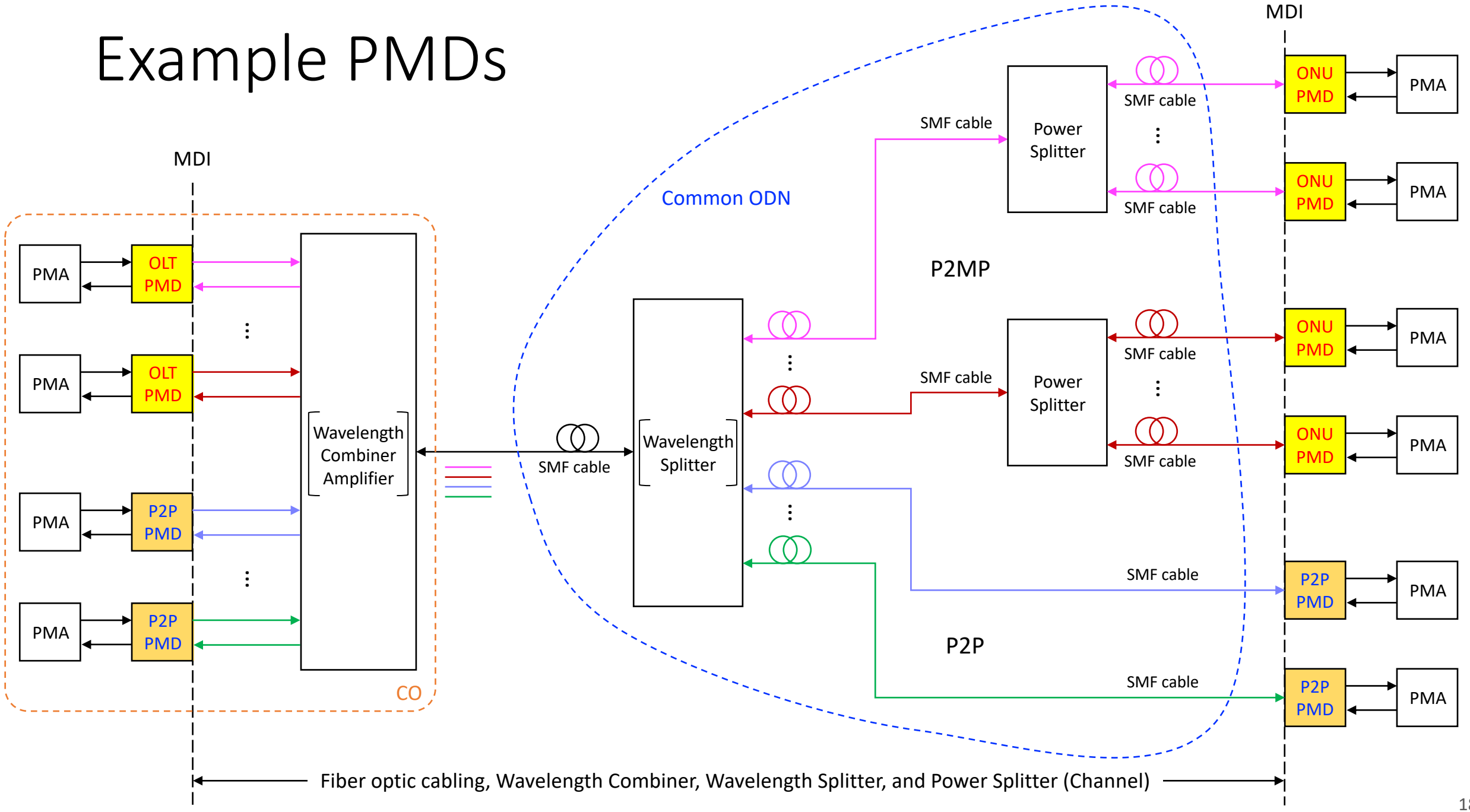
Data Center in Consolidated CO



A consolidated CO is cost effective



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 amplifier for all channels to reduce the cost
- Common ODN for P2MP and P2P operations
  - Wavelengths can carry P2MP or P2P channels
    - P2MP for cost effective ONUs for residential customers
    - P2P for high performance ONUs for business/specialized customers

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
- Support the already defined speeds
  - e.g., 10G-EPON, 25G-EPON for P2MP (upstream and downstream)
  - e.g., 10GBASE-R, 25GBASE-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?

- Many ODN builds are happening now in developing countries
  - E.g., India's BharatNet initiative alone brings an opportunity of several millions PMDs
- The need for broadband requires ODN expansion and optimization for emerging applications
  - 5G cellular field trials are underway
  - COs are beginning to migrate to data center architectures
  - New residential developments need to be served
  - Rural areas are still underserved
- Competing technologies do not provide the needed reach or coverage
  - E.g., XG(S)-PON, NG-PON2

Straw Poll (1)

- Should a study group be formed?
  - Y:
  - N:
  - Abs:

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