# Status and challenges for practical implementation of synchronization in a NGN network seen from a Telecom Operator’s perspective

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# Implementation of SyncE in the Telenor Core network in Norway for frequency synchronisation.



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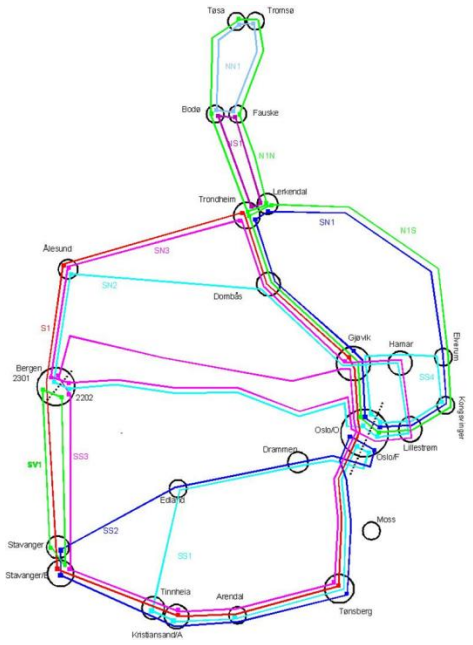
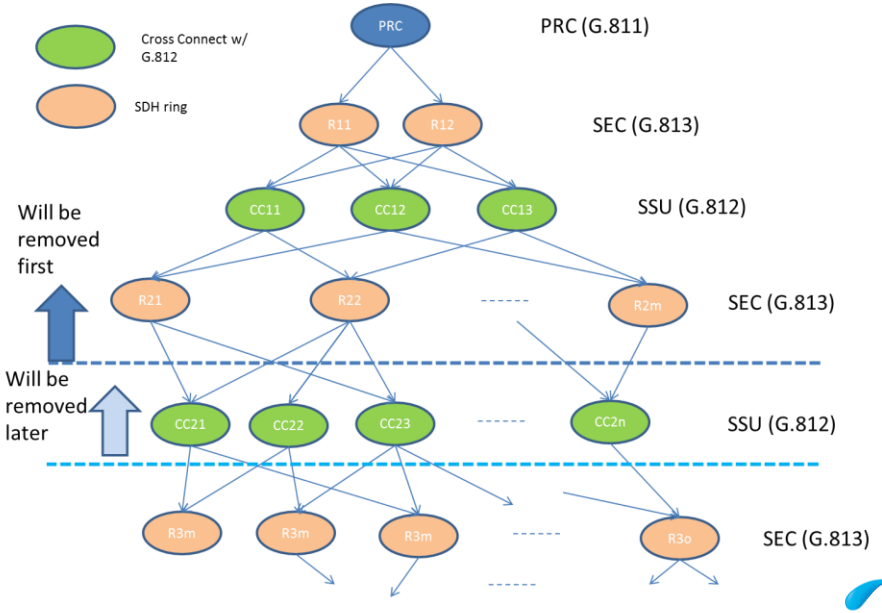
# Implementation of SyncE in the Norwegian Core network for frequency synchronisation.

- NEs used in SDH-Core are the oldest SDH-NEs and should be replaced (>15y)
- Old STM-16 SDH-rings which is carrying sync are nearly emptied.

From sync distribution in SDH CORE



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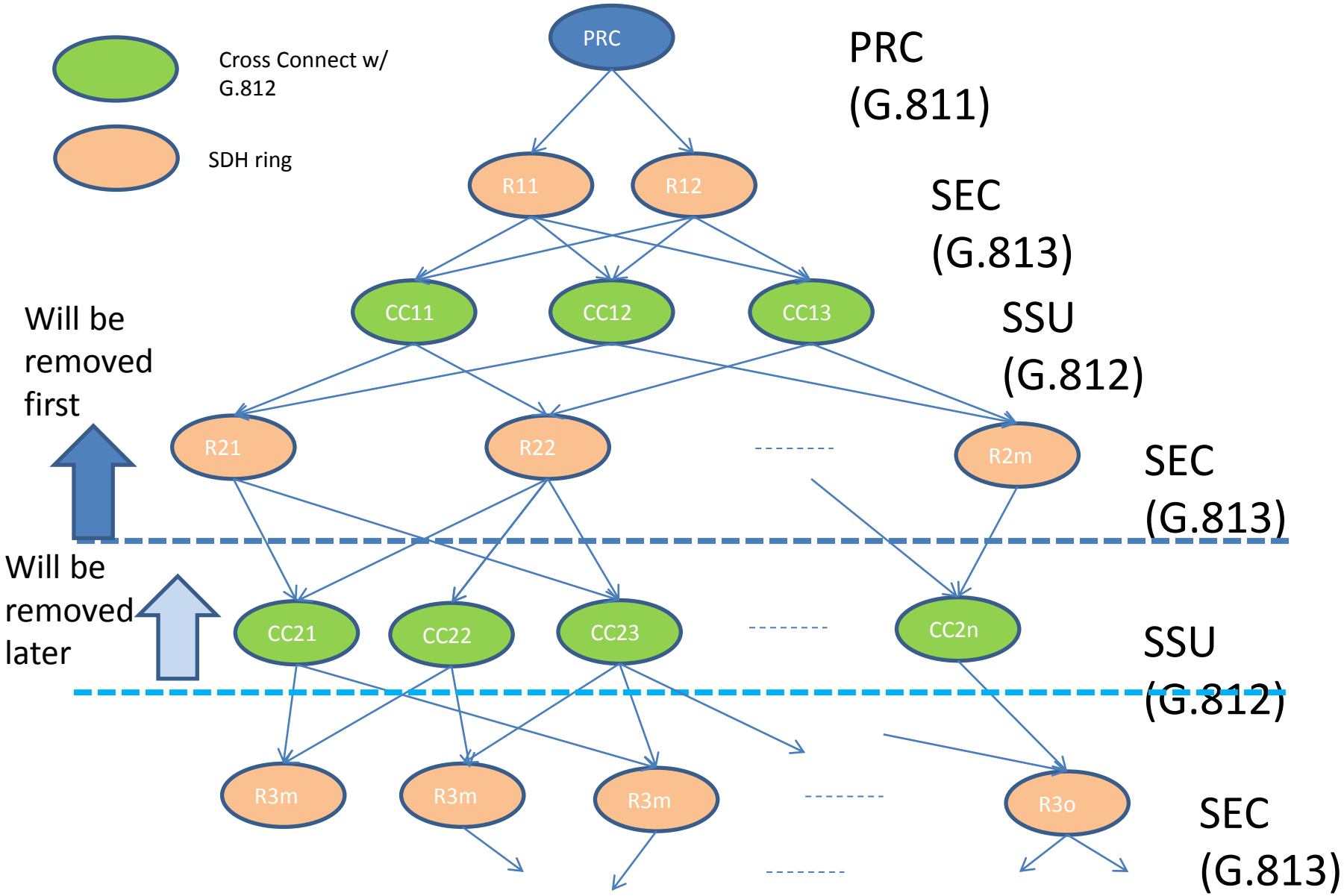
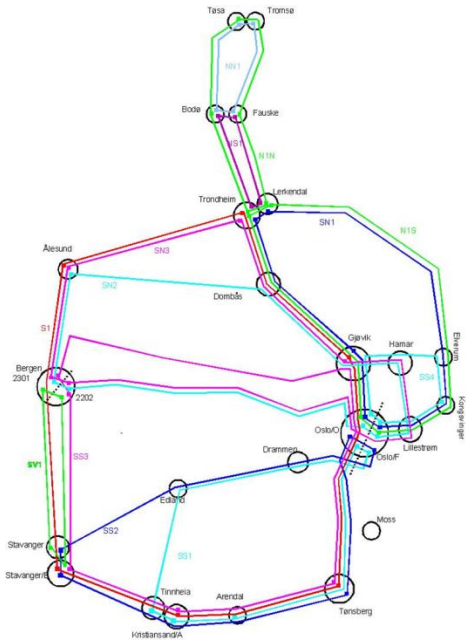

Cross Connect w/ G.812
SDH ring
PRC
R11
R12
CC11
CC12
CC13
R21
R22
R2m
CC21
CC22
CC23
CC2n
R3m
R3m
R3m
R3o
PRC (G.811)
SEC (G.813)
SSU (G.812)
SEC (G.813)
SSU (G.812)
SEC (G.813)
Will be removed first
Will be removed later

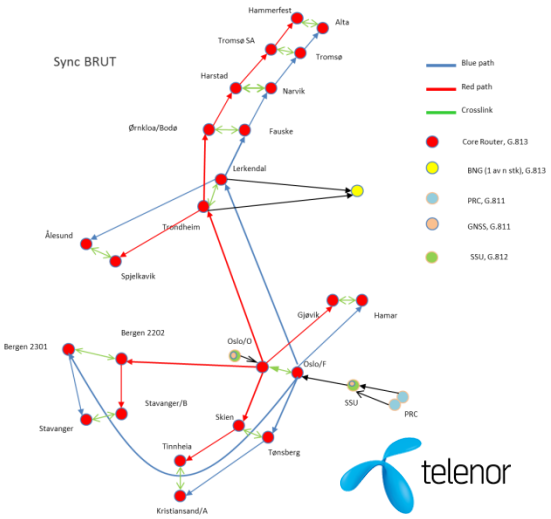
# Implementation of SyncE in the Norwegian Core network for frequency synchronisation.

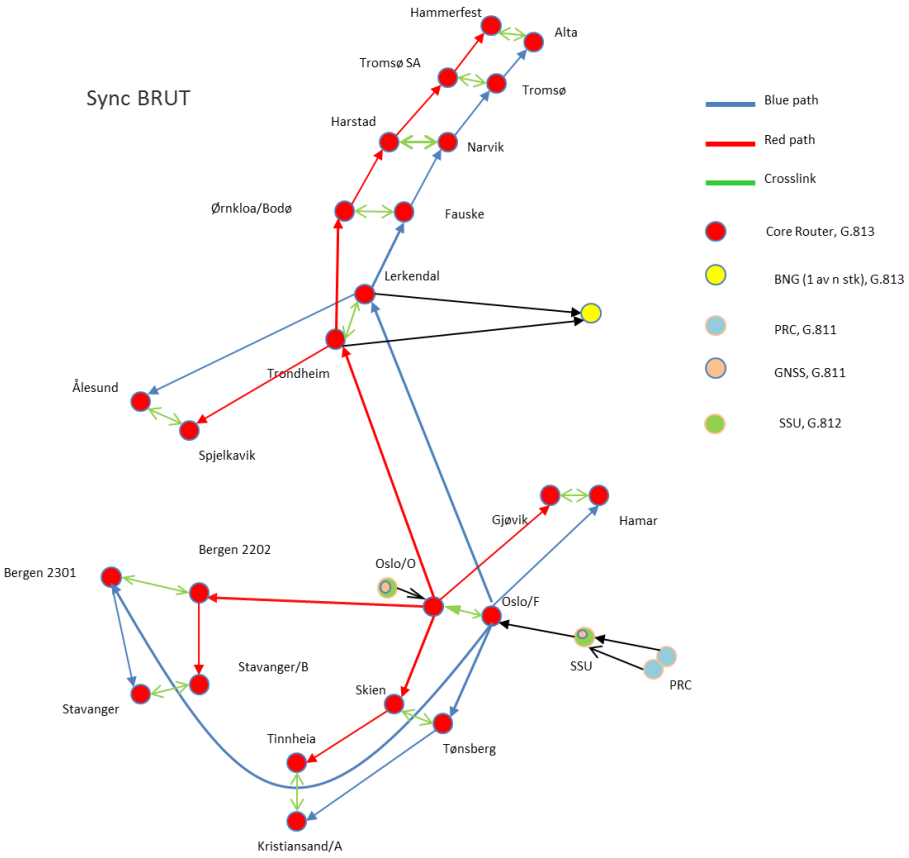
- NEs used in SDH-Core are the oldest SDH-NEs and should be replaced (>15y)
- Old STM-16 SDH-rings which is carrying sync are nearly emptied.
- Traffic are moved to IP over WDM.
- IP network are chosen as carrier for synchronisation

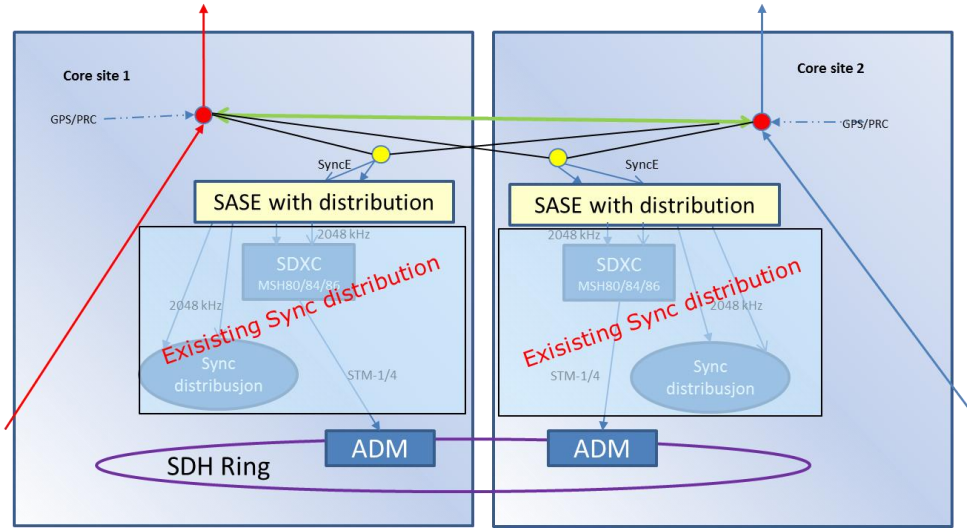
From sync distribution in SDH CORE




To SyncE distribution in Telenor MPLS and IP/VPN CORE network






## SyncE distribution in Telenor MPLS and IP/VPN CORE network

## Sync distribution from IP Core Network to SDH regional network

- Test to be executed with SyncE from PRC in Oslo to IP nodes with GPS reference in Tromsø (1966 km fibre + 14% delay due to DCMs).
- SASE (G.812 clocks) to be used between SyncE distribution in Core and sync input via SDXC to the regional SDH network



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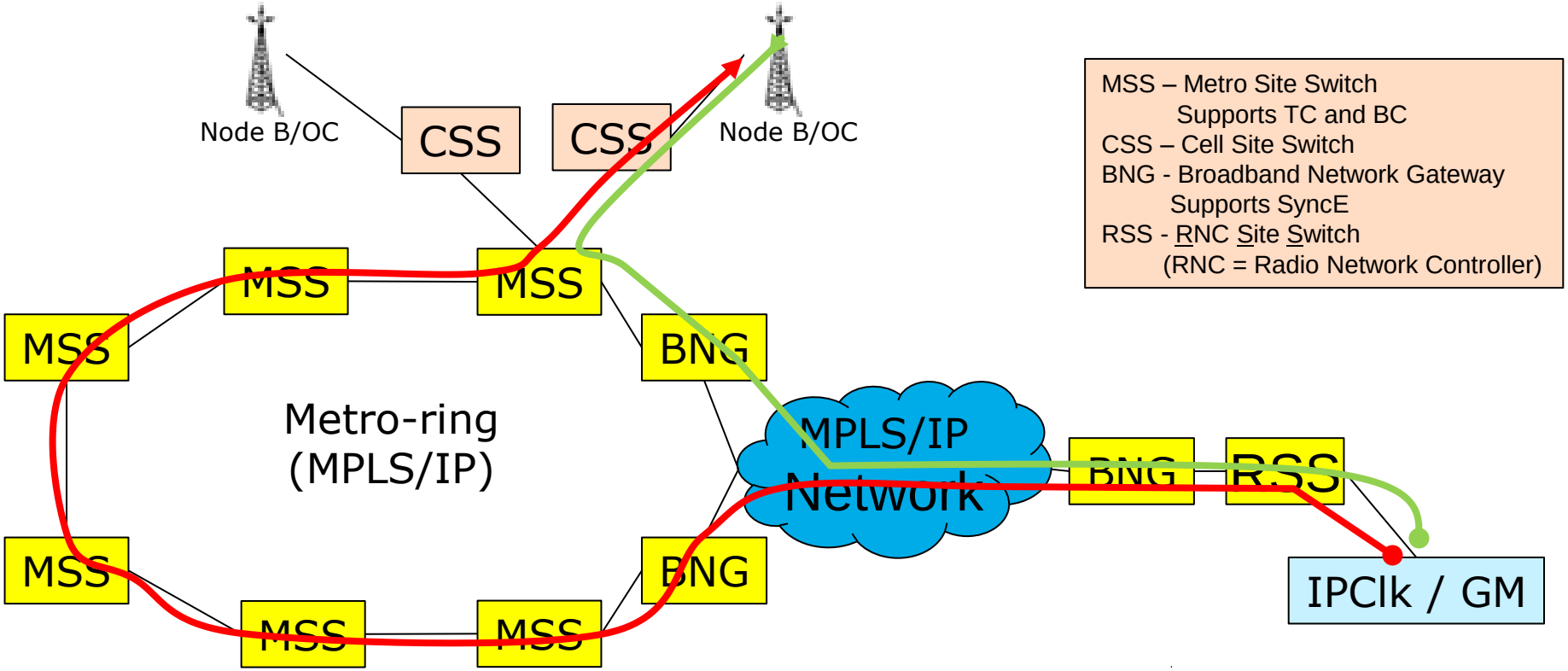
# Status for implementation of 1588v2 for frequency synchronisation

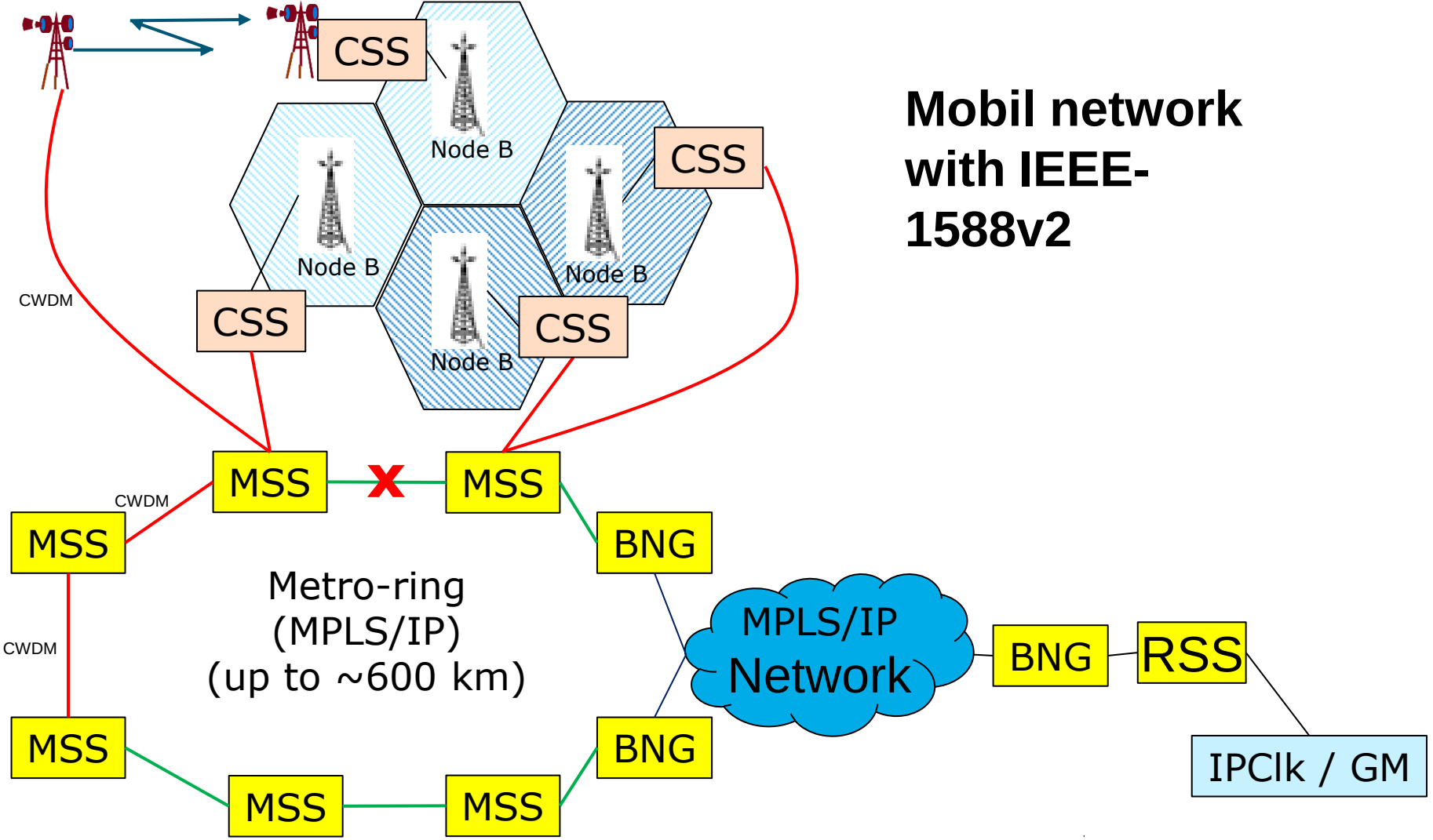
# Mobile network with IEEE-1588v2 sync distribution - frequency.




- Green: 6 hops minimum + MPLS-core
- Red (Fault situation): 11 hops maximum + MPLS-core

# Challenges for an existing operators network when phase-synchronization is introduced for LTE-A / LTE-TDD

# Mobil network with IEEE-1588v2




Green: 2-fiber WDM system

Red: 1-fiber CWDM system or BiDi SFP

Blue: Micro-wave system (No adaptive modulation used)



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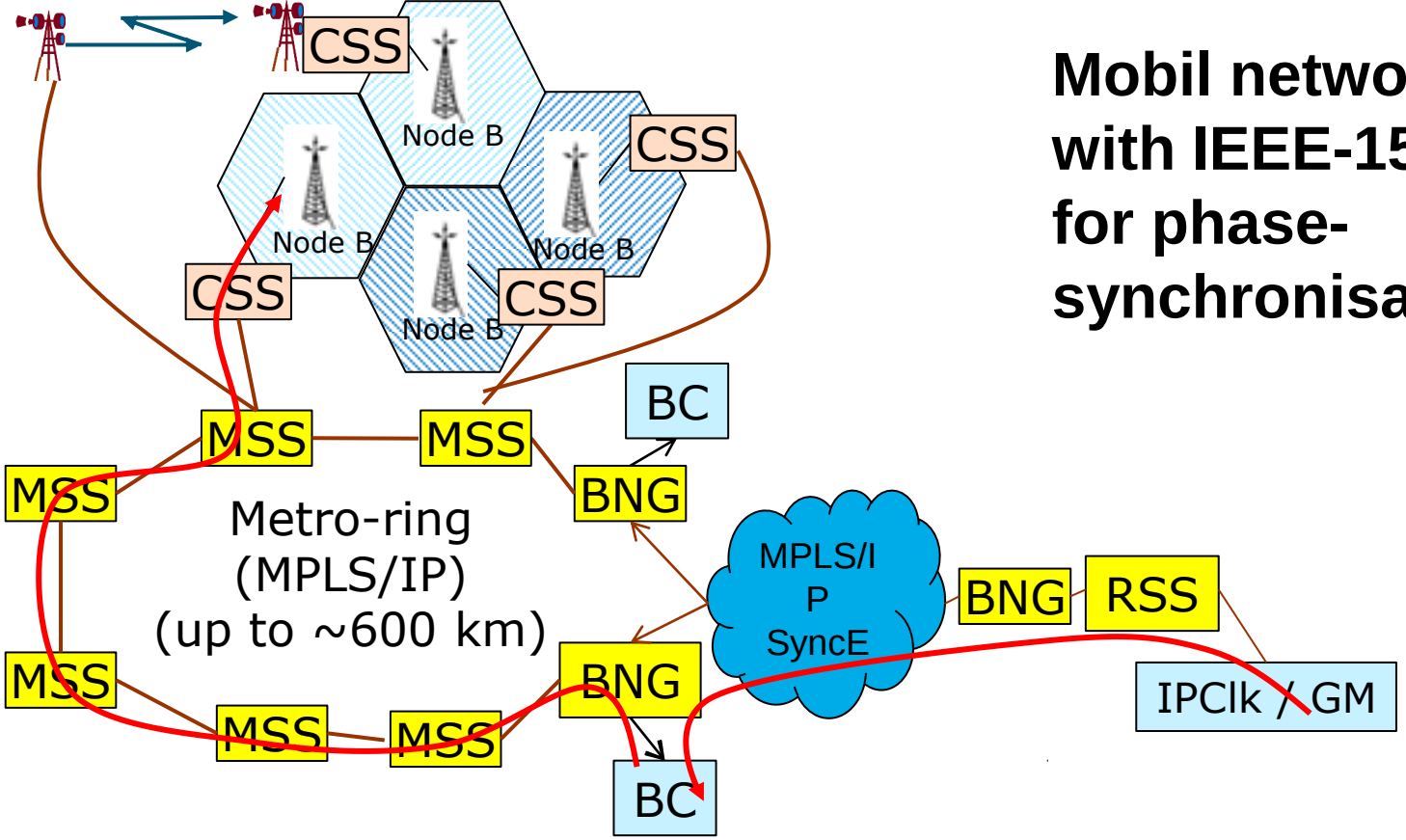
# Mobil network with IEEE-1588v2 for phase-synchronisation




- Introduction of BC with SyncE support will:
  - Reduce the number of clients to be connected towards GM
  - Reduce the number of hops from Node B to nearest master
  - Crypto between Node B and BNG. PTP packets not available between Node B and BNG. TC/BC in MSS not available!
  - Layer 3 and preferably also multicast have to be activated to use TC/BC in Metro-ring



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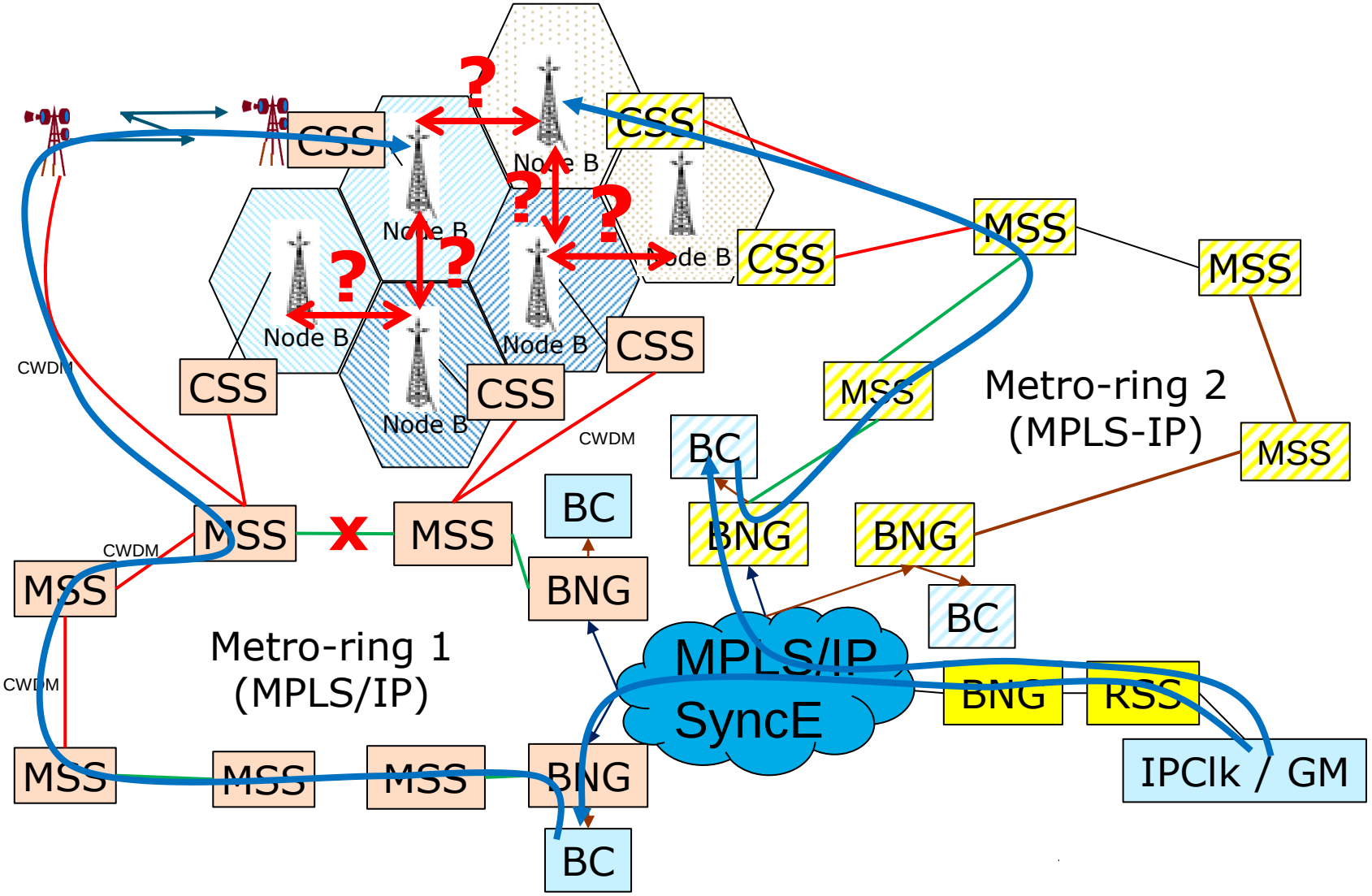


Requirements for adjacent clusters using different parts of the transport network providing timing for LTE-A with or without CoMP (coordinated multipoint)



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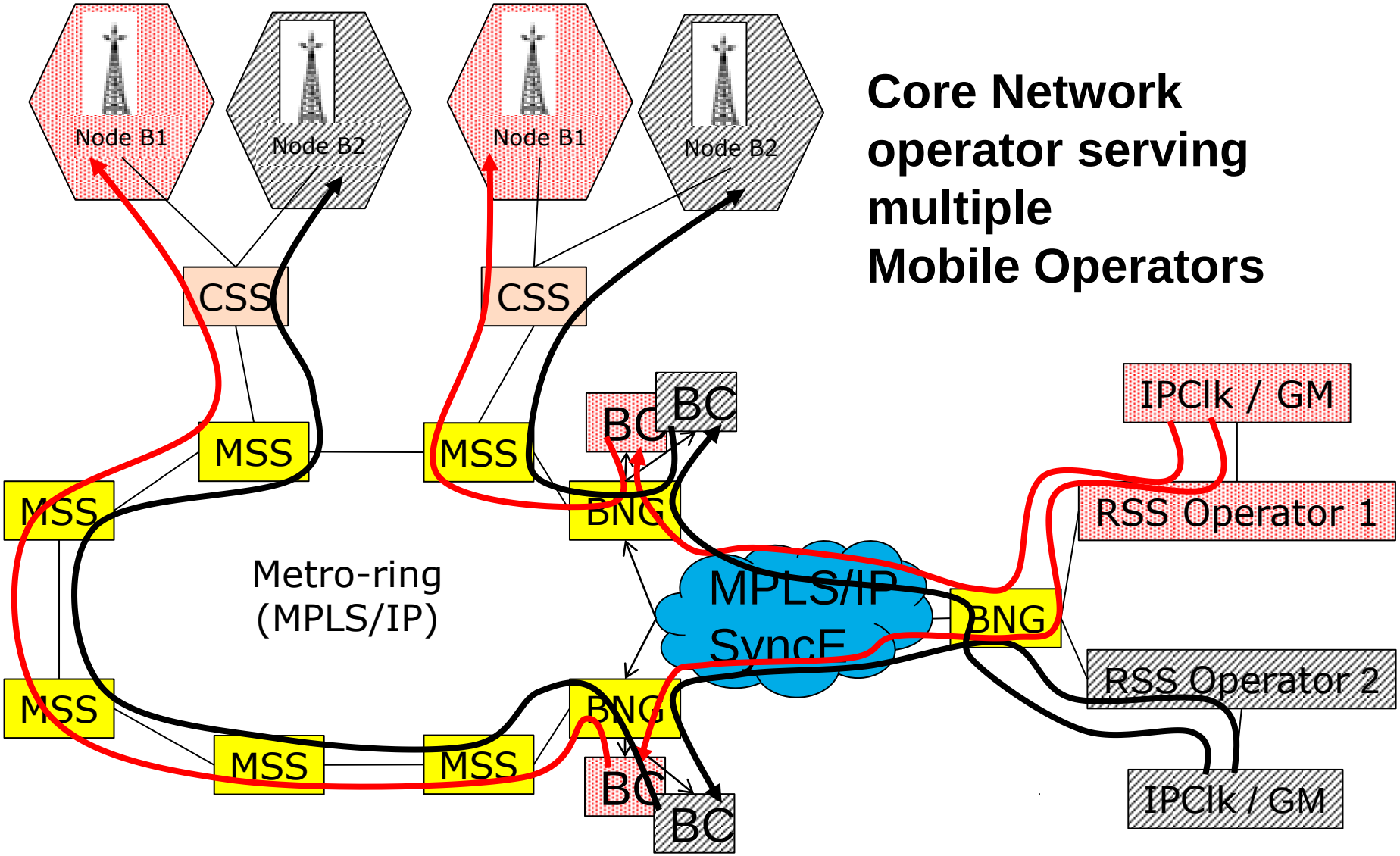
# Core Network operator serving multiple Mobile Operators




- Mobile operator owns GM and provides timing for his own purpose
- Requirements for the Core Network
  - BC at BNG will have support for SyncE
  - TC at Metro-Ring is desirable, but will have problems due to Crypto and MPLS



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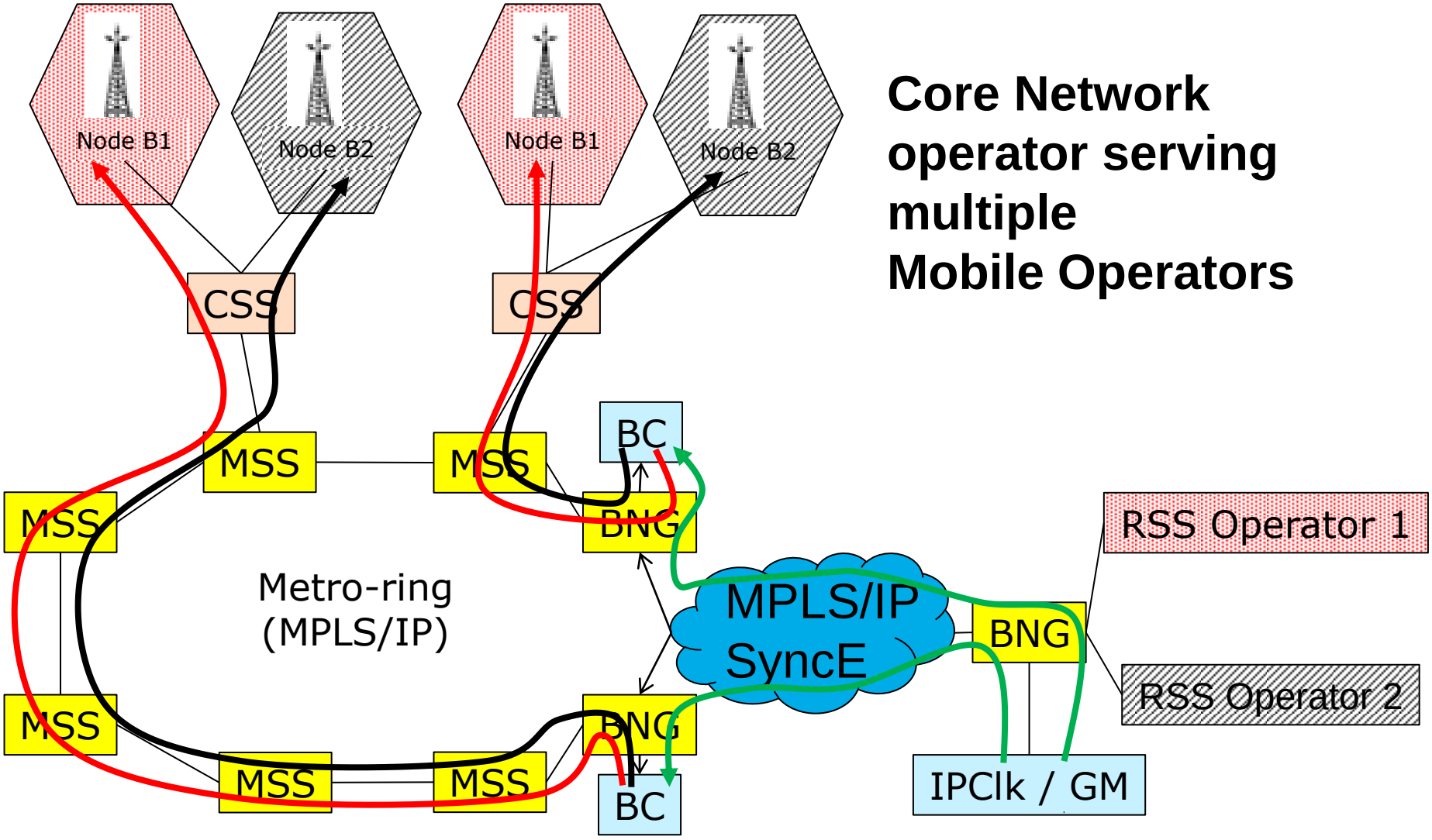
# Core Network operator serving multiple Mobile Operators




- Network operator owns GM and provides timing



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# Summary

- This presentation is made in order to point out challenges for an operator to support phase-synchronization.

- New infrastructure just installed for IP/MPLS Core and IP mobile backhaul. Short term solutions should be based on existing hardware!

- LTE-A, LTE-TDD and LTE-A CoMP
  Which phase-requirements will be relevant for the Network to serve different sizes of radio sub-networks?

- Implementation of TC and BC in MPLS-networks is a challenge

- CRYPTO when used is a challenge as traffic- and sync-packets use the same VPN between Node B and a «CRYPTO-Box»

Thank you