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Mobile Backhaul Synchronization Architecture

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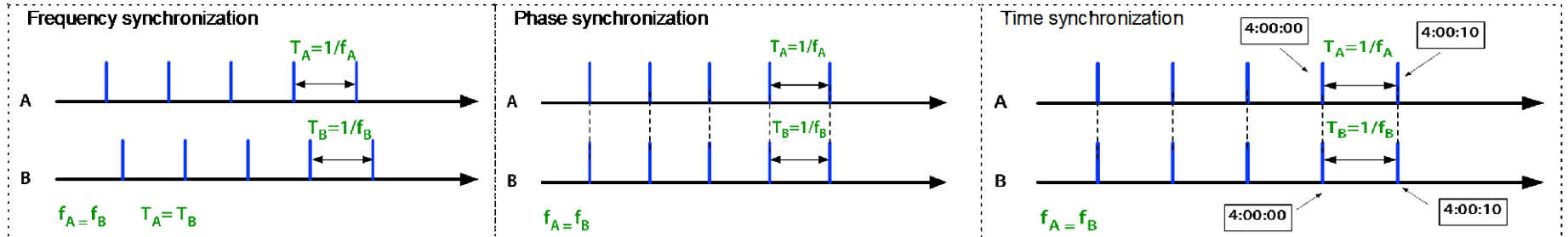
Synchronization is fundamental to running a mobile network.

Can DOCSIS-based mobile backhaul address modern synchronization needs?

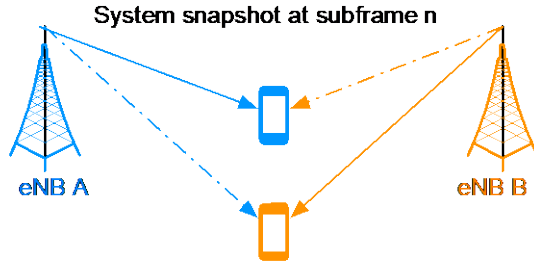
The White Paper



1. Drivers for modern backhaul synchronization requirements
2. Sync technology toolkit
3. Options for DOCSIS
 - Networks with full timing support
 - Networks with partial timing support

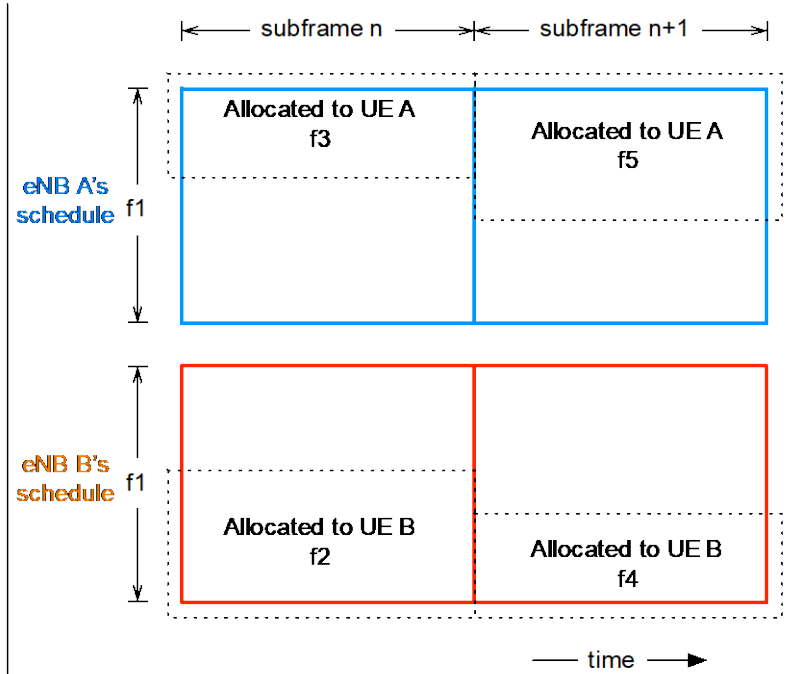
Types of synchronization



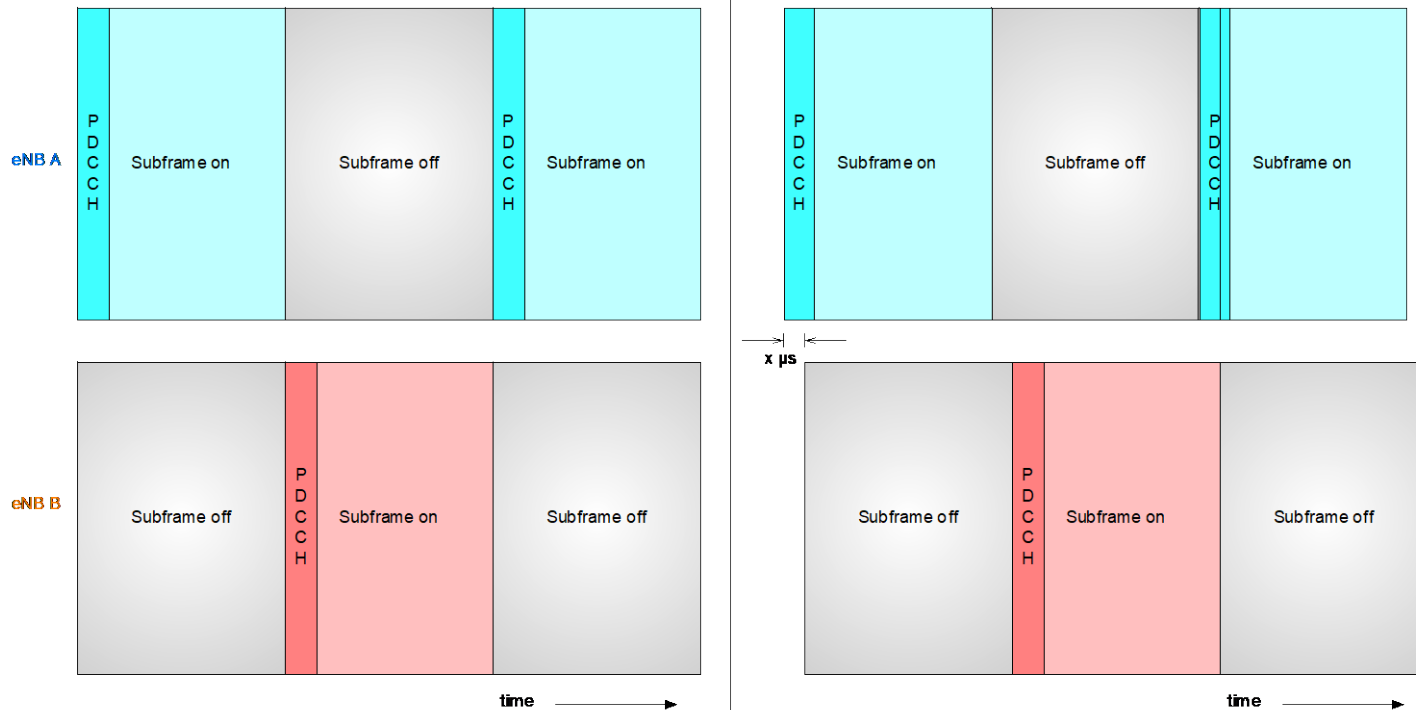
What is LTE-A? Let's look at an example, CoMP



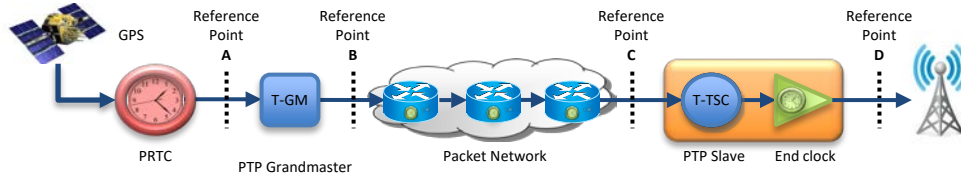
- Signal from A, sent on f3 —→
 - Signal from B, sent on f2 —→
 - - - Interference from A on f3 - - -→
 - - - Interference from B on f2 - - -→
-  UE A serviced by eNB A
 UE B serviced by eNB B



Why does LTE-A need time and phase synchronization?

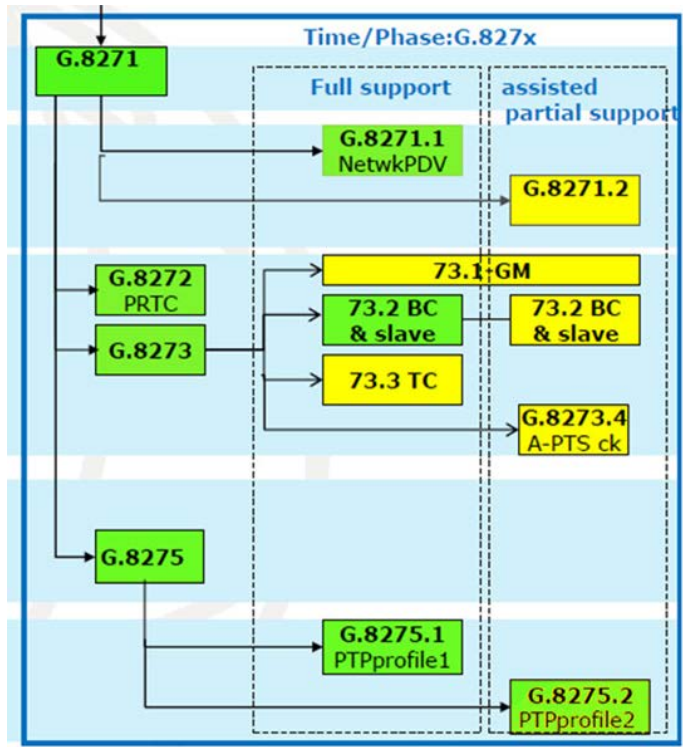


LTE-A and LTE TDD sync requirements



	Frequency	Phase	Notes
LTE FDD	± 50 ppb	None	3GPP TS 36.104 [1] §6.5.1
LTE TDD	± 50 ppb (wide area) ± 100 ppb (local area) ± 250 ppb (home)	$10 \mu\text{s}$ (wide: cell radius $>3\text{km}$) $3 \mu\text{s}$ (local: cell radius $<3\text{km}$) $1.33 \mu\text{s} + T_{\text{prop}}$ (home eNB radius $>500\text{m}$) $3 \mu\text{s}$ (home eNB radius $<500\text{m}$)	3GPP TS 36.133 [2] §7.4.2
CoMP	None	$\pm 1.5 \mu\text{s}$	
eICIC	None	$\pm 1.5 - 5 \mu\text{s}$	
eMBMS / MBSFN	None	$\pm 10 \mu\text{s}$	

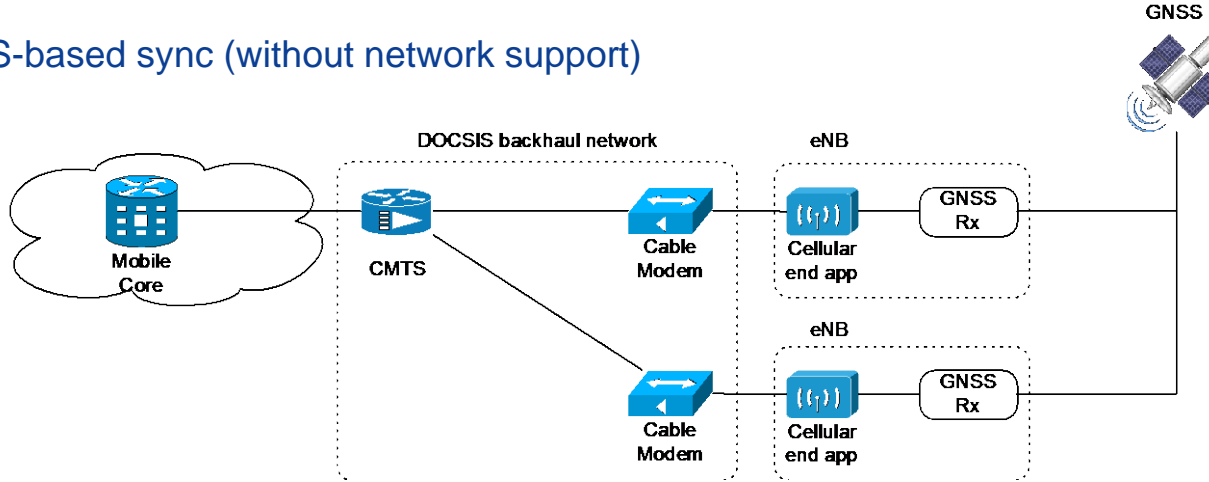
What's in the toolkit?



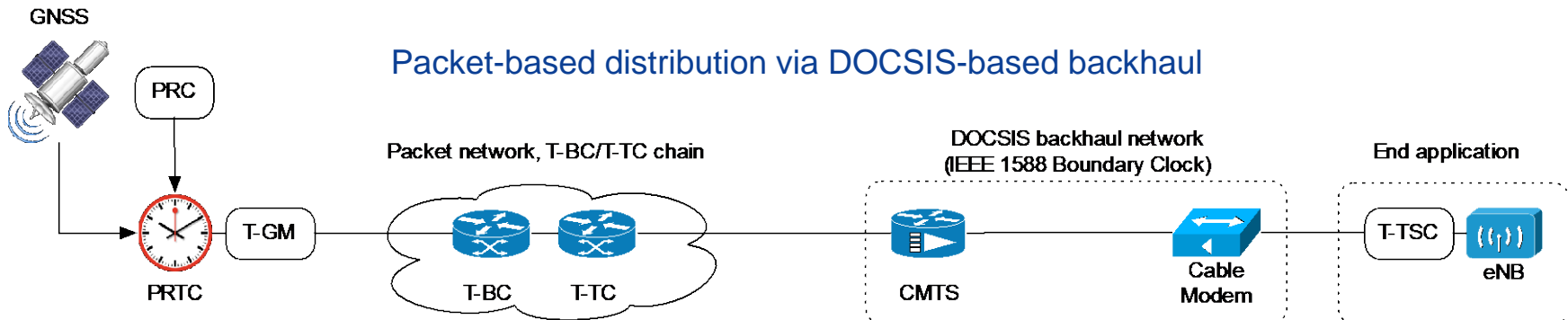
Sync technologies

- GNSS
- PTP, NTP
- SyncE

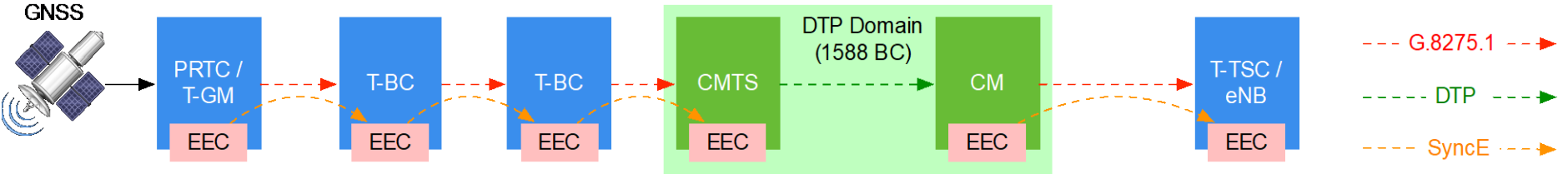
Distributed GNSS-based sync (without network support)



Packet-based distribution via DOCSIS-based backhaul



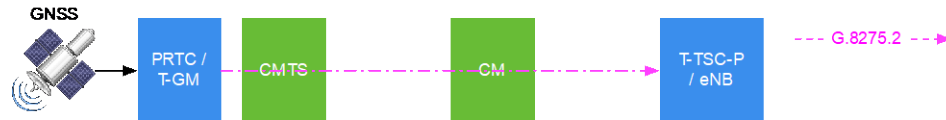
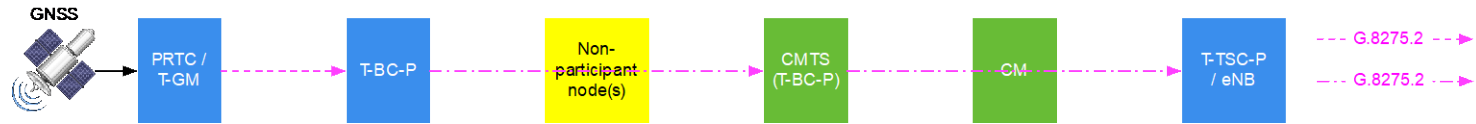
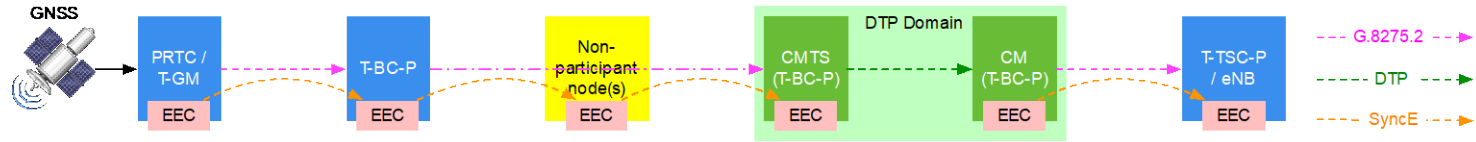
Options for networks with full timing support



Time error budgeting



Options for networks with partial or no timing support



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THANK YOU!

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