Synchronisation over the air

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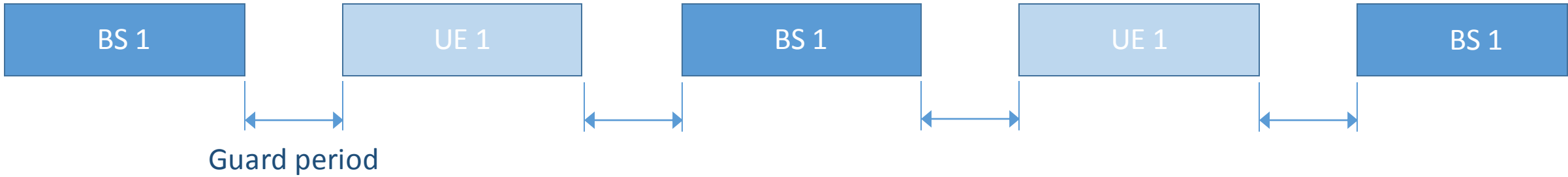
Agenda

- TDD Synchronisation Requirement
- Overlapping Coverage Areas
- Synchronisation Over The Air
- Measurement Over The Air
- Conclusions

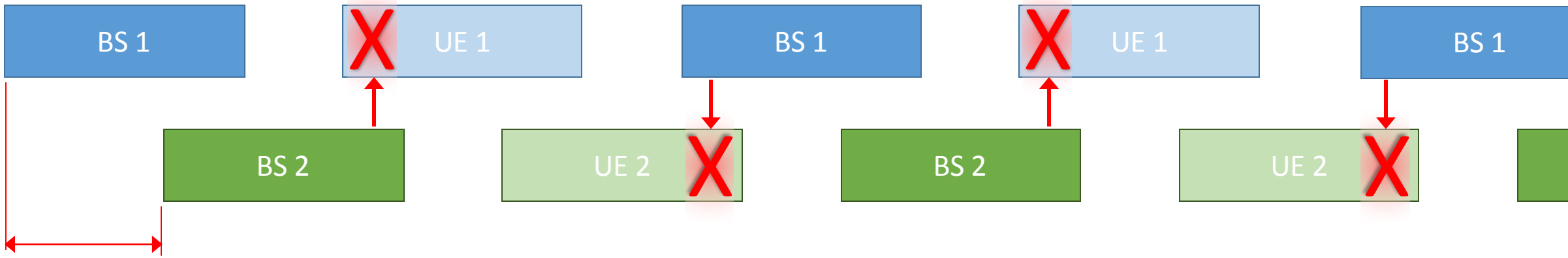
TDD Synchronisation and Overlapping Coverage Areas

Why do we need synchronisation?

- TDD networks alternate between upstream and downstream transmissions:

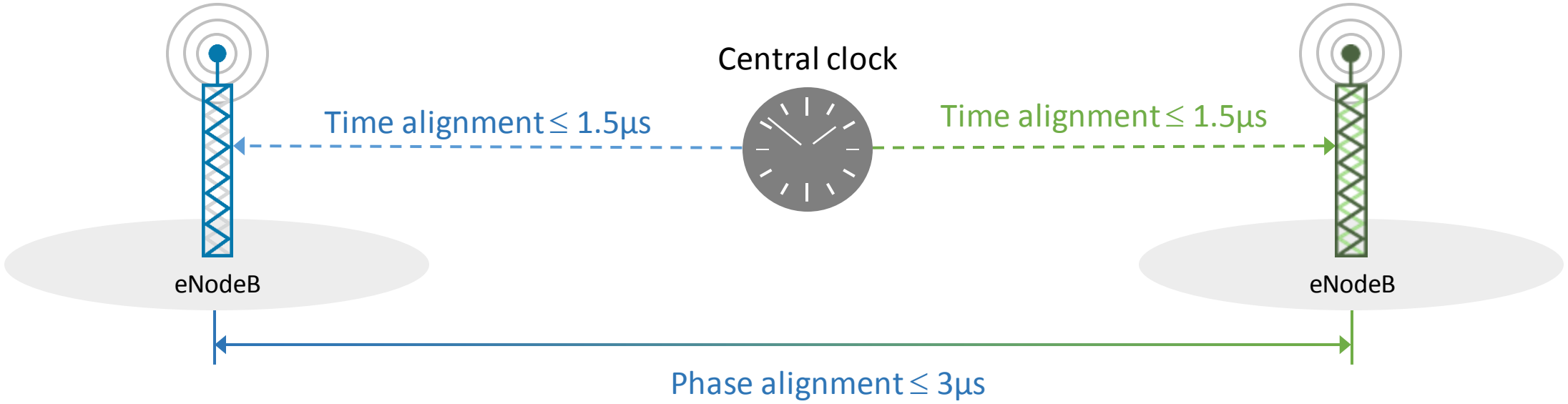


- If synchronisation is poor between cells, a neighbouring cell transmission can interfere with UE transmissions:



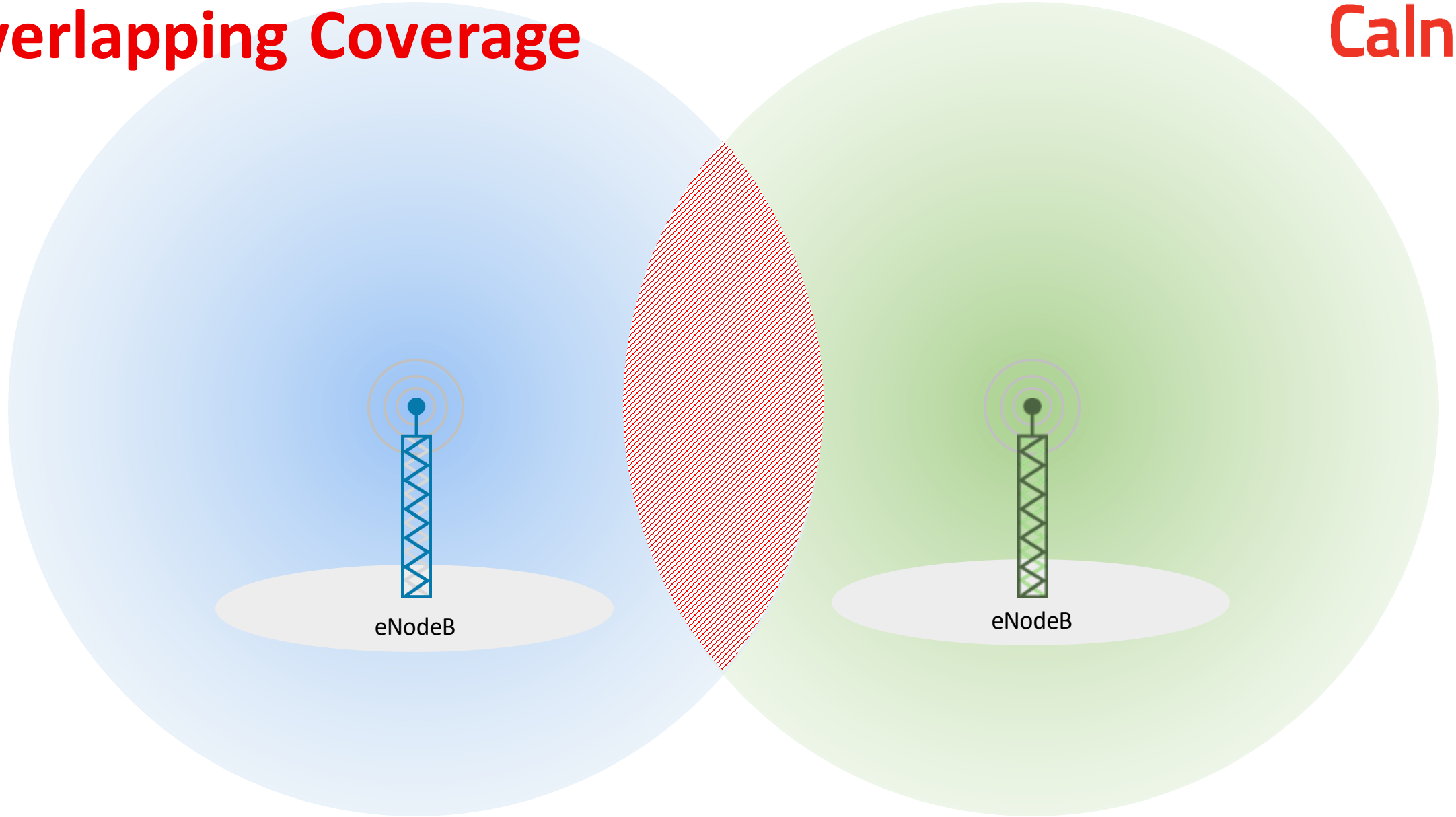
Synchronisation Requirement

- "The maximum absolute deviation in frame start timing between any pair of cells on the same frequency that have overlapping coverage areas shall be ≤ 3μs" *
- This is a ***phase requirement*** (i.e. it is relative to the other cell), not a ***time requirement***
- It is normally implemented as a ***time requirement*** to a ***central clock***

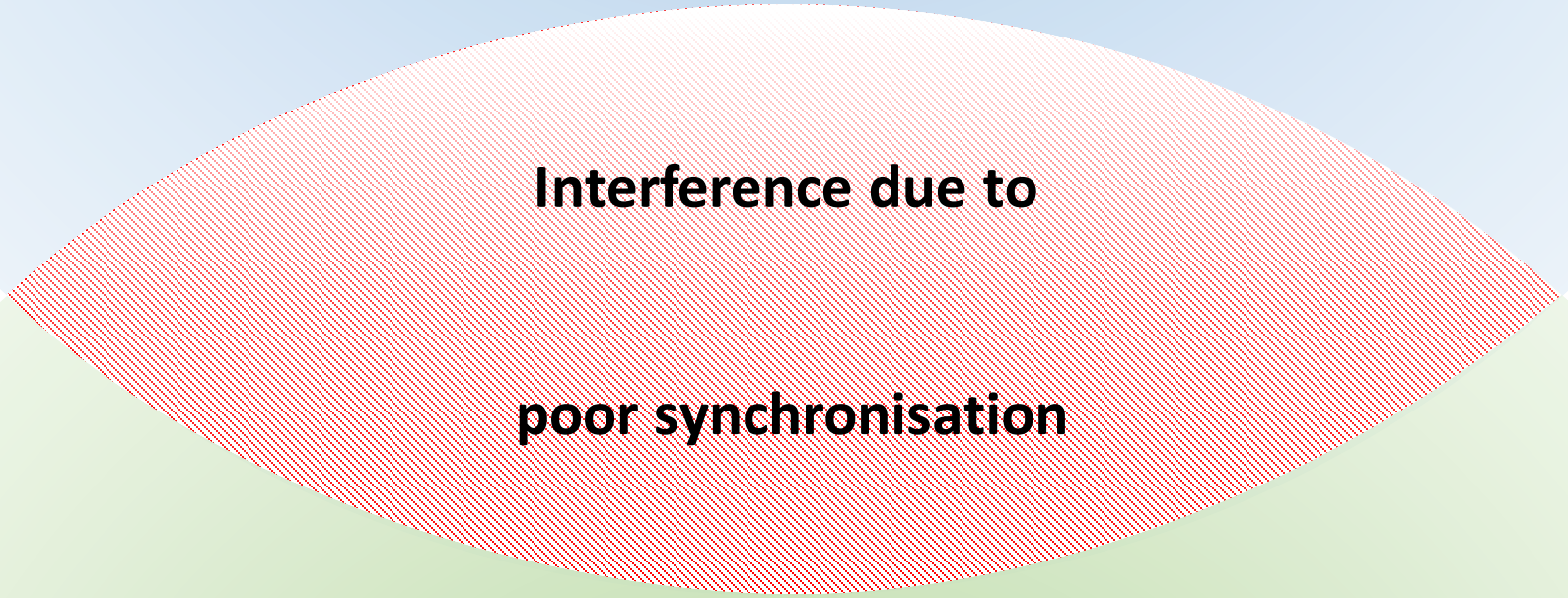


* 3GPP TS 36.133, section 7.4

Overlapping Coverage

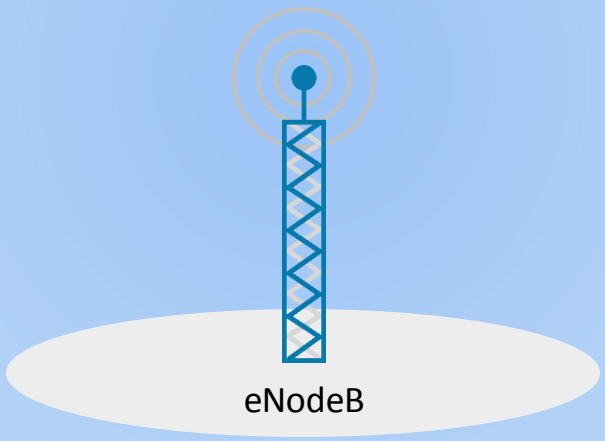


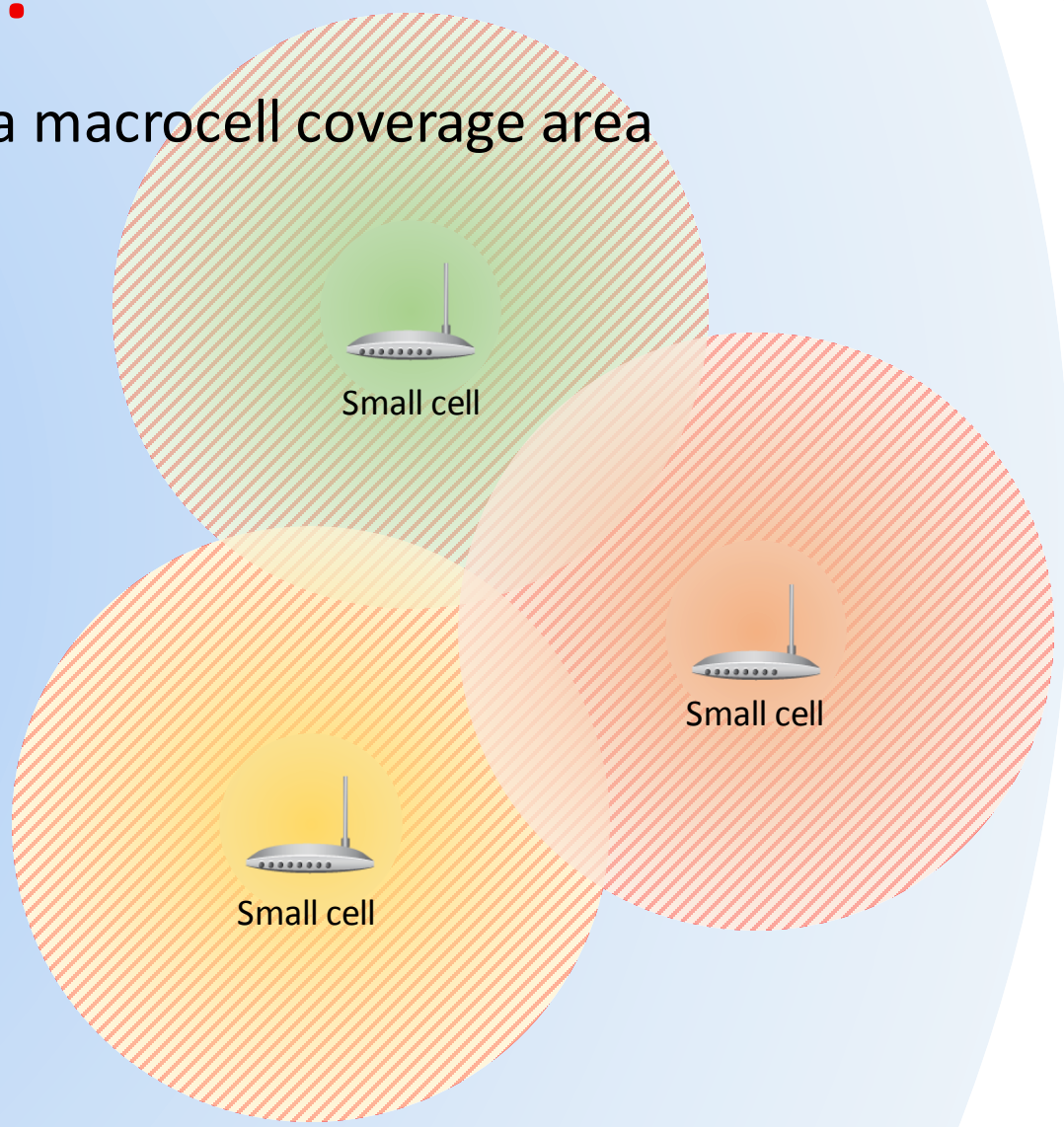
Interference Area



What about small cells?

- Small cells are often entirely within a macrocell coverage area
- Synchronisation errors may cause a significant interference problem

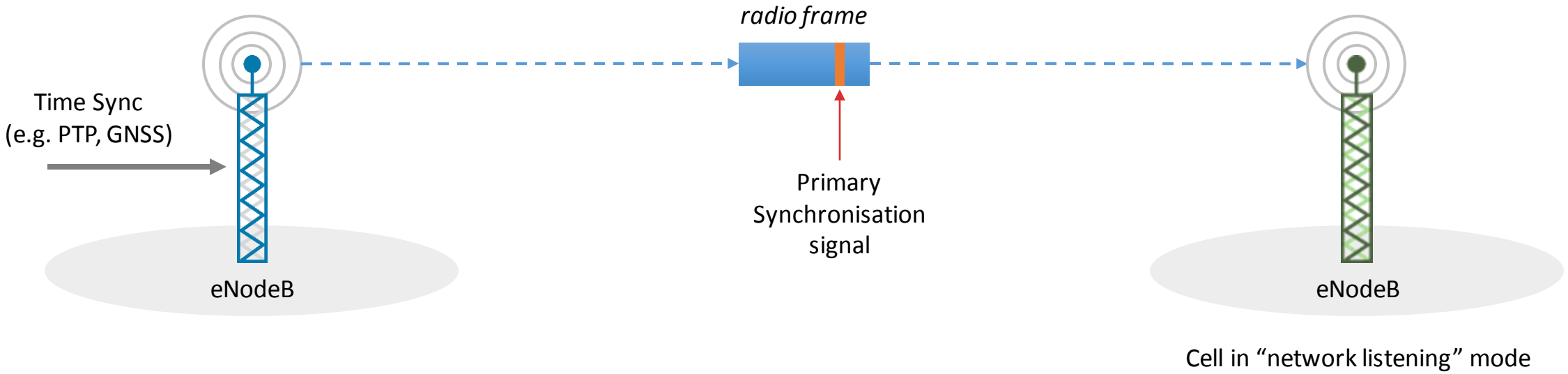




Synchronisation Over The Air

Synchronisation over the air

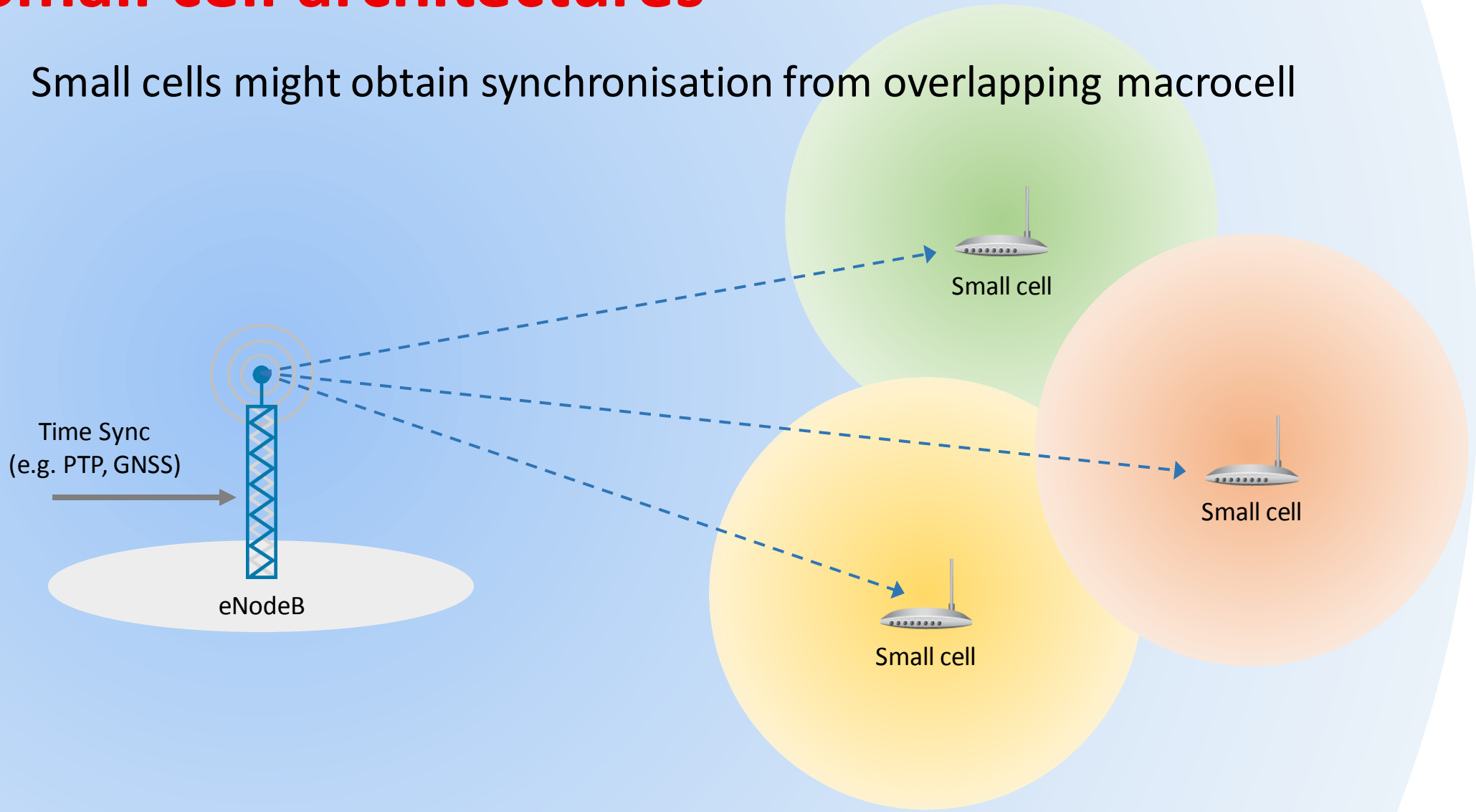
- What if you could synchronise one cell from another?



- “Network Listening” cell synchronises itself to the radio frames coming from a nearby cell that is already synchronised
- Also known as “radio interface based synchronisation” or RIBS

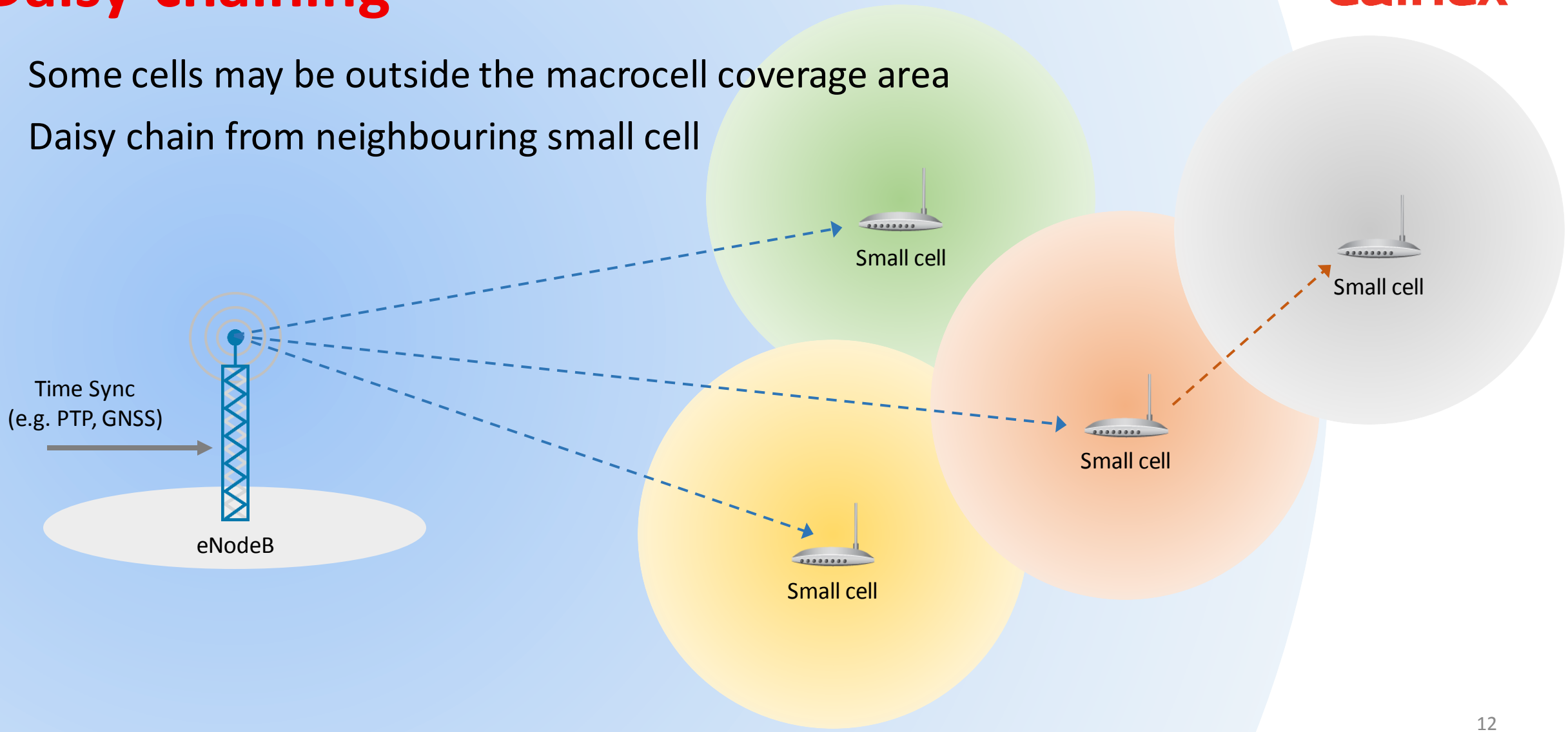
Small cell architectures

- Small cells might obtain synchronisation from overlapping macrocell



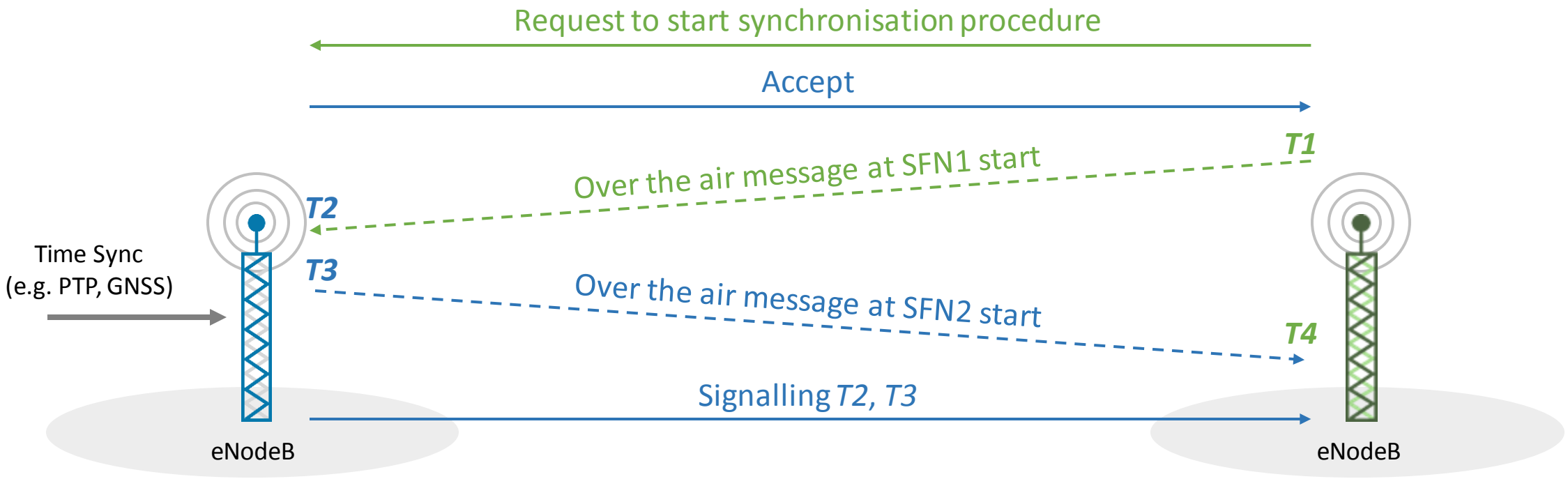
Daisy-chaining

- Some cells may be outside the macrocell coverage area
- Daisy chain from neighbouring small cell



What about delay?

- Several methods proposed to compensate for delay between the transmitting and receiving cells
- For example, one method includes two-way signals:

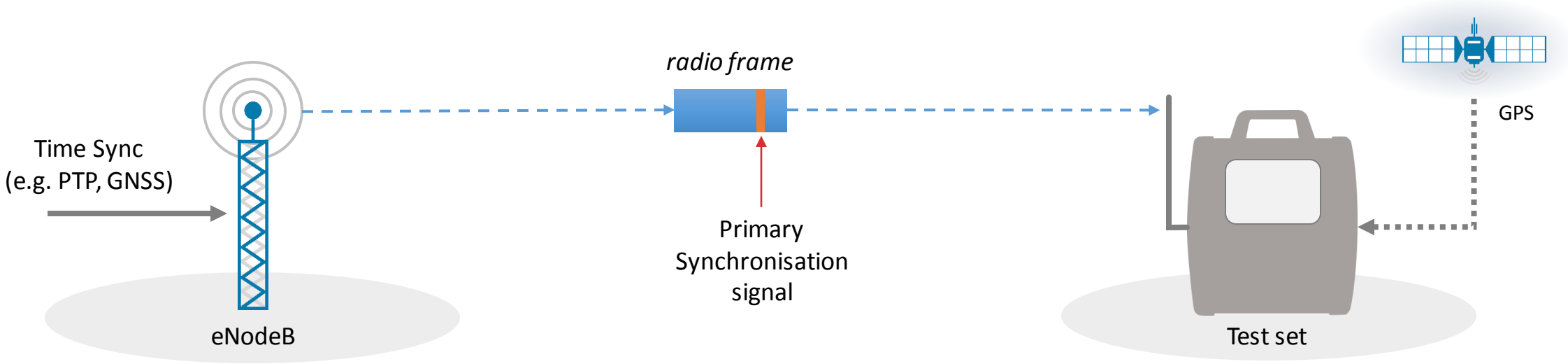


Estimate propagation delay from round trip time

Measurement Over The Air

Measuring synchronisation over the air

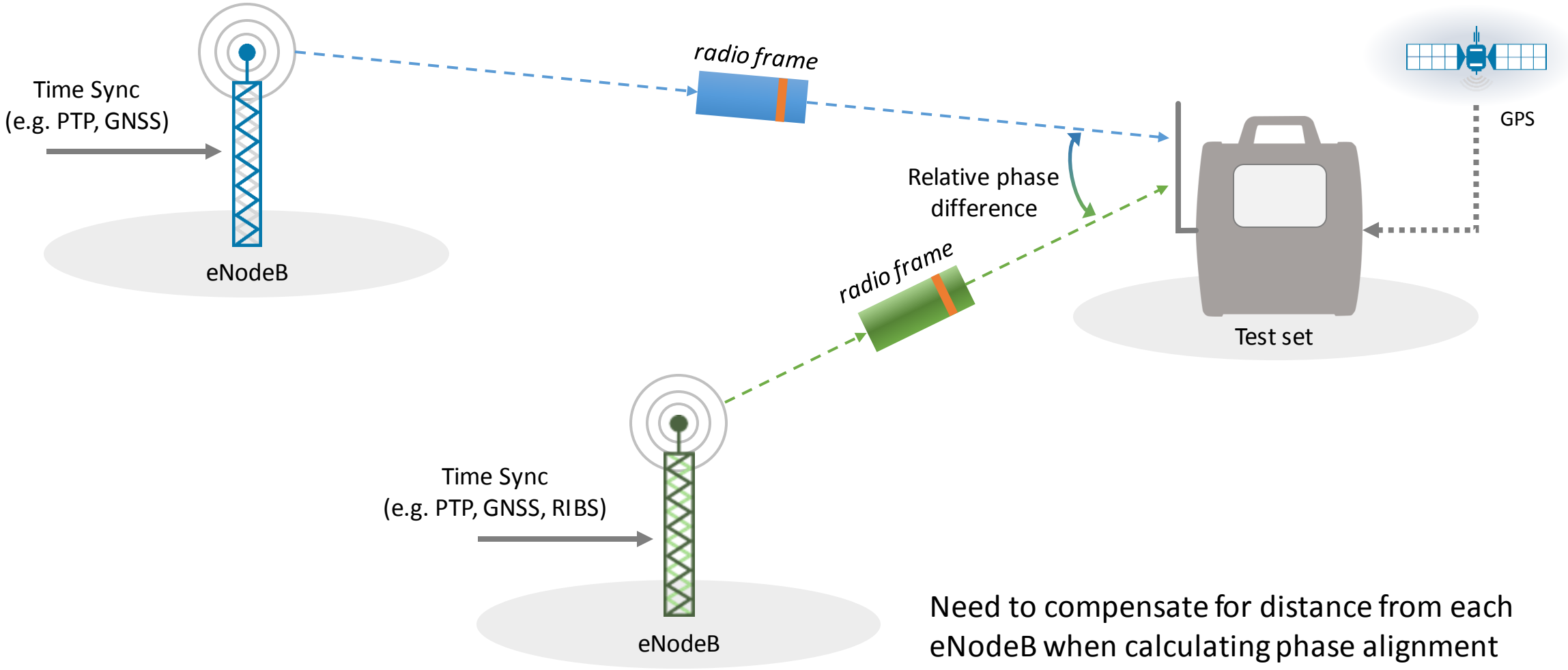
- If radio signals are being used for synchronisation, you'll want to measure them, right?



- Need to compensate for distance from eNodeB when calculating time error

Relative phase measurements

- Since phase alignment is the fundamental requirement, measure that too



Need to compensate for distance from each eNodeB when calculating phase alignment

Conclusions

Conclusions

- Synchronisation over the air is a viable technique for small cells
  - The cellular signal itself becomes part of the sync chain
- Measurement over the air verifies the entire synchronisation chain
- Uses include:
  - Network design verification
  - Installation test
  - Troubleshooting

Insight and Innovation

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