



# Evolution of Network-Based PTP Timing Services in Canada

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# Agenda

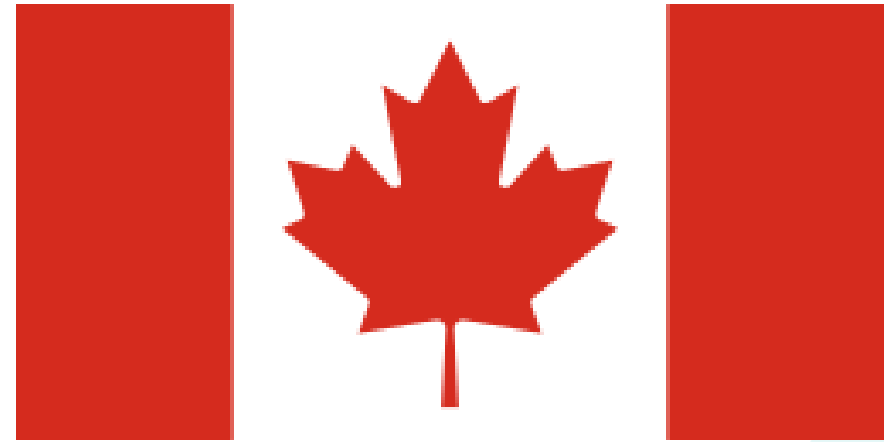
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- Landscape of Mobile Service Providers in Canada
- Challenges for Canadian Wireless Operators
- Evolution of Synchronization and Network Based Timing Services



# Landscape of Mobile Service Providers in Canada

- Rogers Communications
  - BCE Inc. (Bell Mobility)
  - Telus
  - Shaw Communications
  - Videotron
  - Sasktel
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- Fido, Virgin Mobile, Koodoo
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- Service providers own their own infrastructure...for the most part (Rogers, Bell/TELUS)
  - Population densification (or lack there of) a challenge for providing services
  - Implementing and maintaining a network is costly across such a large geographic area



# Canadian Population Density



# Challenges for Canadian Wireless Operators

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- **Sparse Population**
  - Expensive to build and maintain telecommunications infrastructure in these areas
- **Geographical Barriers**
  - Forests, mountains, and lakes, can make it challenging to build and maintain telecom networks
- **Weather Conditions**
  - Difficult and expensive to maintain telecom infrastructure in certain parts of the country.
- **Remote Areas**
  - Lack of infrastructure and additional challenges of operating in these areas.

# A Contrast in Population and Geography

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- **Canada**

- Total Area: 9.985 million km<sup>2</sup>
- Population: 38,586,061
- 4 people per square km
- Mobile subscribers: 32 million

- **United States**

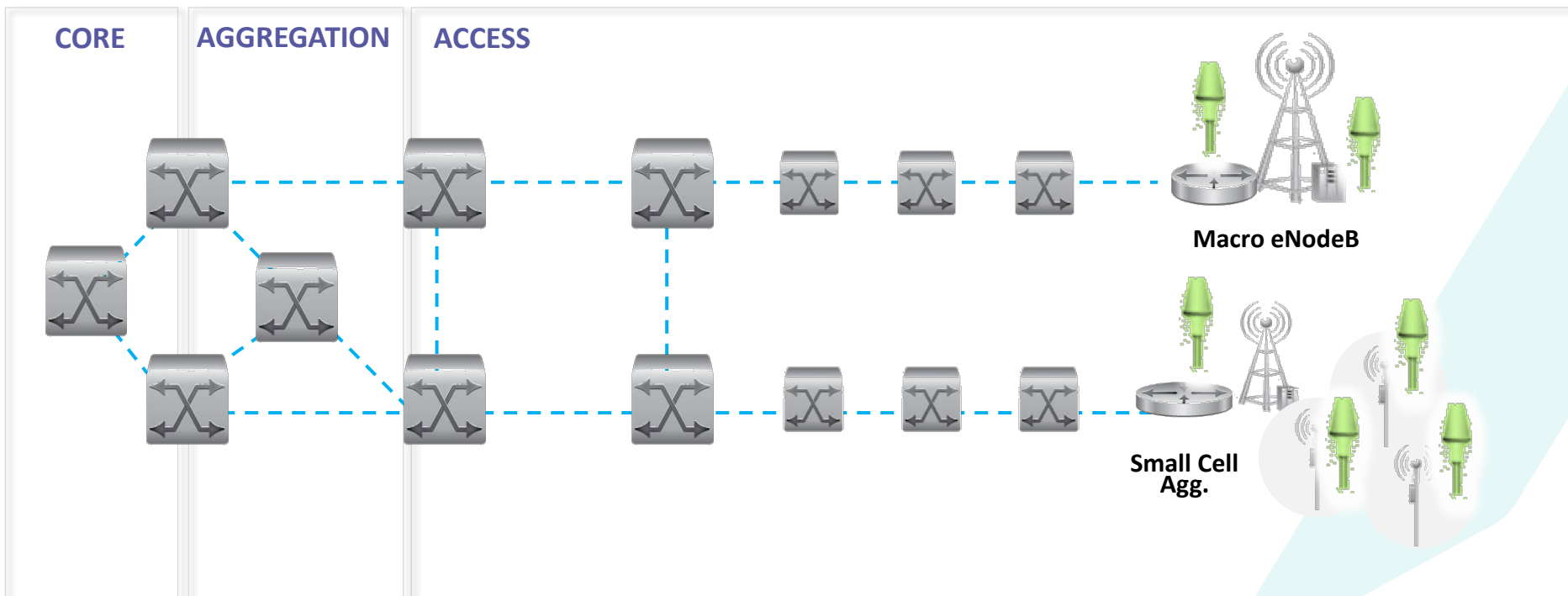
- Total Area: 9.834 million km<sup>2</sup>
- Population: 335,956,837
- 34 people per square km
- Mobile subscribers: 351.4 million

Land Border: 8,890-km border with the United States, the longest international border in the world

# 3G—Synchronization Evolution—GPS - T1/E1

- 3G

- GPS receivers
- T1/E1 for clock recovery
- Transition from TDM to ethernet

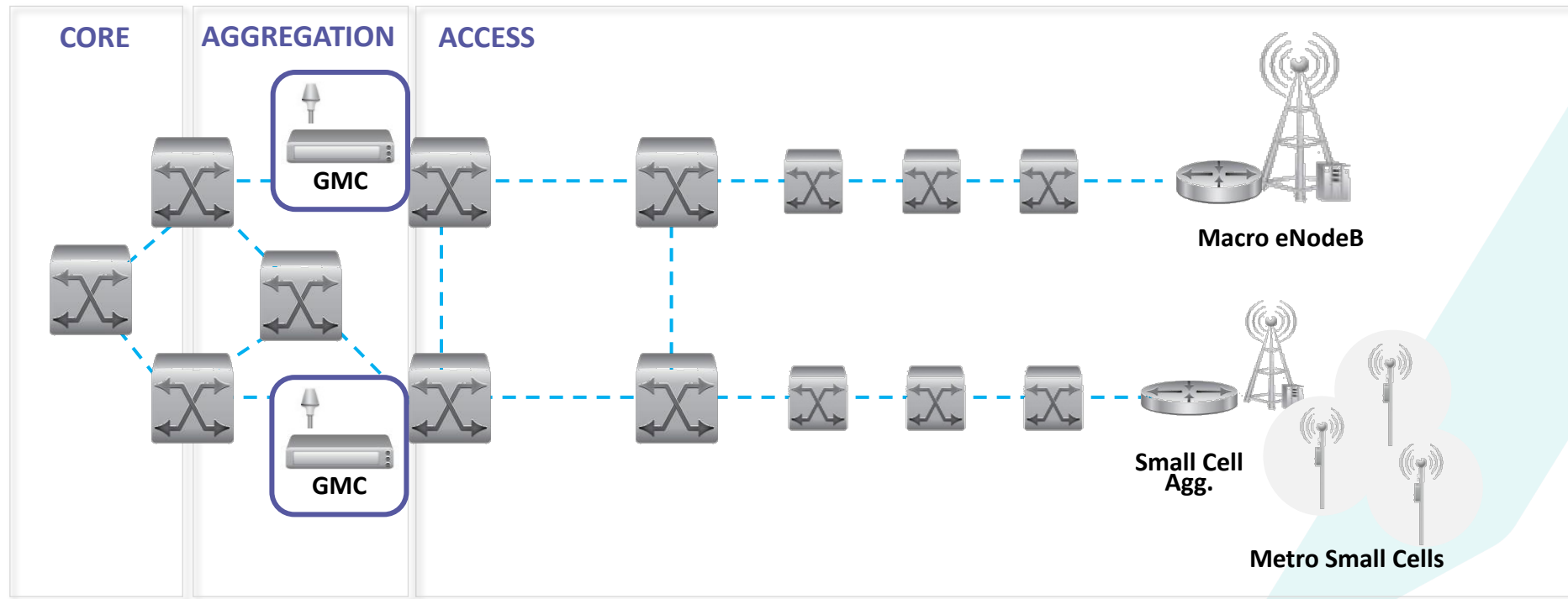




# 3G- 4G Synchronization Evolution – PTP – Frequency - G8265.1

- 4G

- GNSS antennas still in place, but with increased radio and small cell densification that number would need to increase
- PTP deployed for frequency synchronization (FDD) for mobile backhaul, small cells and circuit emulation as an alternative to GNSS.
- Timing could traverse through many hops with good performance



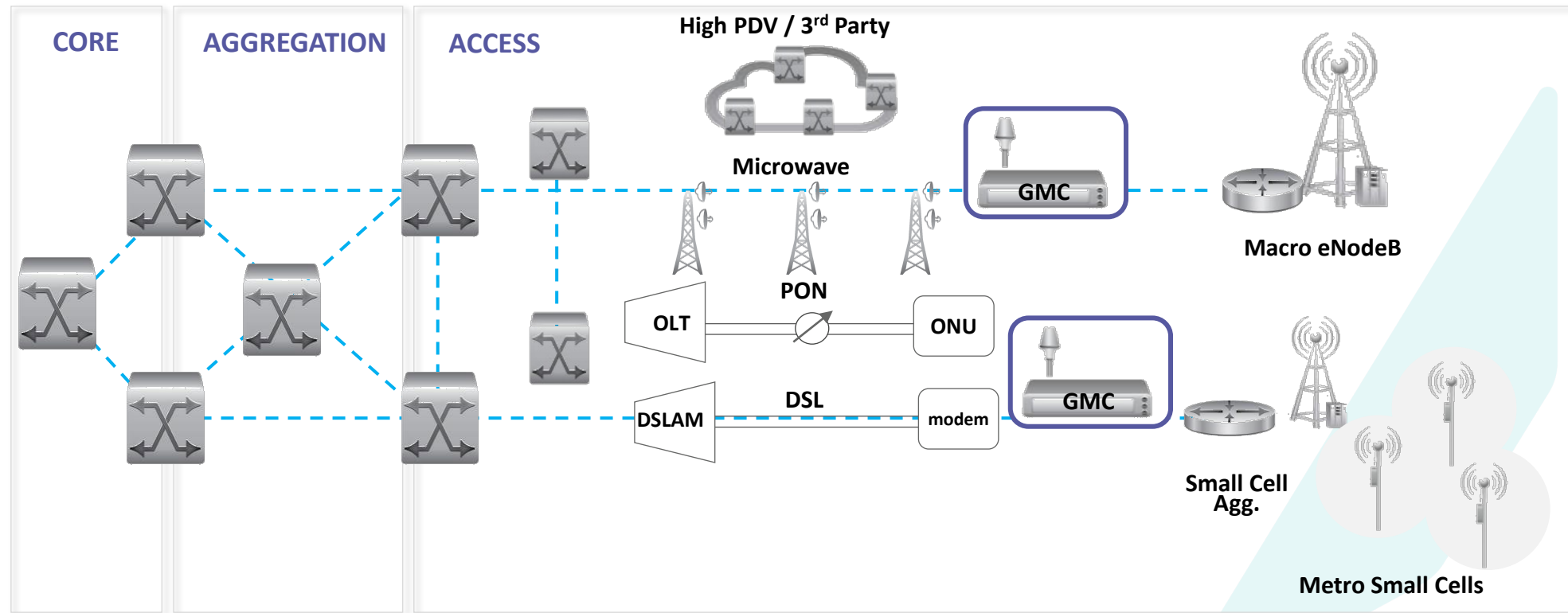
GMC – Grandmaster Clock  
FDD – Frequency Division Duplexing



# 4G Synchronization Evolution – PTP – Frequency - G8265.1

- 4G

- High PDV a concern through 3<sup>rd</sup> party facilities and certain transport technologies
- Move GMC closer to the applications consuming timing

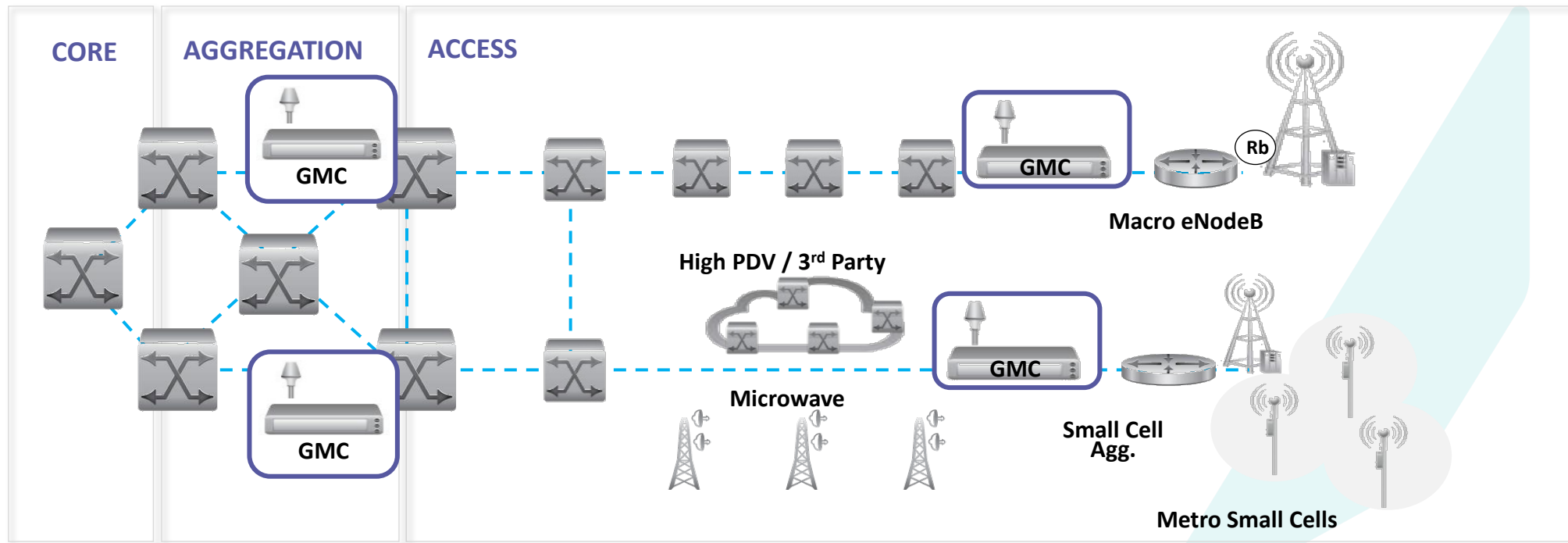


GMC – Grandmaster Clock  
PDV – Packet Delay Variation

# 4G- 5G Synchronization Evolution – Phase I – Time/Phase - G8275.2

- 5G

- Network is brownfield, legacy equipment is PTP unaware for the most part
- Upgrading equipment to be PTP aware will take time, overhaul of network
- Re-purpose for TDD synchronization using G.8275.2 as a backup to GNSS
- APTS from upstream GM's to edge clocks

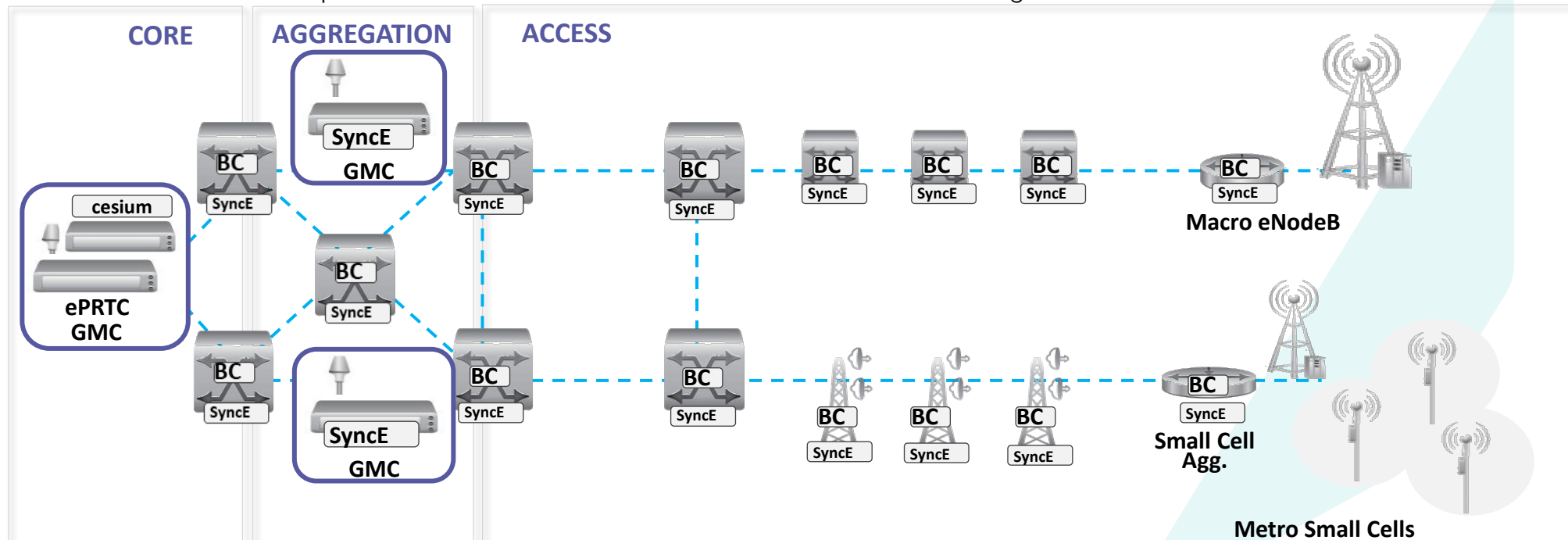


GMC – Grandmaster Clock  
PDV – Packet Delay Variation  
APTS – Assisted Partial Timing Support  
TDD – Time Division Duplexing

# 5G Synchronization Evolution – Phase II – Time/Phase - G8275.1

## • 5G

- Move away from APTS (G.8275.2) to Full On-path Support (G.8275.1) in dense urban areas for better performance, increased accuracy and less reliance on GNSS
- GNSS performance more difficult to achieve in dense downtown locations with tall buildings, urban canyon effect
- No immediate need to switch to G.8275.1 in rural areas due to much lower density of population
- Addition of ePRTC for superior holdover in the event of an extended GNSS outage



GMC – Grandmaster Clock  
BC – Boundary Clock  
SyncE – Synchronous Ethernet  
APTS – Assisted Partial Timing Support  
ePRTC – Enhanced Primary Reference Time Clock

# Summary

- Canadian market has some unique challenges
  - Will continue to follow and rely on the standards
- Will likely continue using a hybrid of profiles:
  - G.8275.1 – Urban population density
  - G.8275.2 – Rural less populated areas
- Full 5G rollout will take time
  - Large amount of legacy equipment needs to be upgraded/replaced







# Thank you.

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