Heterogenous Network

Synchronization Architecture

Rajen Datta

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Precise Timing Requirements

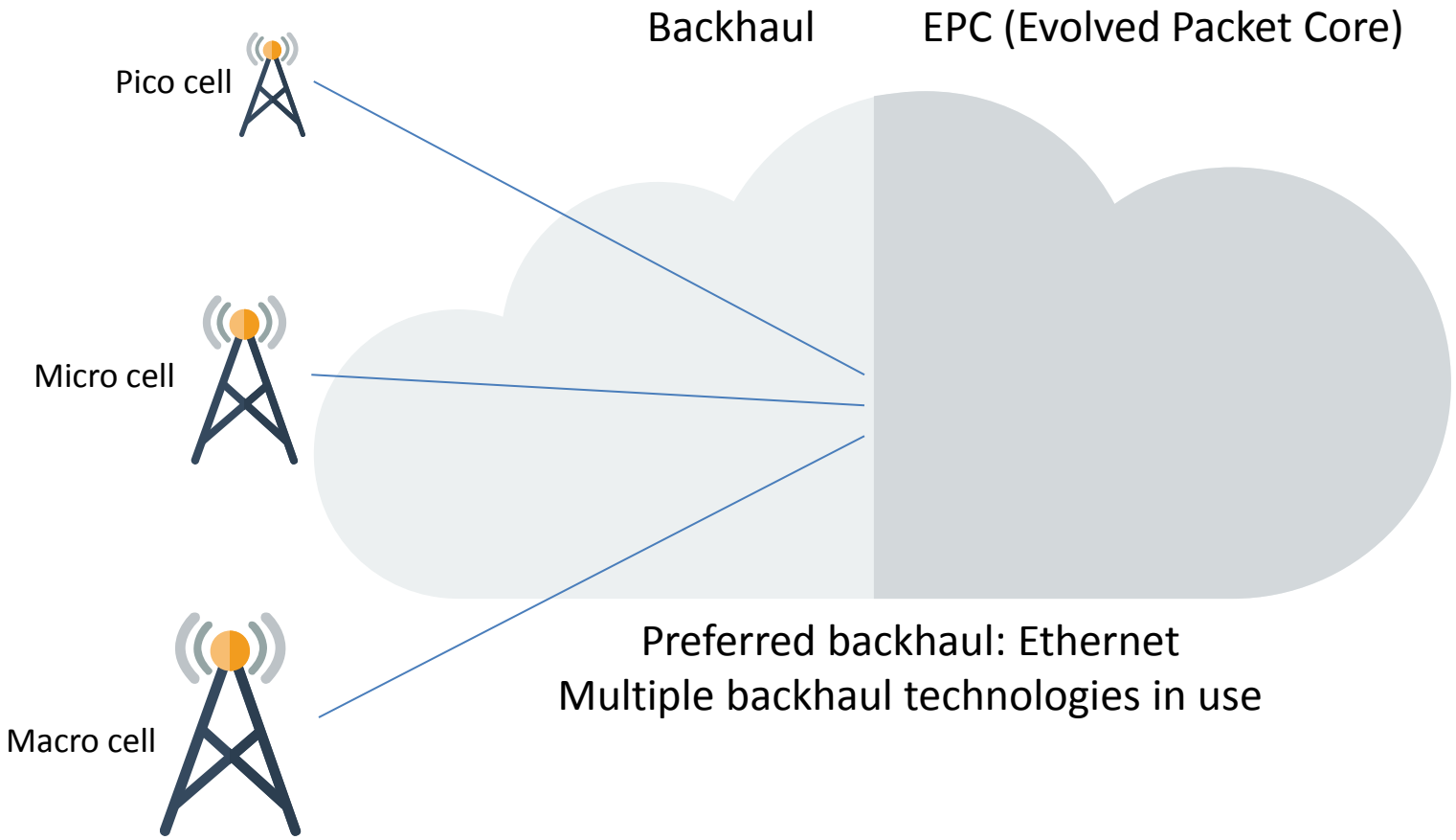
ITU / 3GPP sync requirements:

Standard	GSM	CDMA	LTE-FDD	LTE-TDD	LTE-A
Frequency	$16/250X10^{-9}$	$16 X 10^{-9}$	$16 X 10^{-9}$	$16 X 10^{-9}$	$16 X 10^{-9}$
Time		3-10 µs		1.5 µs	0.5 µs

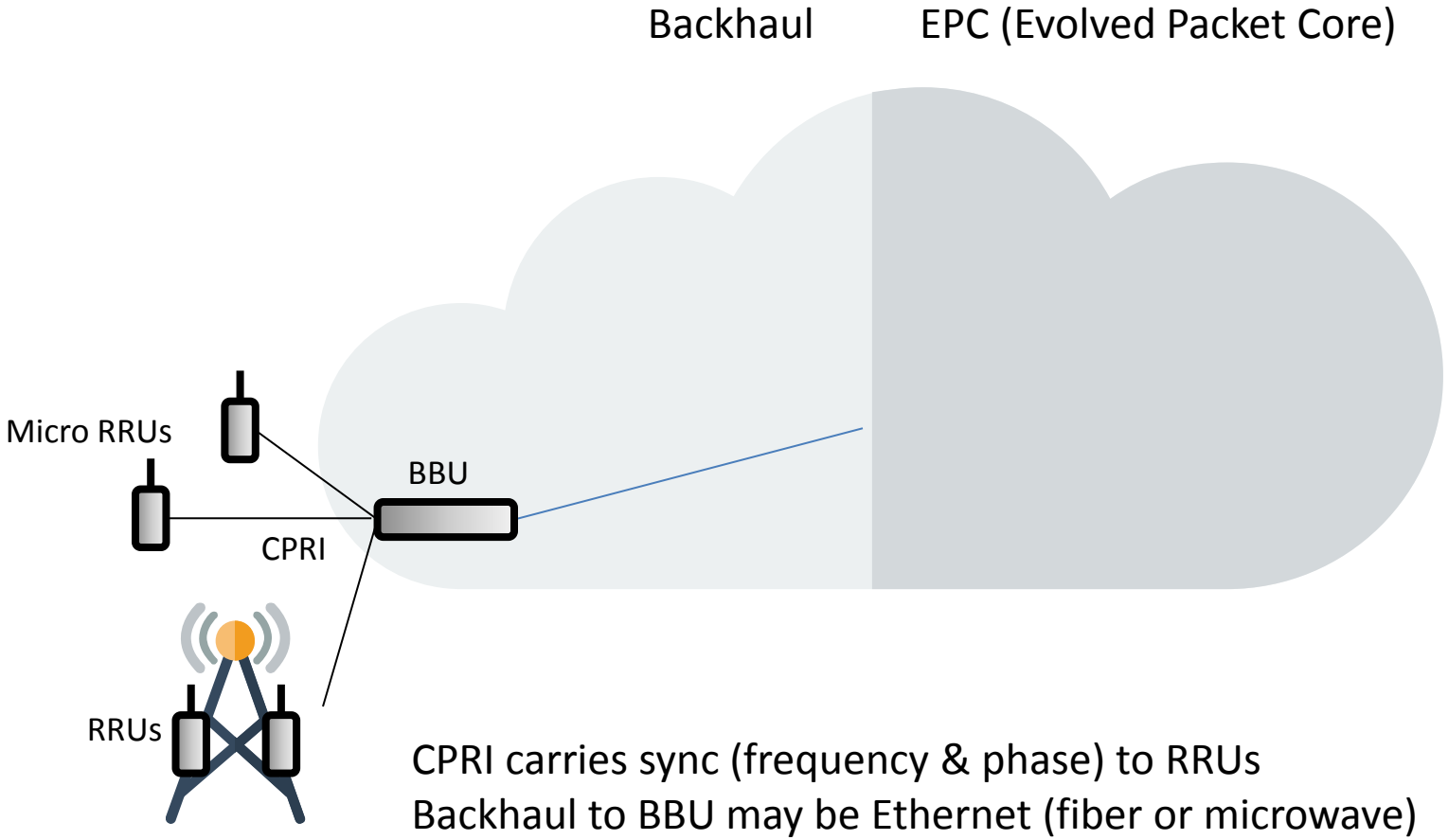
Stricter phase requirements

Simple solution:
The Managed Timing Engine ™

LTE HetNets

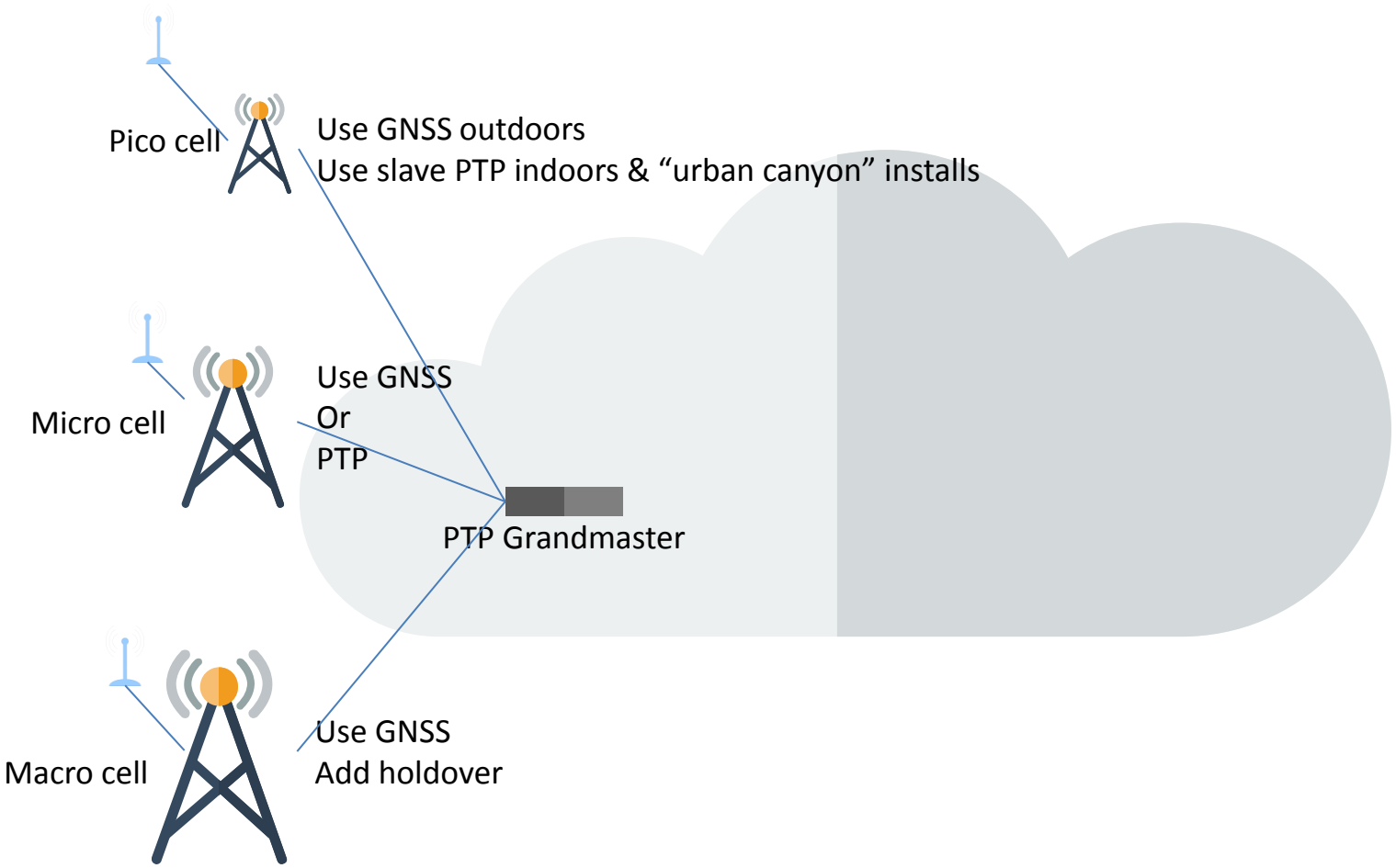


LTE Common BBU Architecture

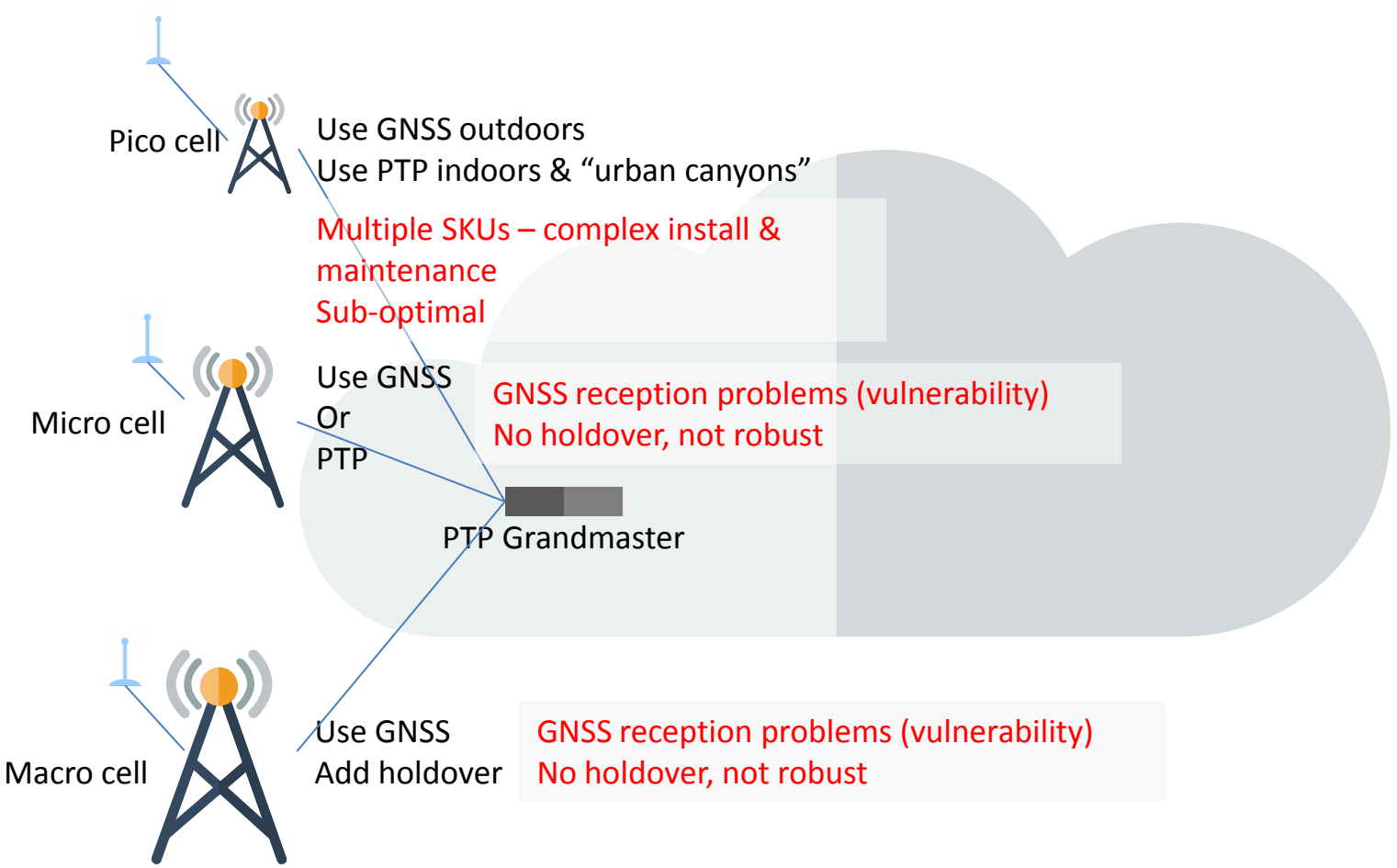


CPRI carries sync (frequency & phase) to RRUs
Backhaul to BBU may be Ethernet (fiber or microwave)

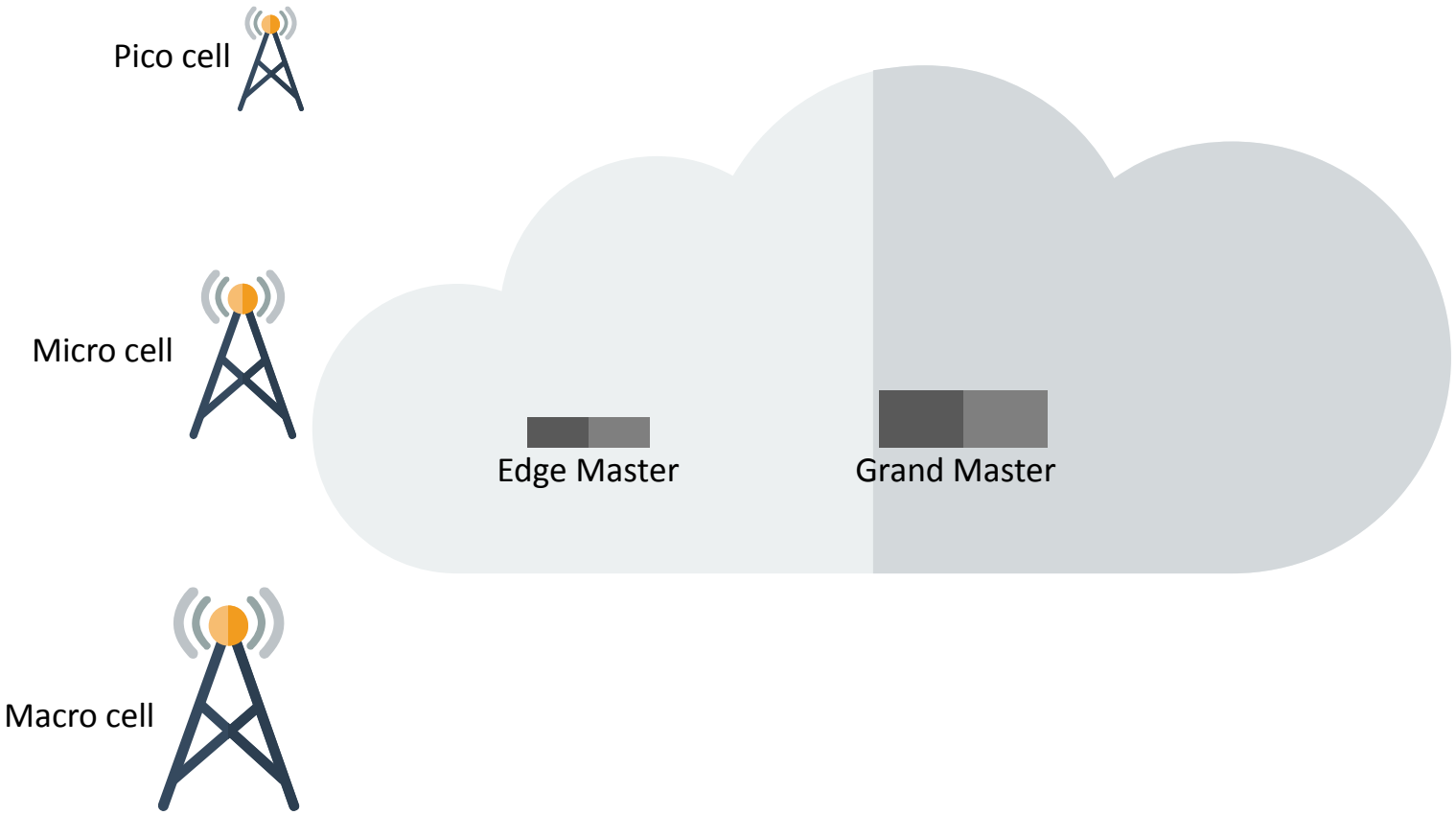
Edge Solutions Today



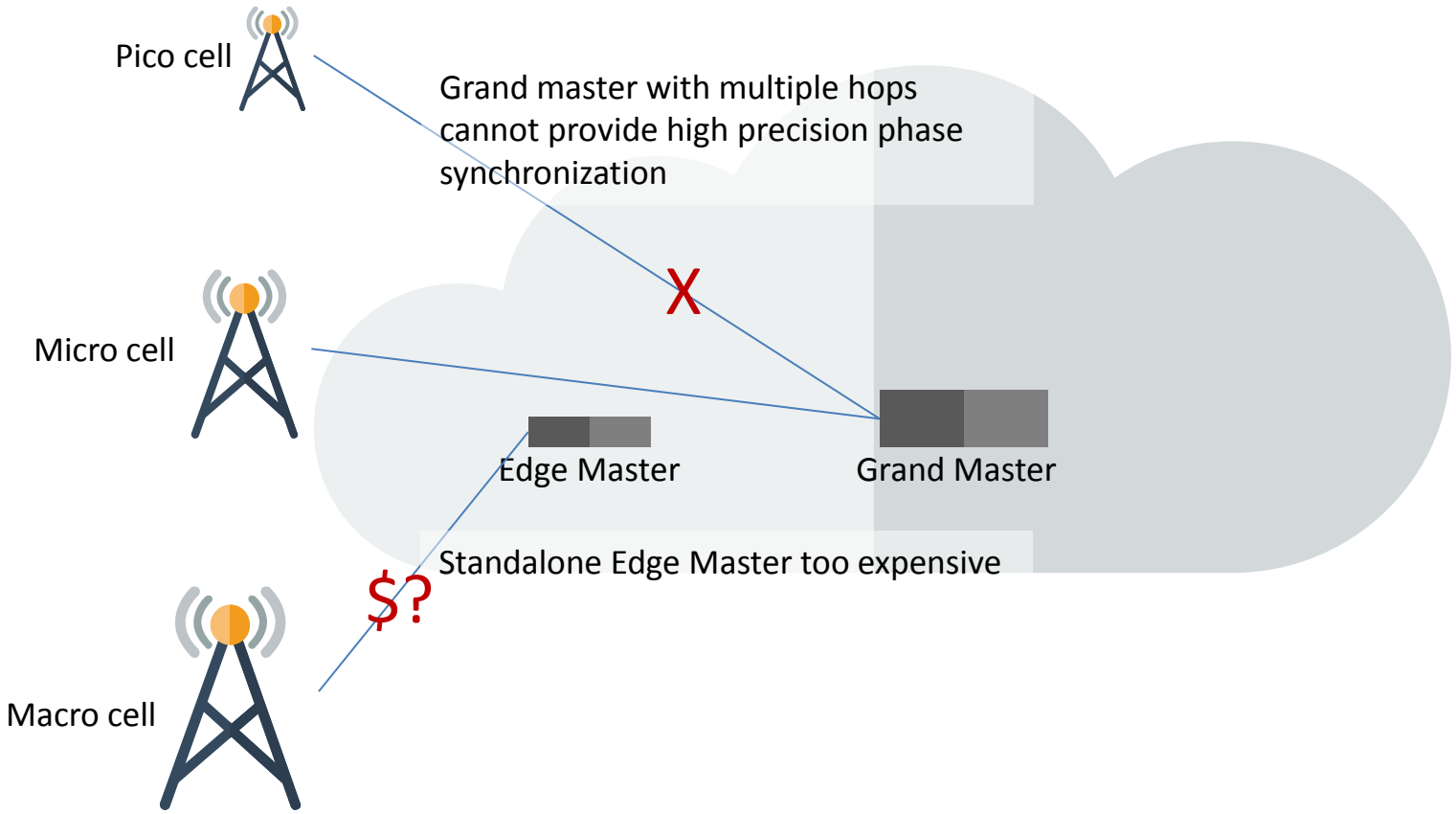
Problems



Master Solutions



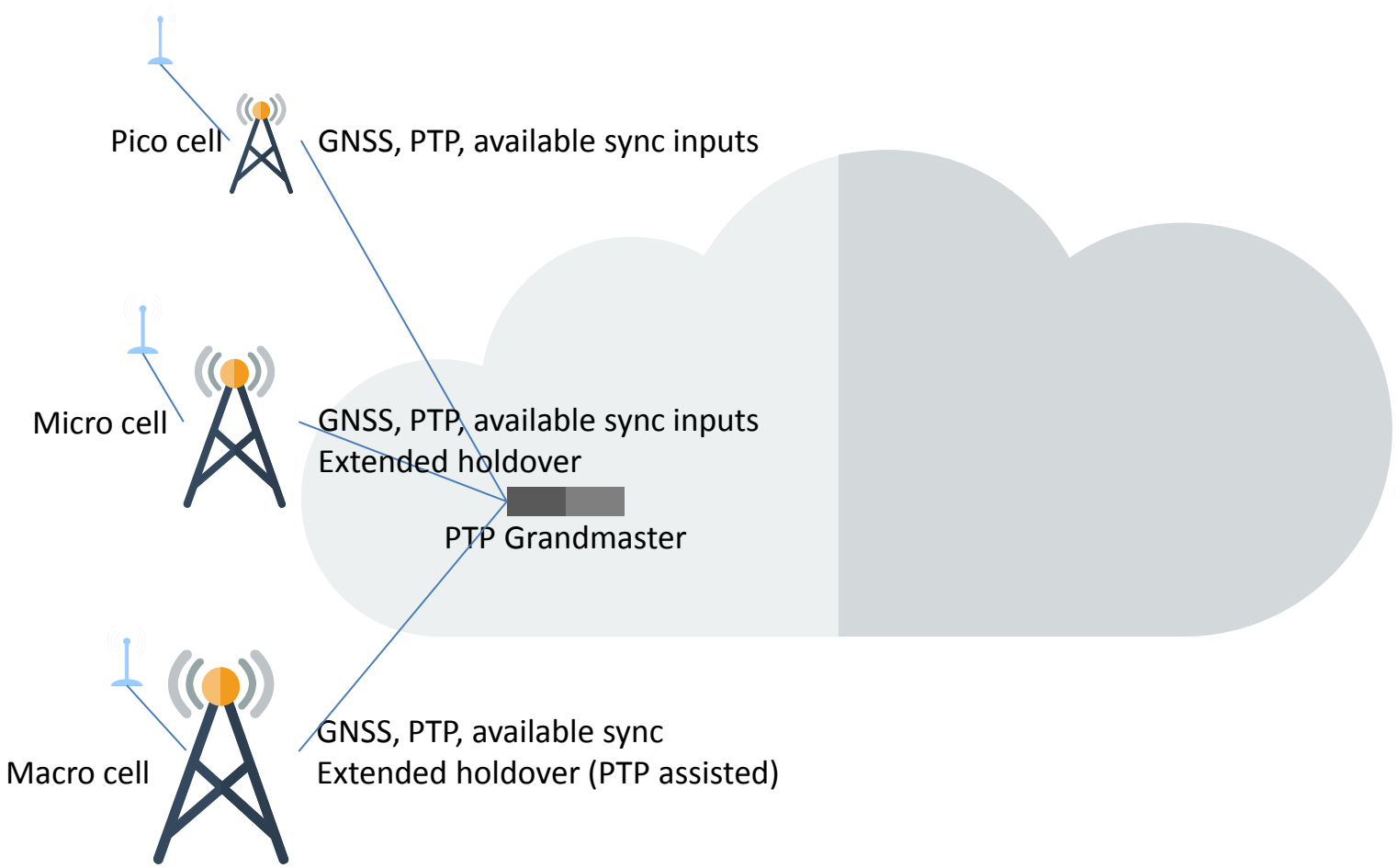
Problems



Optimal Available Sync

- Use Partial on path support (for PTP)
- Pick best sync inputs at the edge
- Pick 2nd best inputs as backup / holdover

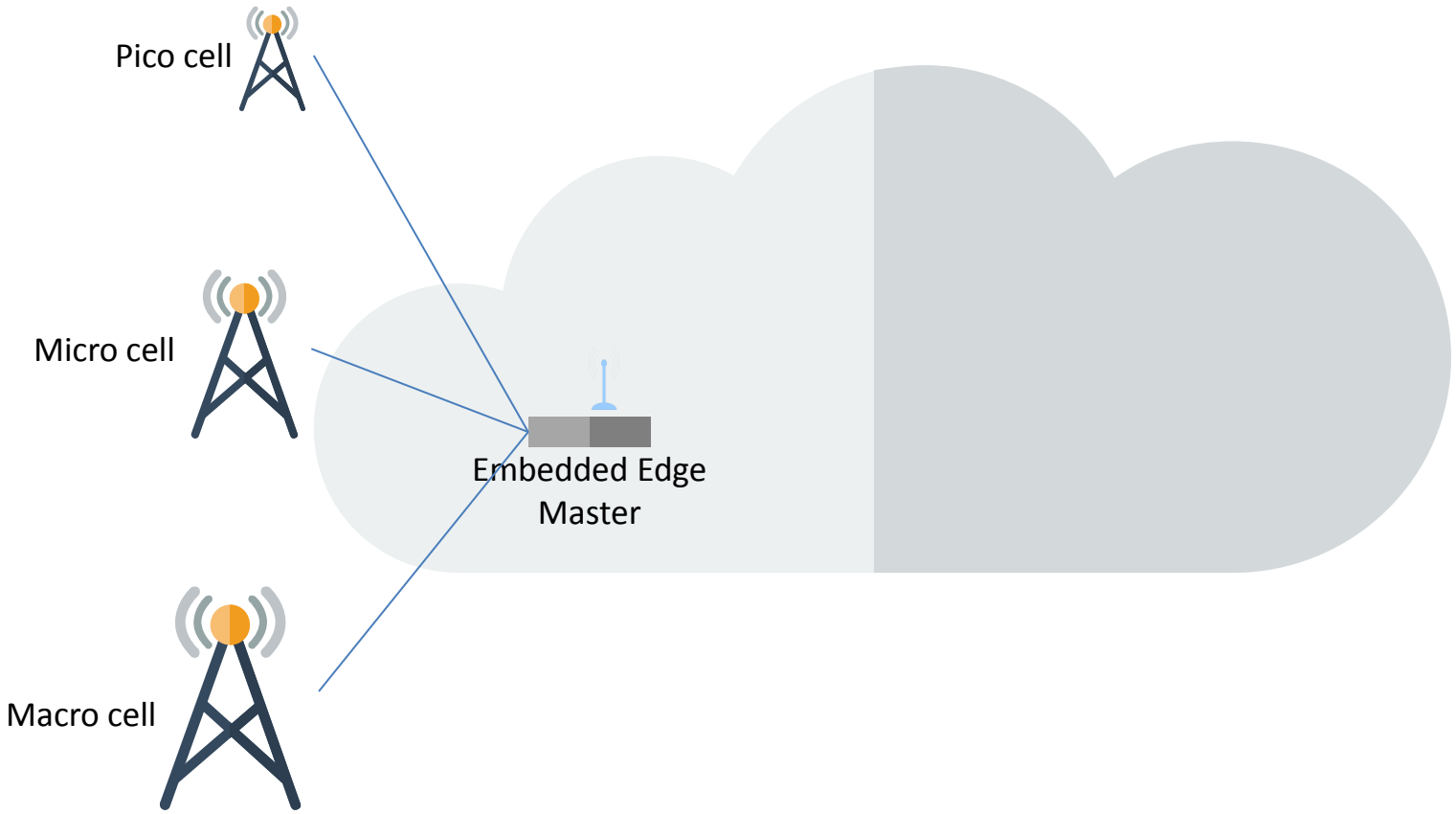
Optimal Sync Choices



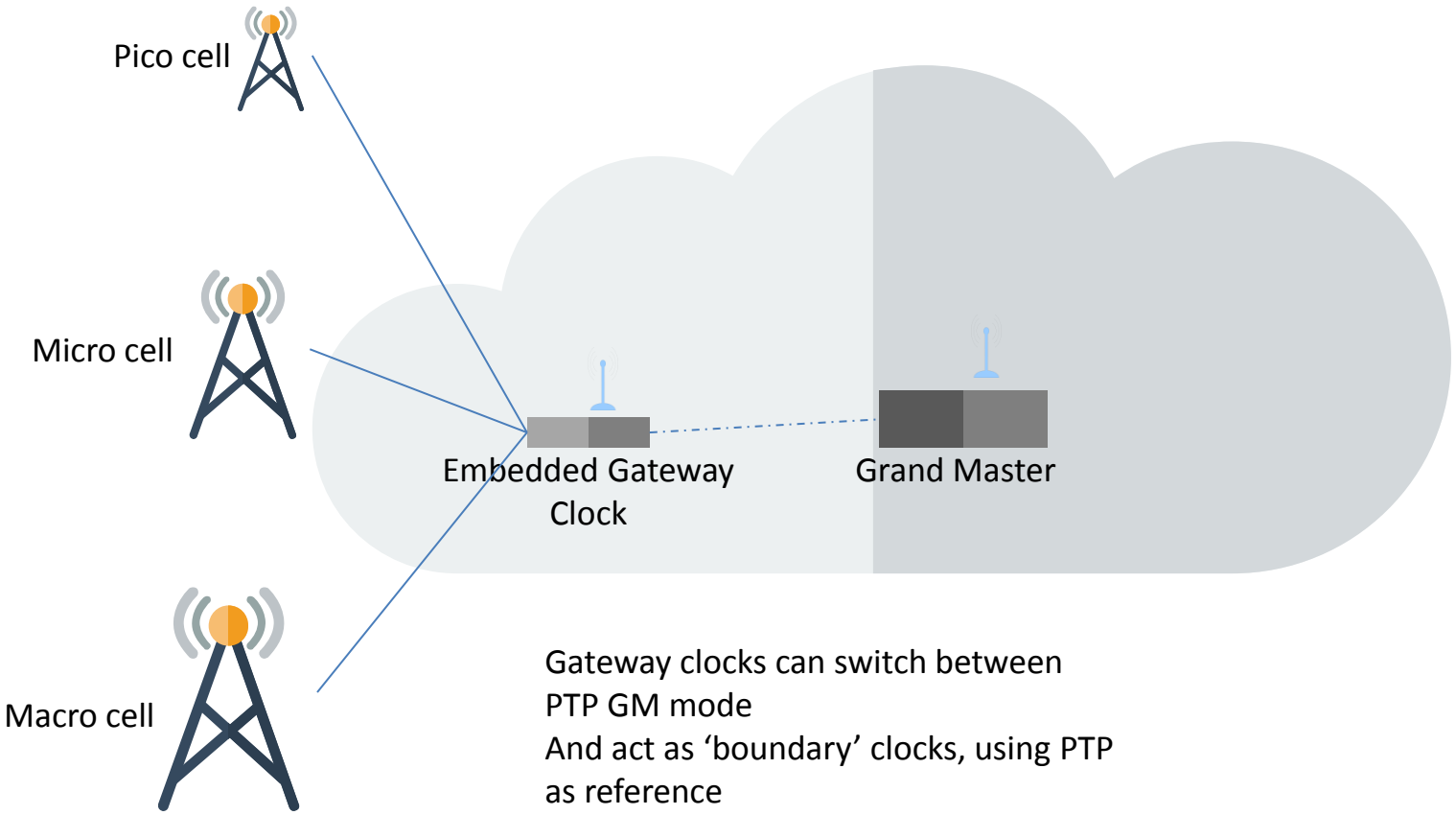
Embedded Sync Solutions

- Embedded partial on path support
  - BCs or GCs must help, not hinder
  - Must be embedded to reduce deployment & operating $s
- Move grand master function to the edge
  - Precision phase sync impeded by too many ‘hops’
  - Multiple edge GMs create a more robust sync network
  - Economically viable only with embedded GM functions

Edge Master Solution



Gateway Clock Solution



Gateway clocks can switch between PTP GM mode
And act as 'boundary' clocks, using PTP as reference

Conclusion

- Roadblocks to current sync deployments
- Optimal solution involves
  - Combination of available technologies
  - Embedding high precision sync into networking equipment
- Results in cost-effective network deployments
- Reduced operating costs for sync
- A more robust & resilient sync architecture