ITSF 2013

Time for mobile - a comparison of options

…for Assured Time and Phase Delivery in mobile networks

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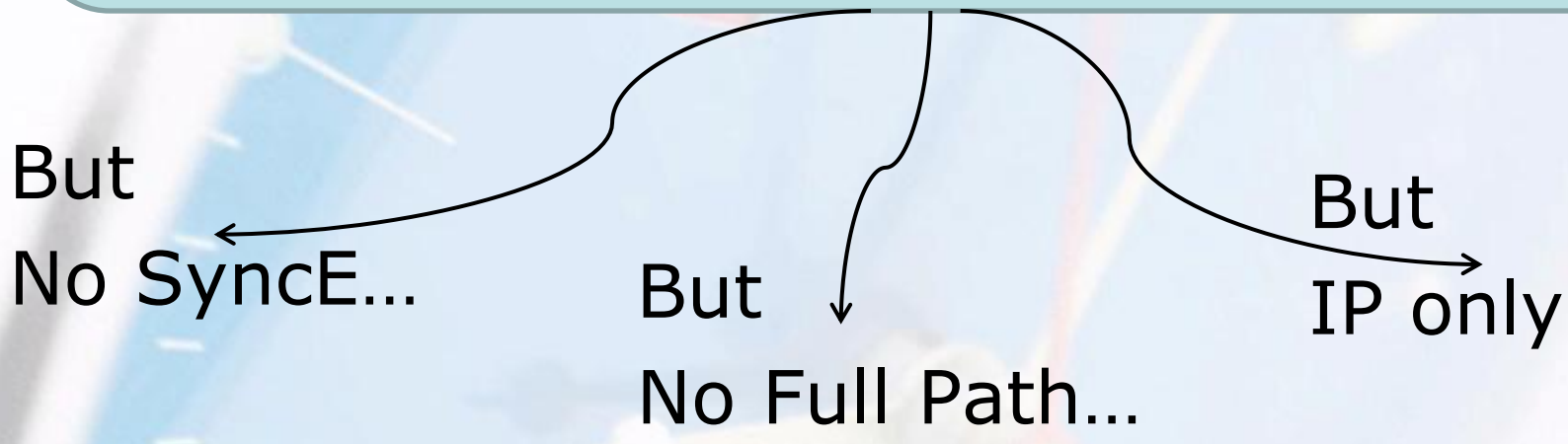
Agenda

1. Time Requirements for Mobile
2. On-Path Support – Partial or Full
3. Options for time distribution today:
   - Direct GNSS
   - IEEE1588 from aggregation switch sites
   - Costs
4. Conclusions

1. Time Requirements for Mobile

Requirements for Mobile

1. Guaranteed time accuracy <1.5us
2. Synchronization topology management
3. Resilience to GNSS outage (SyncE)
4. Cost effective time distribution



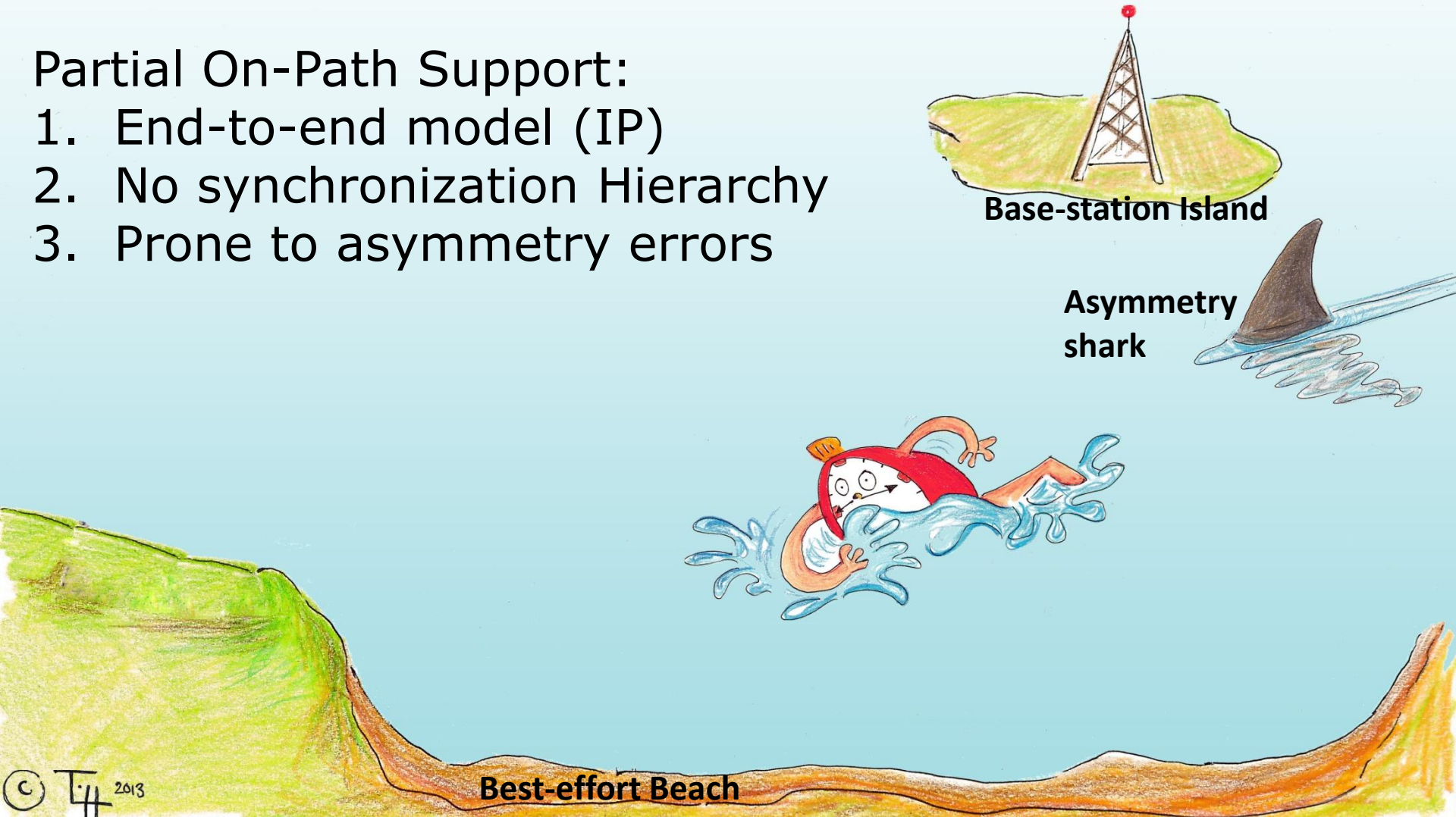
Requirements are "generally" agreed

2. On-Path Support – Partial or Full

Partial On-Path Support …An operator view

Partial On-Path Support:

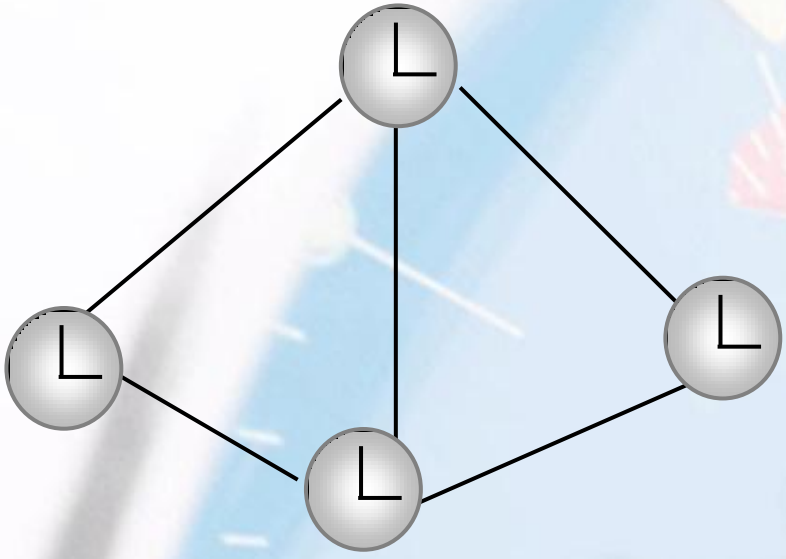
1. End-to-end model (IP)
2. No synchronization Hierarchy
3. Prone to asymmetry errors



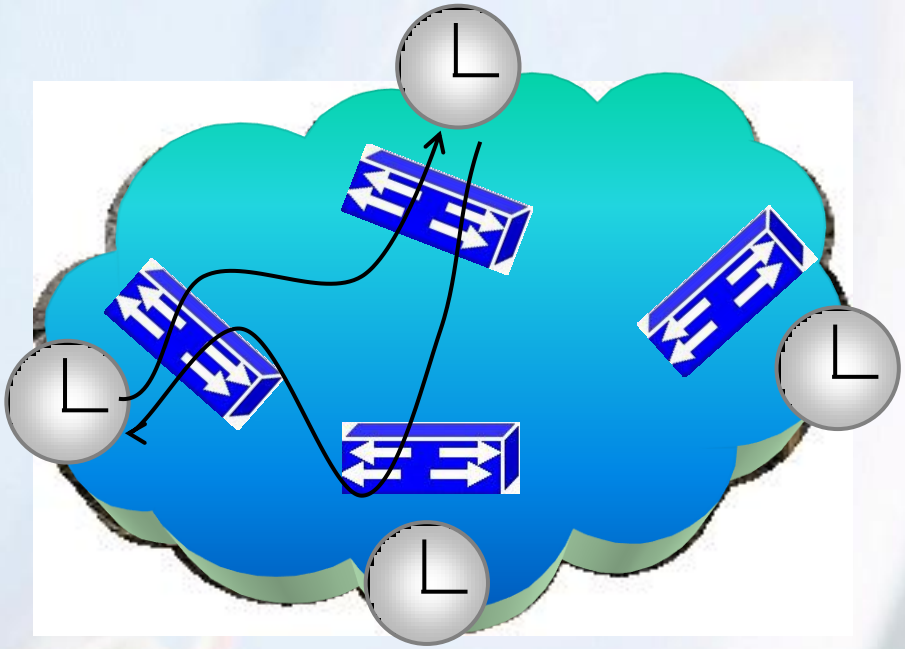
Synchronization Topology

Clocks talk directly to clocks...

... Anything else impairs performance!



Full On-Path Support

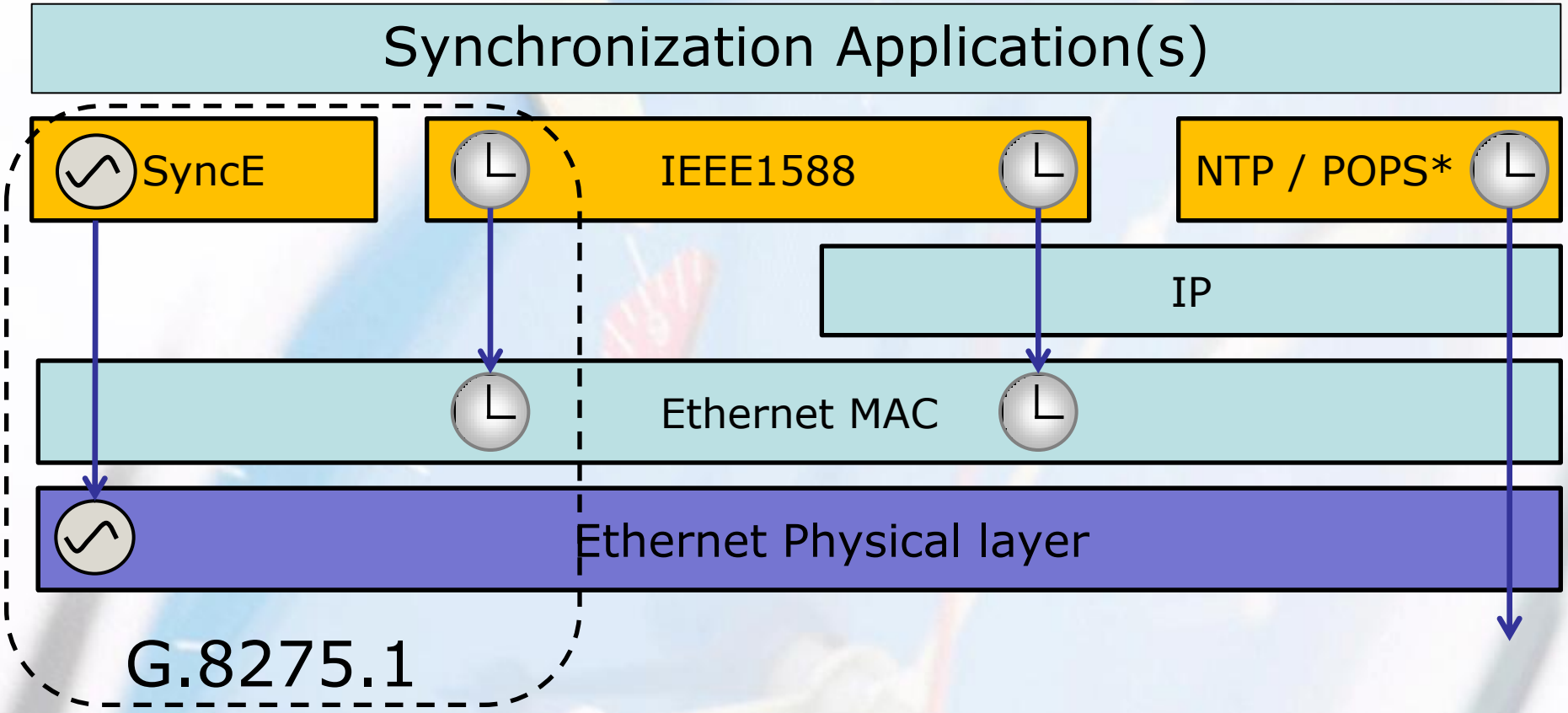


Partial On-Path Support

i.e. Support is between 0-100%

To know or not to know... That is the question!

Synchronization layer?

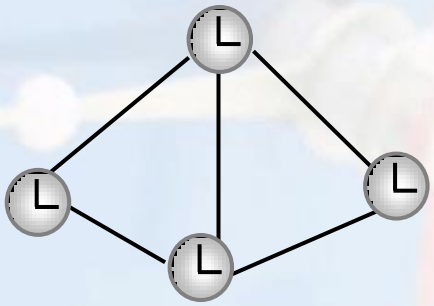


High accuracy Synchronization relies on Ethernet

*POPS – Partial On-path Support

Main Topology Options

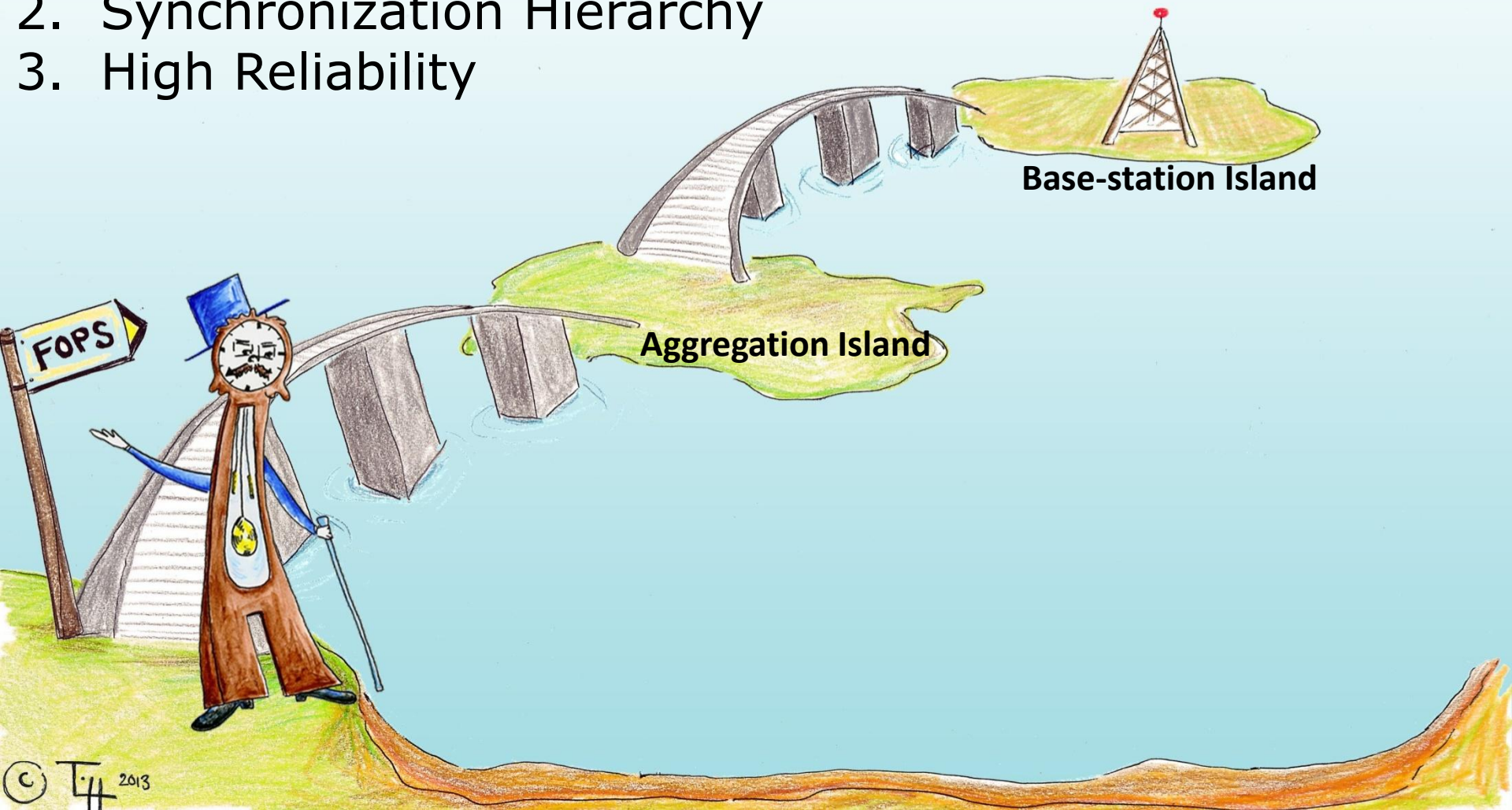
	Link-by-Link (FOPS)	End-to-End
Addressing	L1 (link local)	L3 (L2 forwardable)
Topology impacted by	L0 switching	Routing and switching
Link Asymmetry risk	Low	High
Clock model (1588)	Boundary Clock	Transparent Clock
On-Path Support %	Support = 100%	Support >= 0%



Full On-Path Support

Full On-Path Support:

1. Hop-by-Hop model (G.8275.1)
2. Synchronization Hierarchy
3. High Reliability

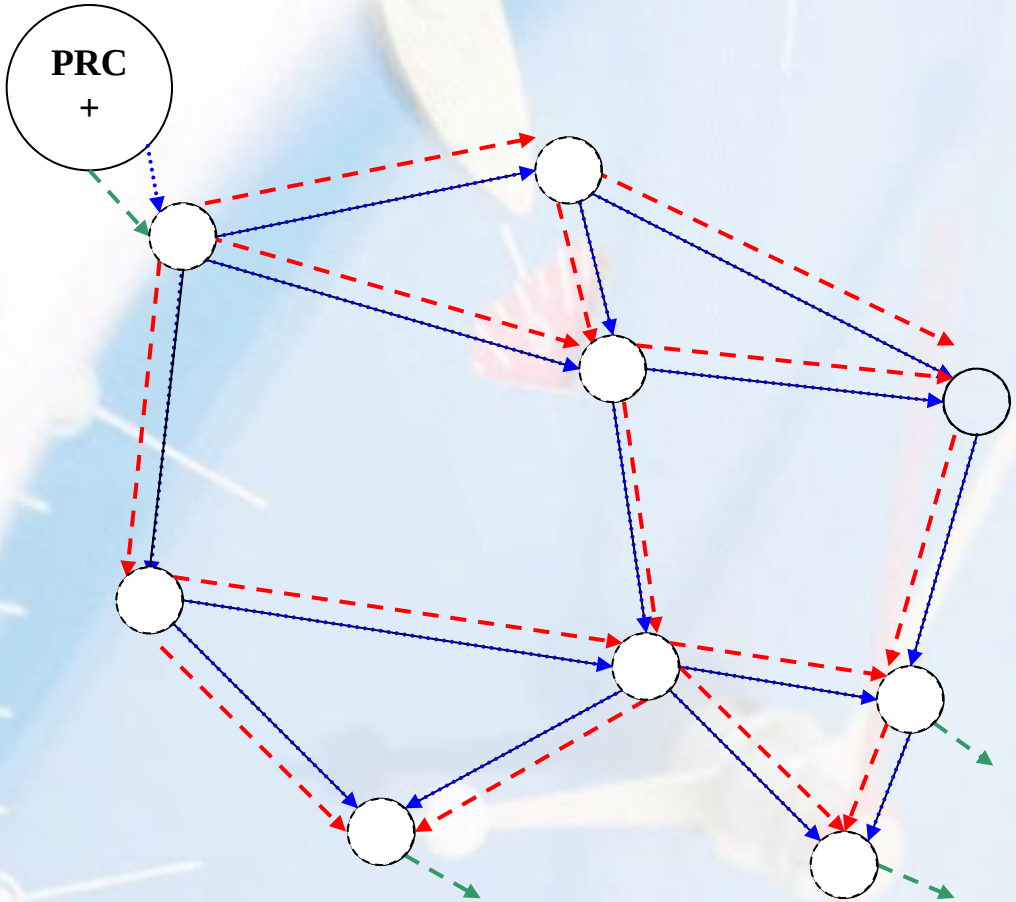


Build the network for Sync or "run Sync" over the network?

1. Effort to plan, design and build
2. Link-by-link model controls topology
3. SyncE can provide accurate Time holdover

Faint heart never won fair lady

Full On-Path Support combining Time and Frequency distribution



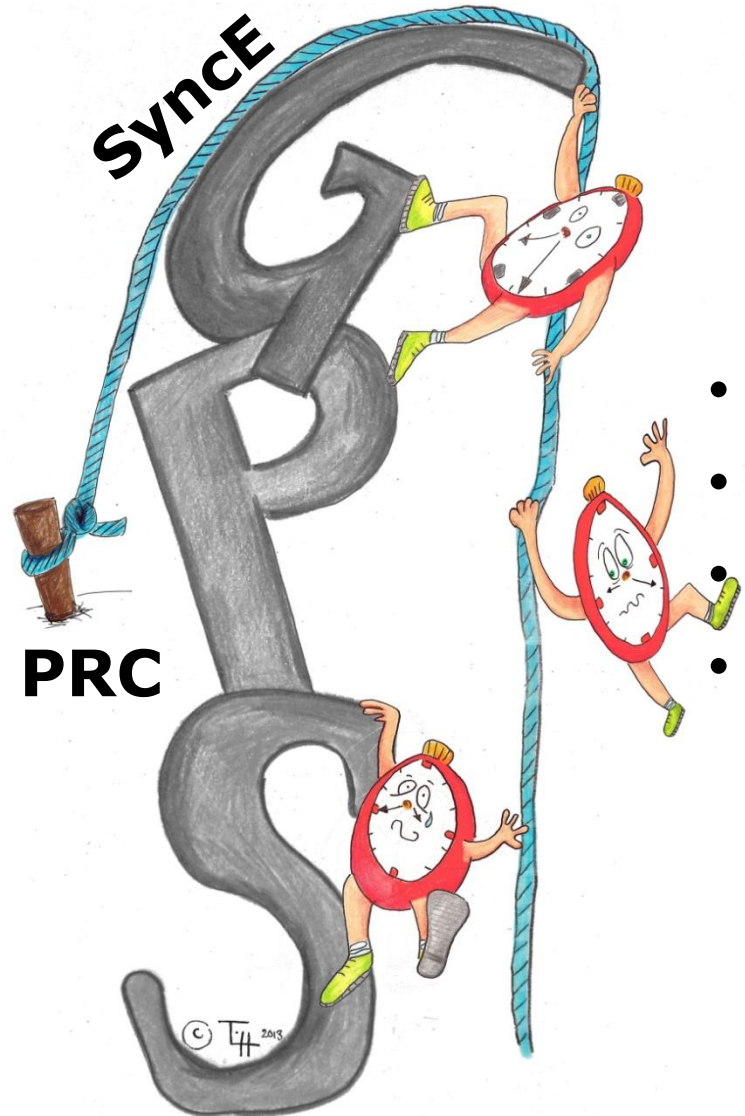
Phase Distribution (ESMC)

Clock Distribution (Synchronous link)

Pulse Per Second (PPS)

From ITSF 2008 Munich – not changed much

Time Holdover available via G.8275.1



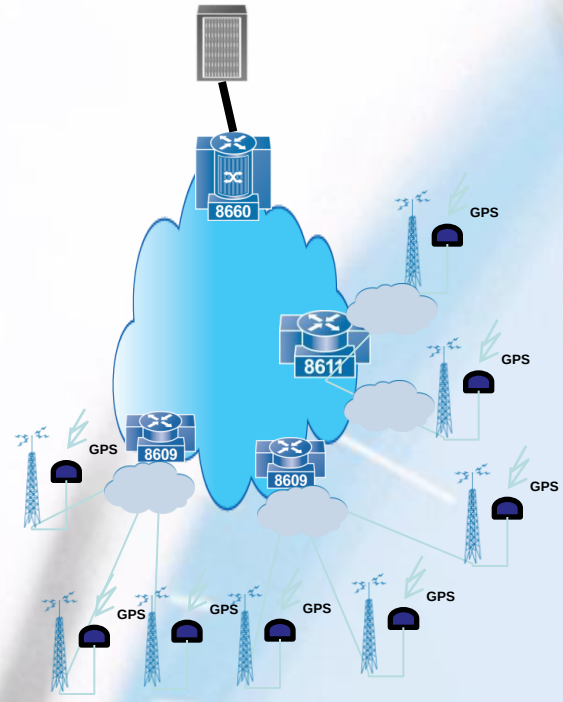
PRC + GNSS + IEEE1588

- Guaranteed accuracy <1us
- Synchronization topology (G.781)
- Time Holdover with SyncE
- Cost efficient solutions

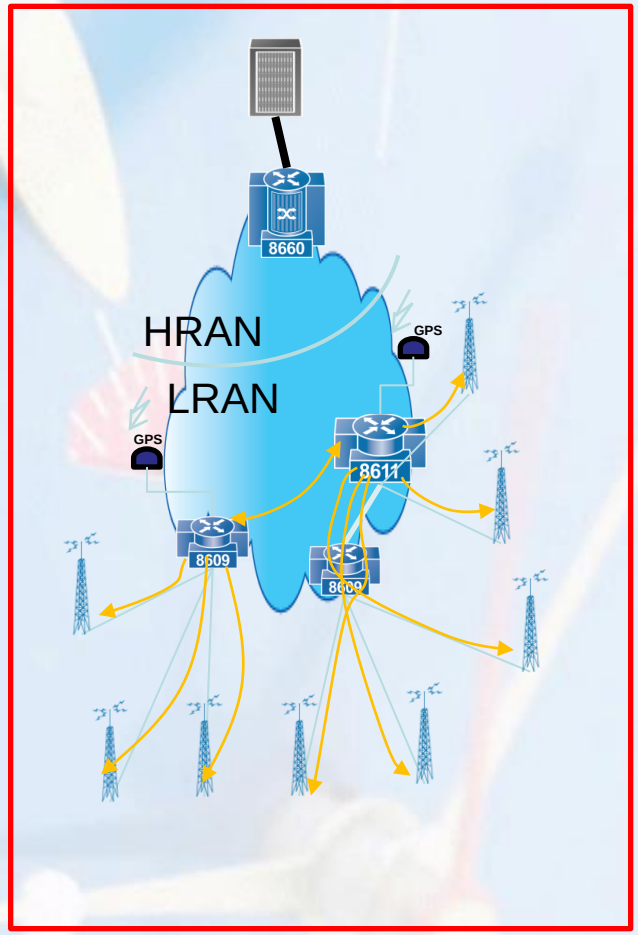
Time from the sky
Freq from the ground

3. Options for time distribution today

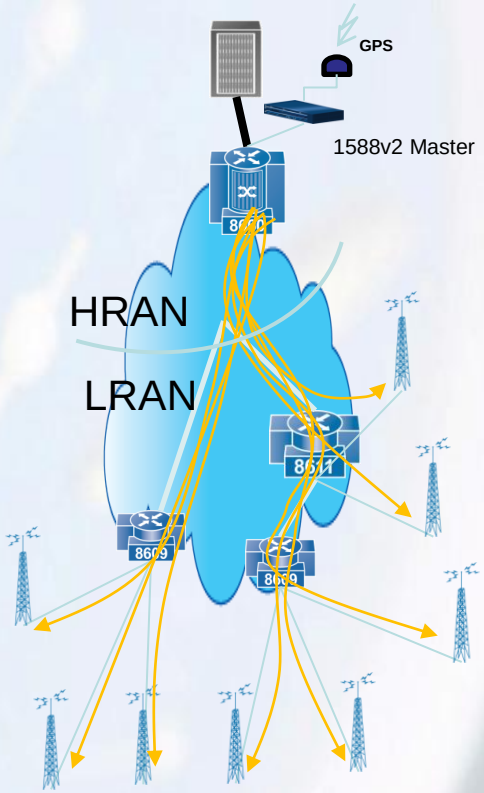
Location of GNSS in a mobile network



GPS on every BTS?
(Antenna installations)

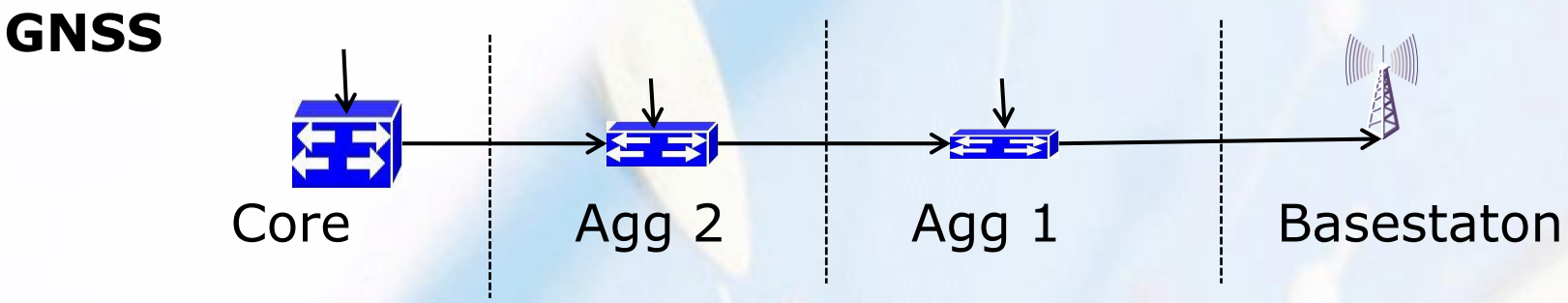


GPS on last aggregation switch
Needs a cost effective solution!



GPS higher in network
No accuracy guarantees

G.8275.1 builds out from the edge



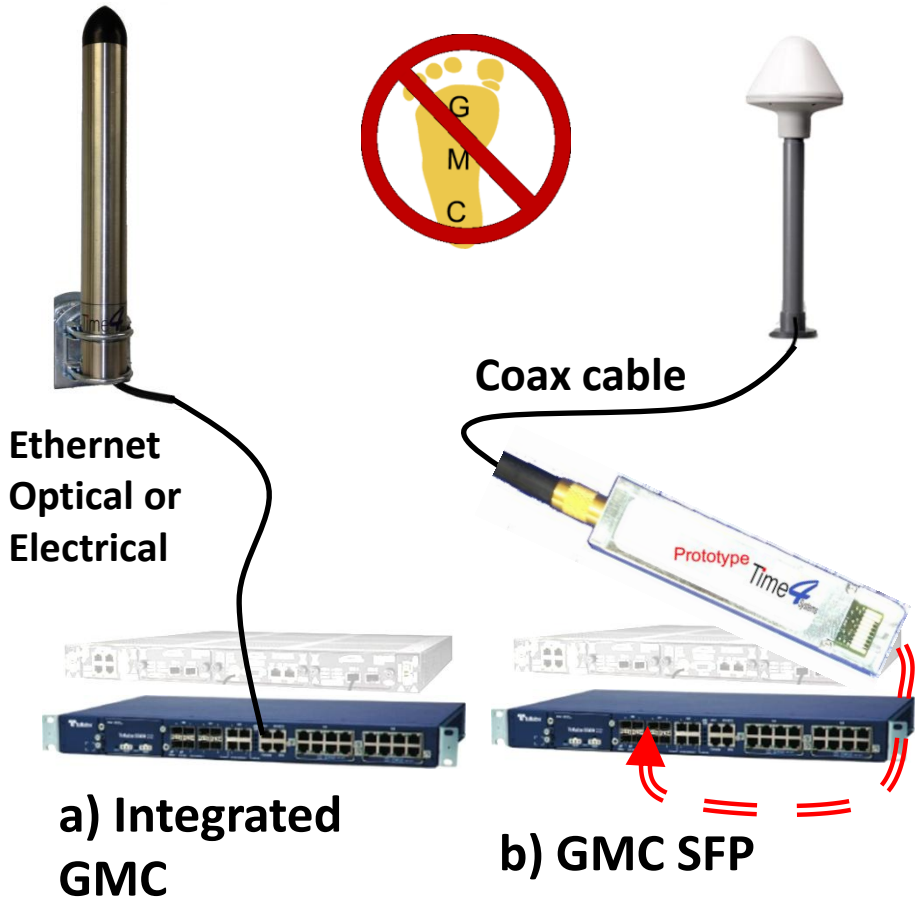
PTP capability			GNSS / GMC location
Core	**Agg 2**	**Agg 1**	
N	N	N	Basestation
-	-	Y	Agg 1
-	Y	Y	Agg 2
Y	Y	Y	Core
*	*	N	Basestation

Applicable to G.8275.1

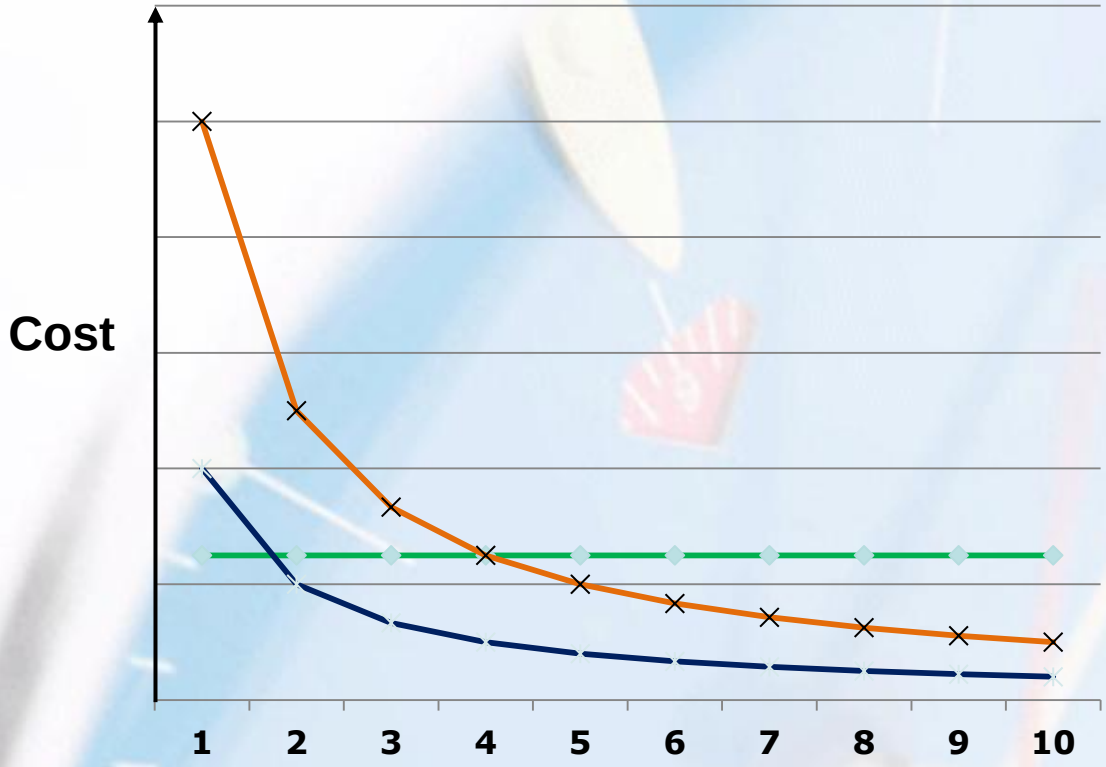
Optimized Grand Master solutions

Enables GM Deployment low in network - using:

- G.8275.1
- Low cost
- Low footprint



Time synchronization cost per Basestation



Baseline is GPS antenna cost

Time distribution from an aggregation switch offers considerable cost savings over direct GNSS

Cost of GNSS versus IEEE1588 on (last) aggregation switch

- GNSS for each basestation has a fixed cost
- GNSS on the aggregation cost shares the cost of antenna installation

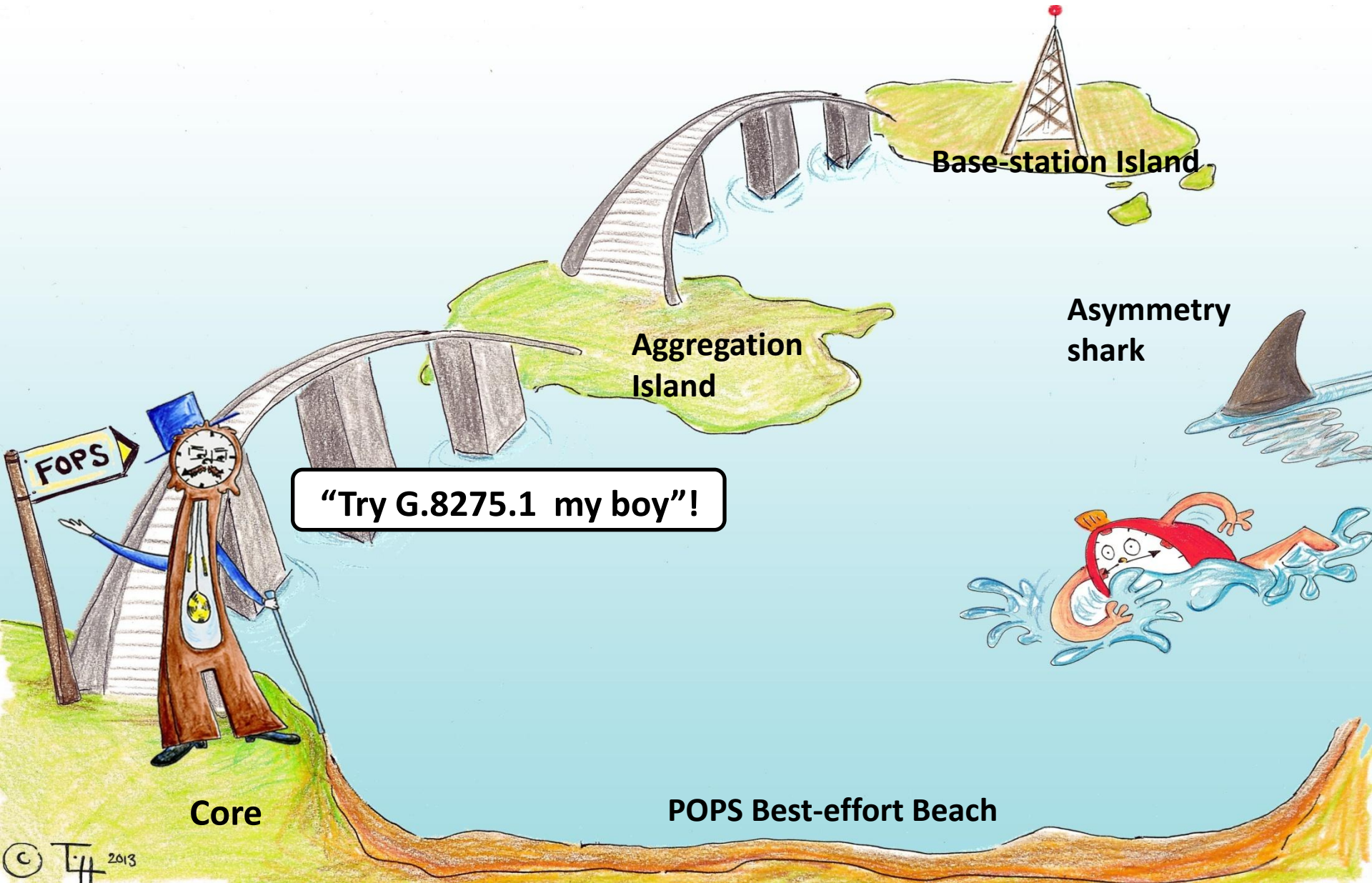
Costs lowered by:

1. Sharing GNSS
2. Using Layer-2 solution
3. Integration into equipment (zero footprint)

Summary

- Long term goal
  - Coherient distribution of IEEE1588 + SyncE from protected core sites
- Short term goals
  - Time distribution from last Aggregation site
- Use G.8275.1 (layer2)

FOPS or POPS – your choice?



Selecting the right wave improves packet clock performance

Thanks!

Questions ?