BBC Design + Engineering

Update on Distributing Timing for Broadcast

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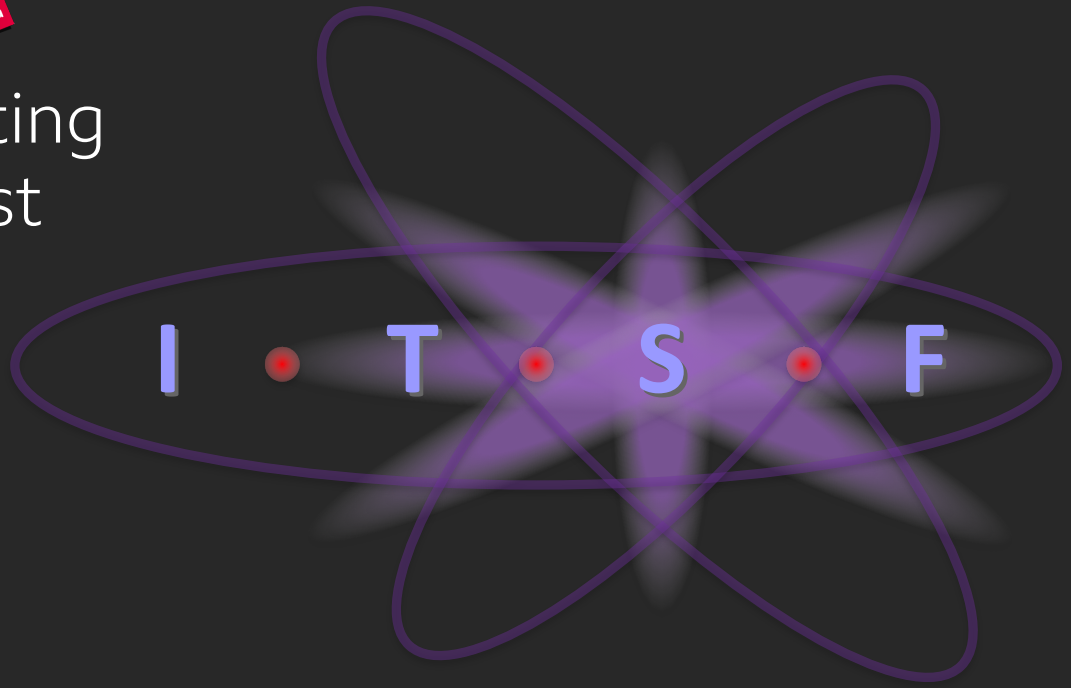

International Timing and Sync Forum

November 2019

Update on Distributing Timing for Broadcast

Why synchronise broadcast?

Why not just use GPS/GNSS?

What other options are there?

Progress so far

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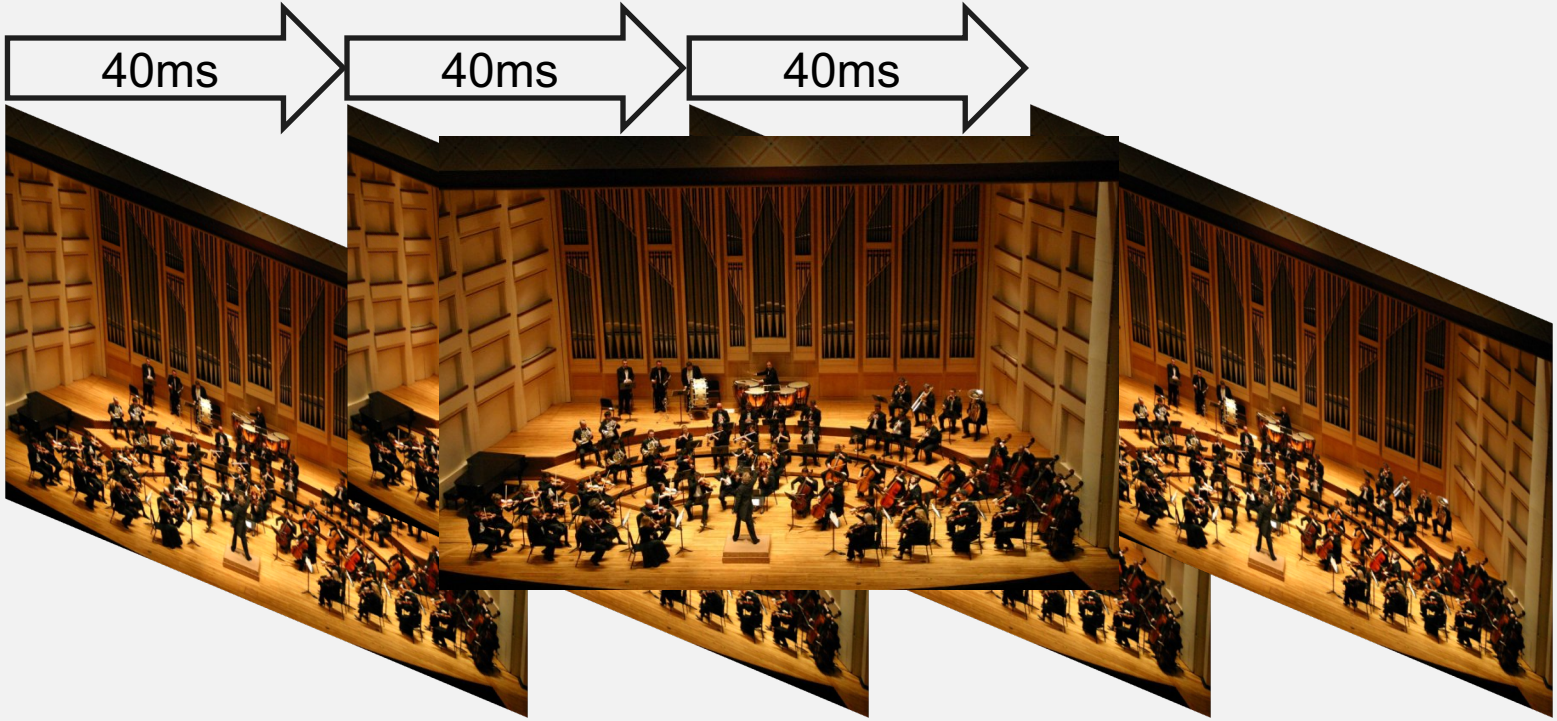
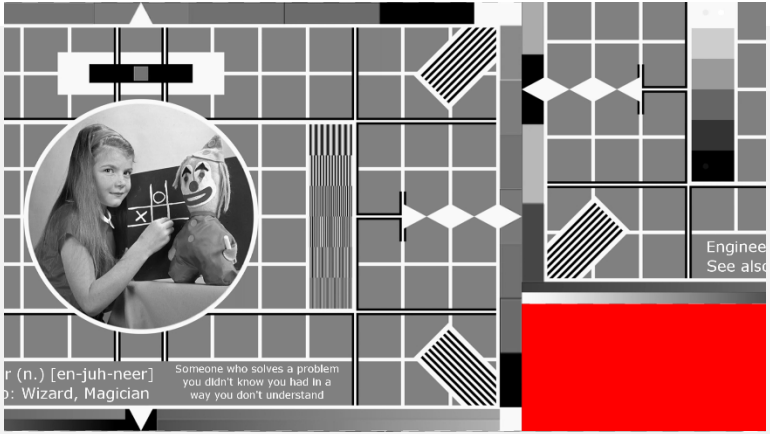
Progress so far

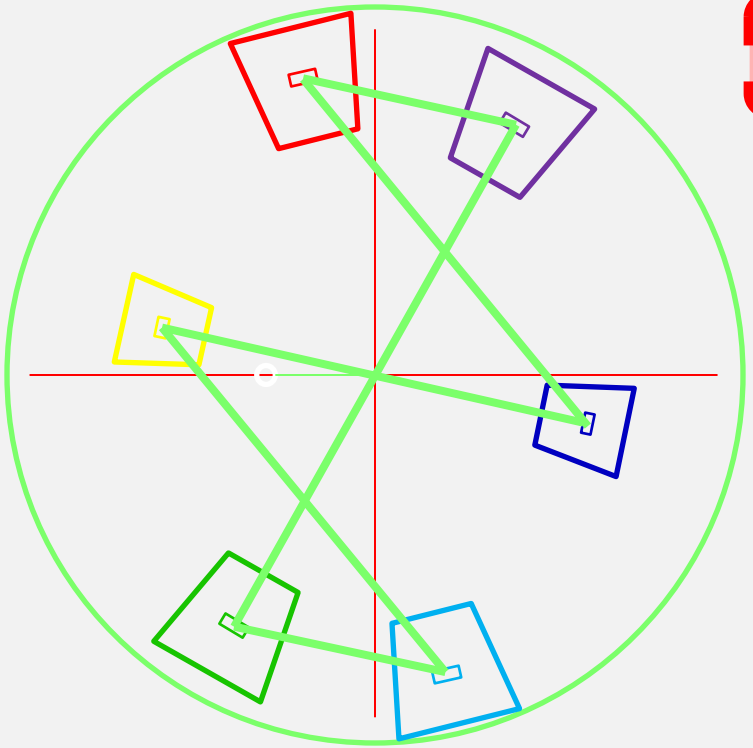
The Illusion of Television



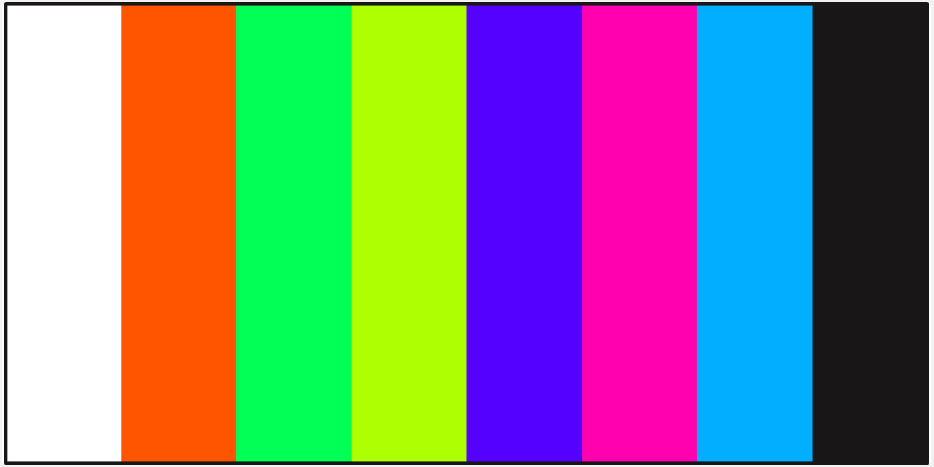
TIME AS A PROXY FOR POSITION



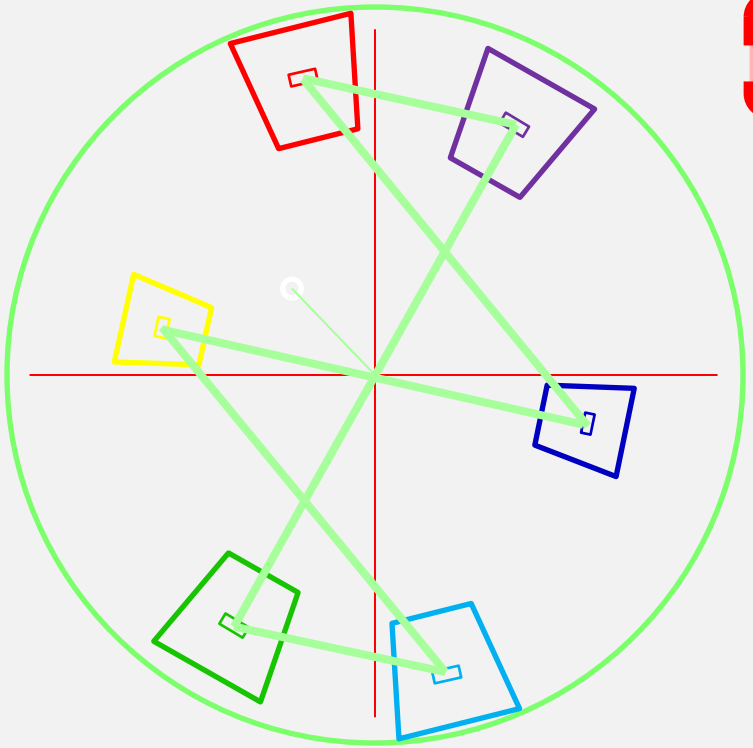
Timing as a proxy for Colour (NTSC)



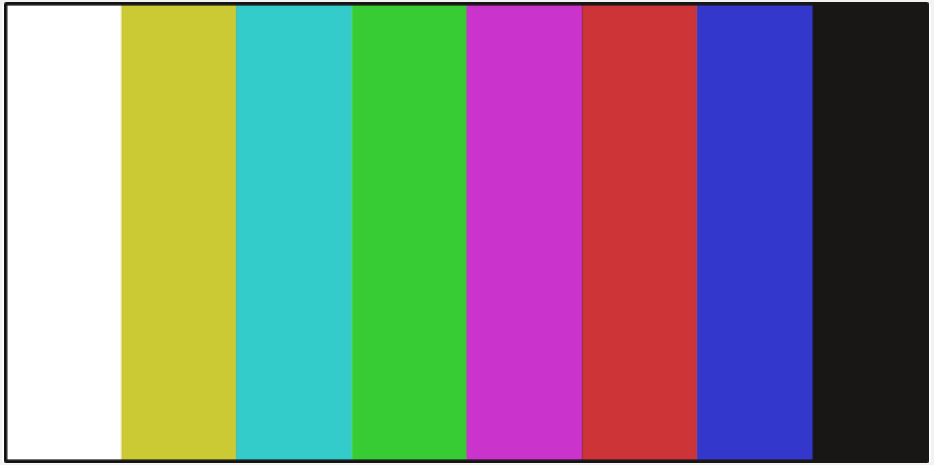
Maximum timing error ~1ns



Timing as a proxy for Colour (PAL)

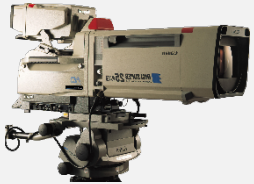


Maximum timing error ~4ns

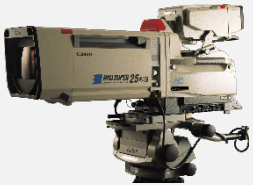


Maintaining the illusion

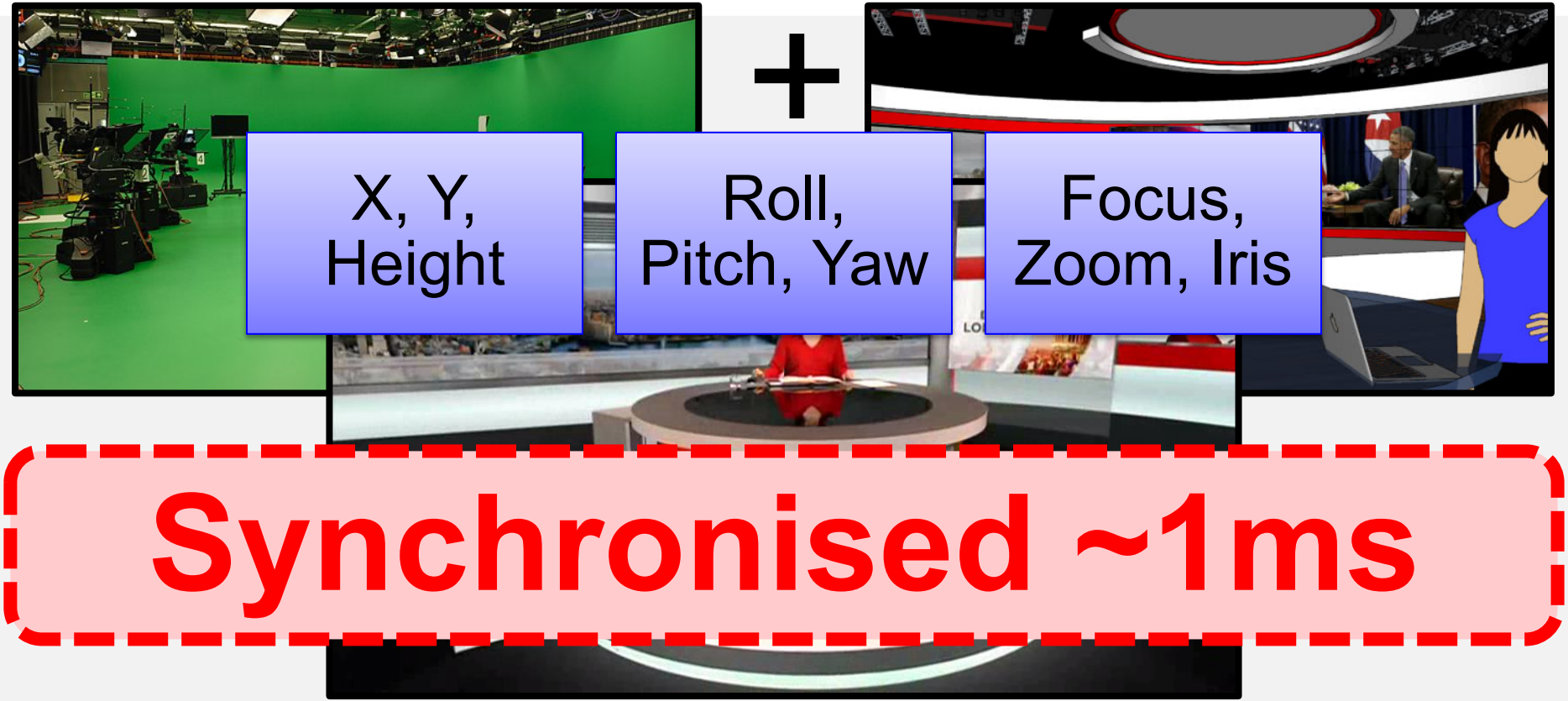
Synchronised to ±10µs



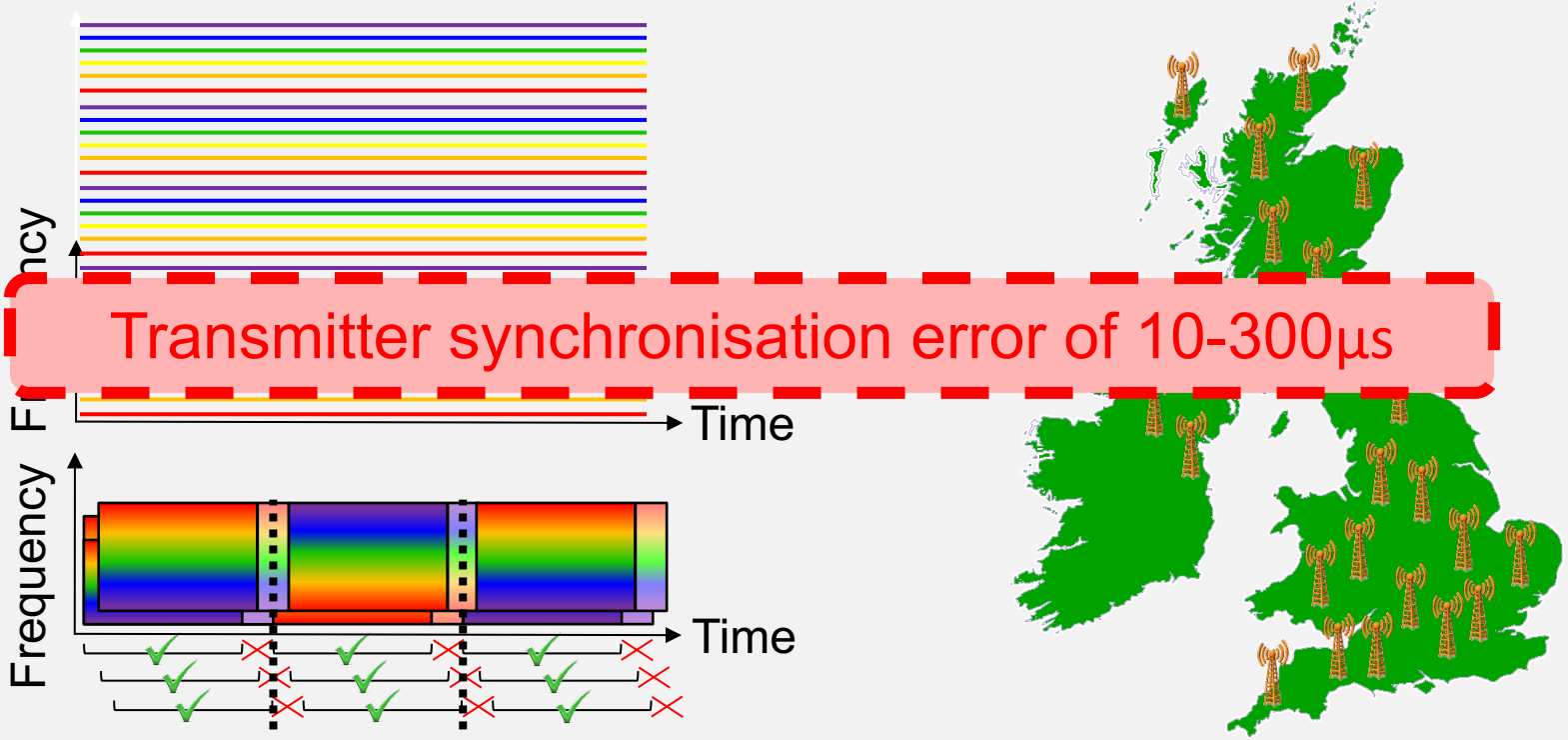
Synchronised to ±10ms



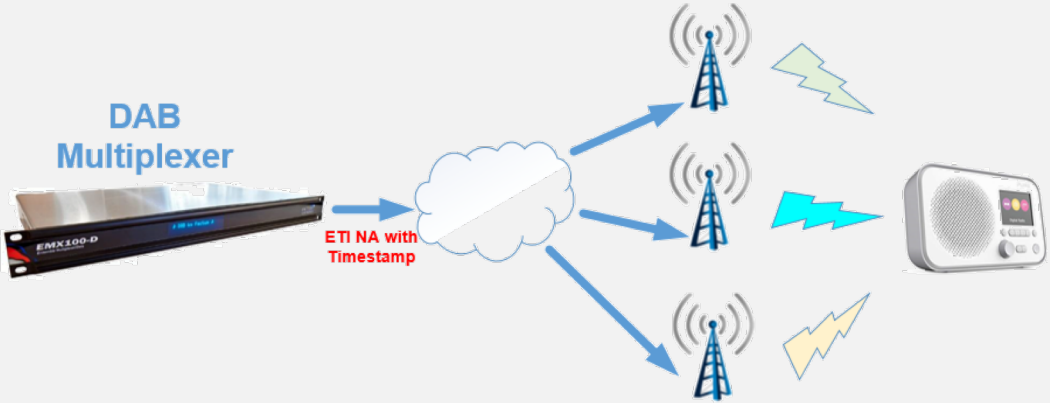
Virtual Reality



Delivering the Programmes



Single Frequency Networks and GNSS



Transmitted COFDM has a Symbol Period of 1ms with a 246µs guard interval

Each transmitter must emit exactly the same Symbol at exactly the same time

Therefore accurate timing at the Multiplexer and Transmitter is critical

Multiplexer output contains Timestamp which defines release time of the Symbol

Transmitters use this Timestamp and GNSS to broadcast the signal at the right time

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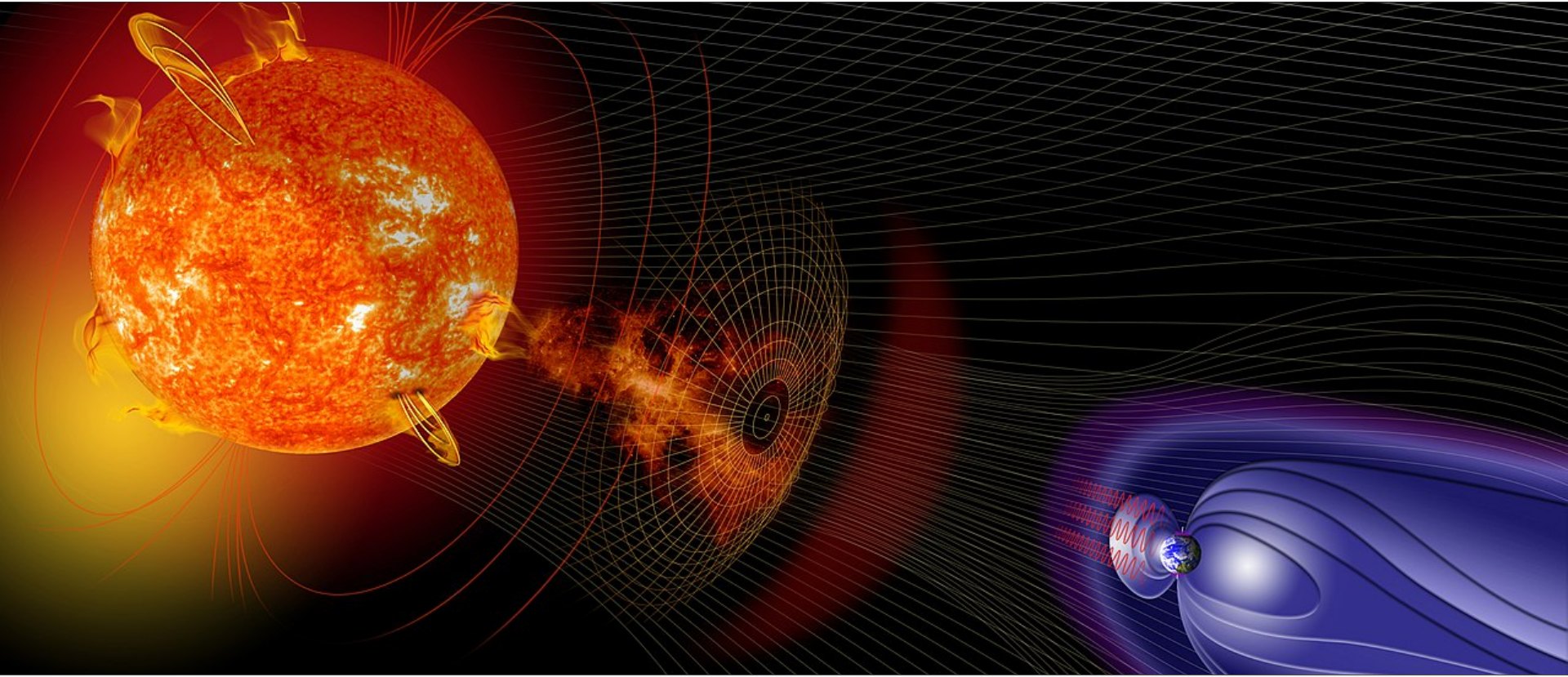
What's Wrong with GPS/GNSS



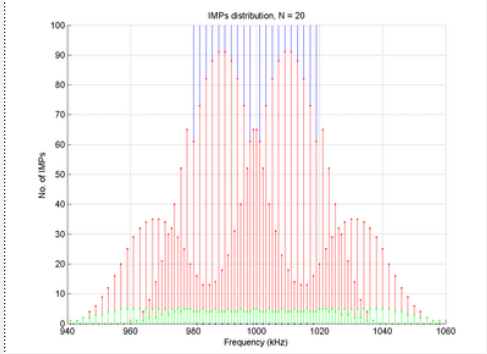
GNSS SIGNAL DISTRIBUTION PROBLEMS

Use quality GPS Antennas with adequate view and spacing

"RF Busy" sites present a problem to GNSS signal distribution

High gain is not always the answer

You need to maintain your distribution system



GPS Week Number Rollover Testing

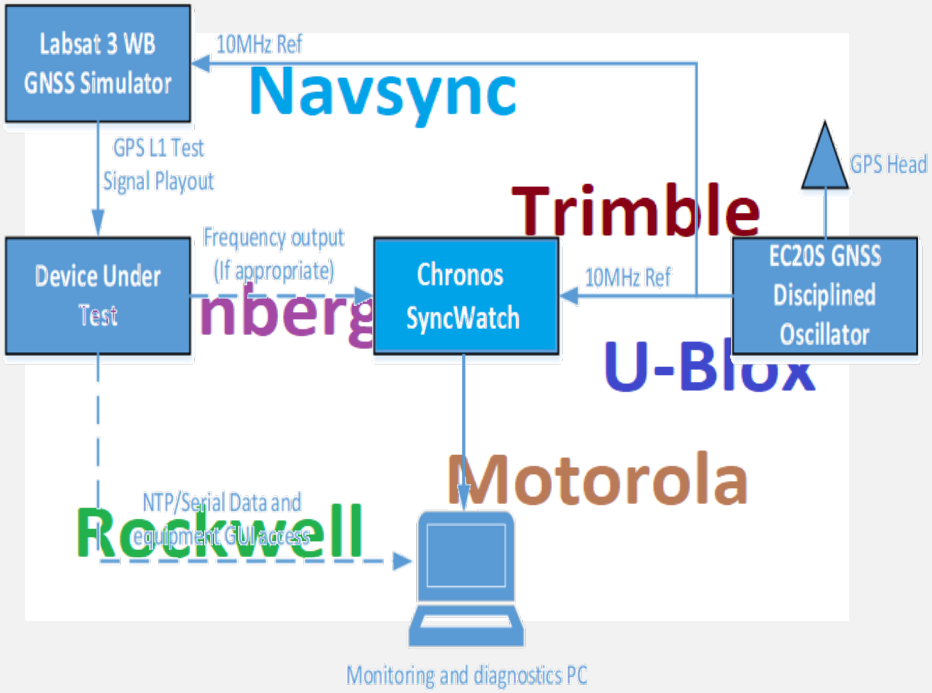
23 GPS chipset variants found in use

Checked for their behaviour during 6th/7th April 2019 rollover

Checks carried out on 1PPS, frequency output and date/time accuracy during or after the rollover

Service affecting issues with the a number of units during the April 2019 WNRO event

Found receivers with past/future “pivot” dates which caused similar behaviour



GNSS Receiver testing - Findings and Surprises

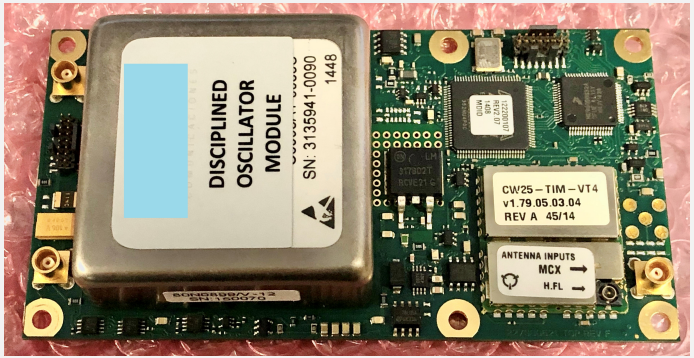
You can “upset” a device by testing it

Multiple serial outputs can mean multiple pivot dates – not just April 2019

Third party equipment manufacturers often not aware of chipset limitations

Processing “engine” south of the chipset can have its own rollover issues

One GPS Disciplined Oscillator… so many issues!



GPS Disciplined oscillator providing 10MHz and 1PPS

Over 900 units deployed

1PPS jumping back and forth by **1ms!**

Easily enough to break the Single Frequency Network

GPS chipset was very prone to overload/intermodulation

Power feed to GPS head could not cope with active DA due to wrong choice of current sense

Also discovered to have Week Rollover issue on NMEA

Spends all of GPS Week Zero in holdover

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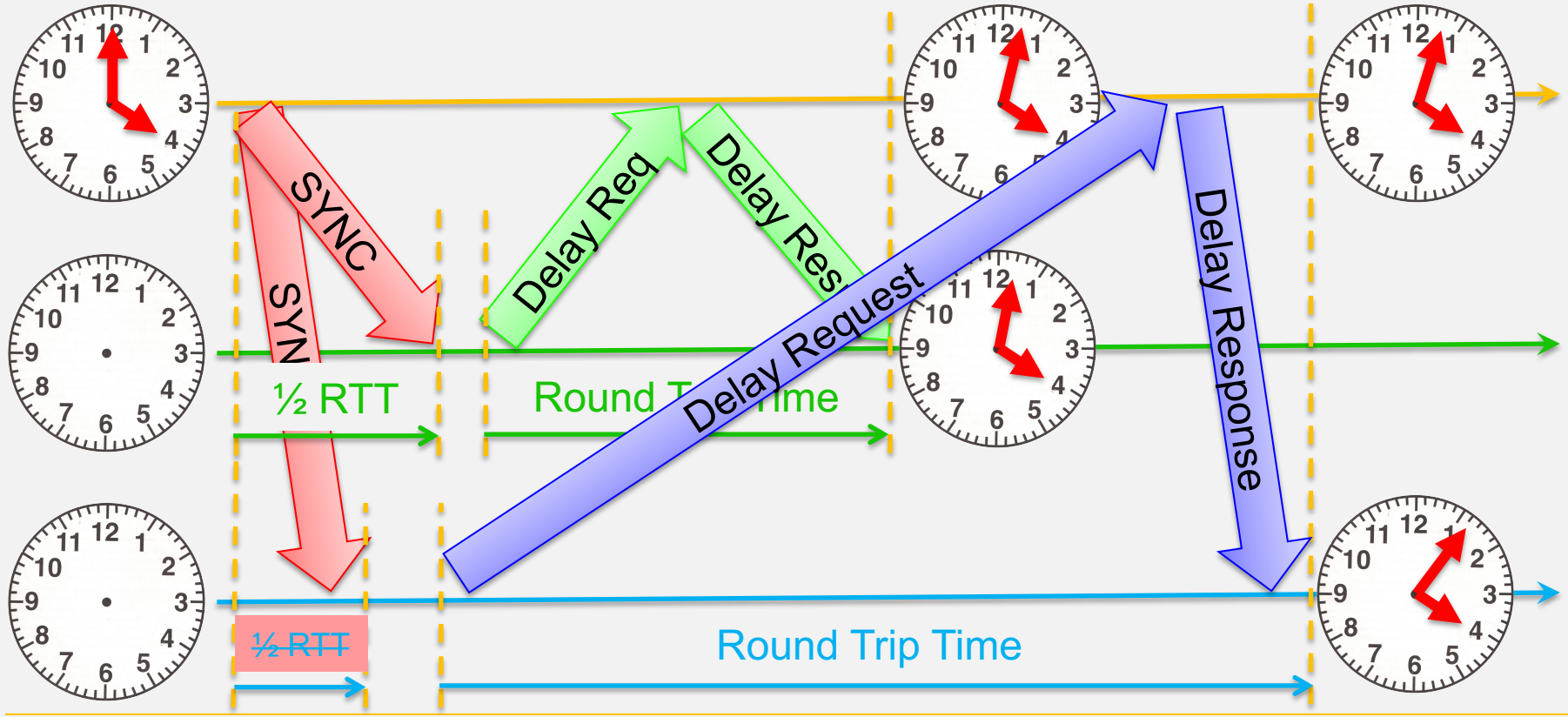
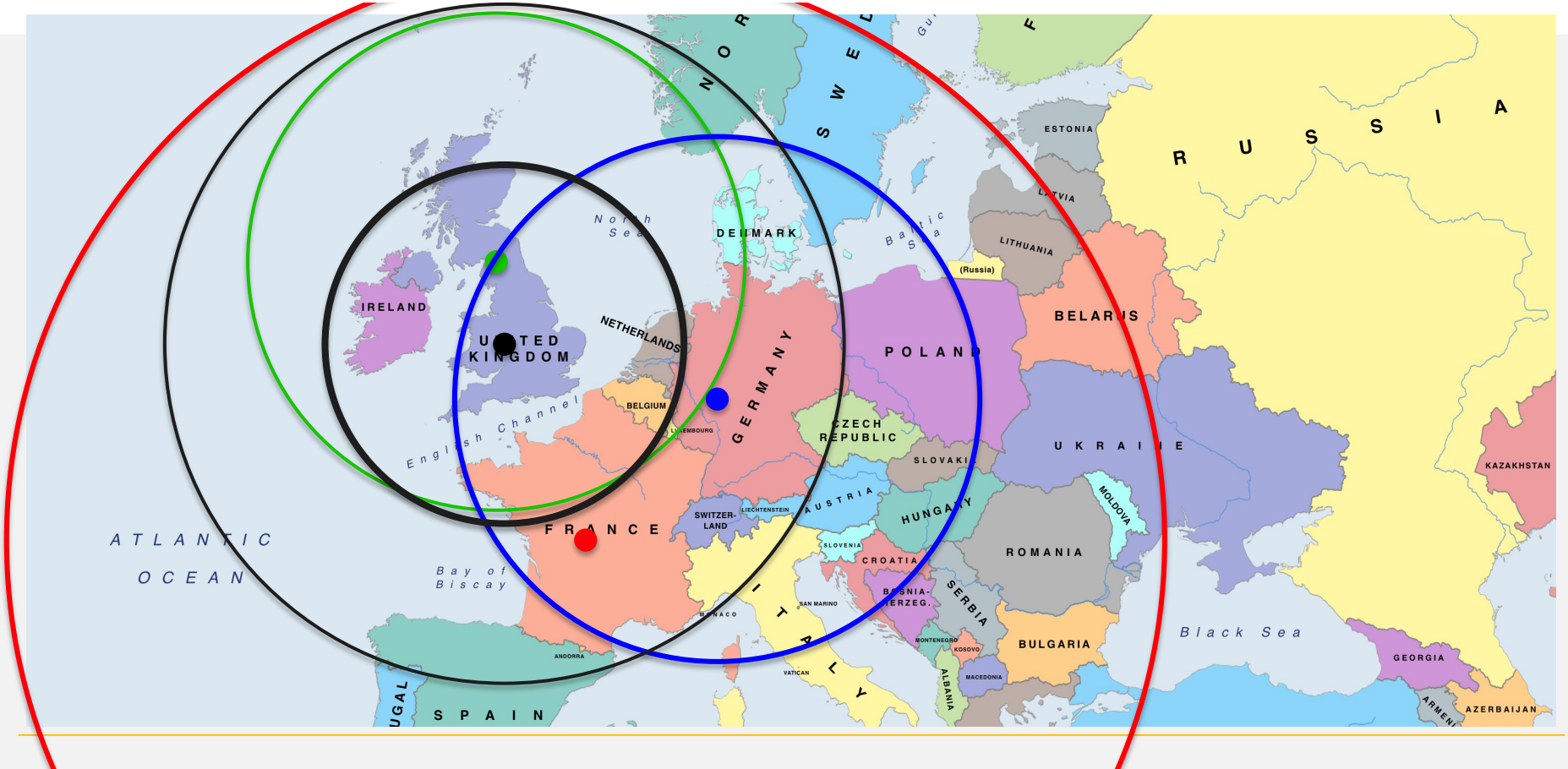
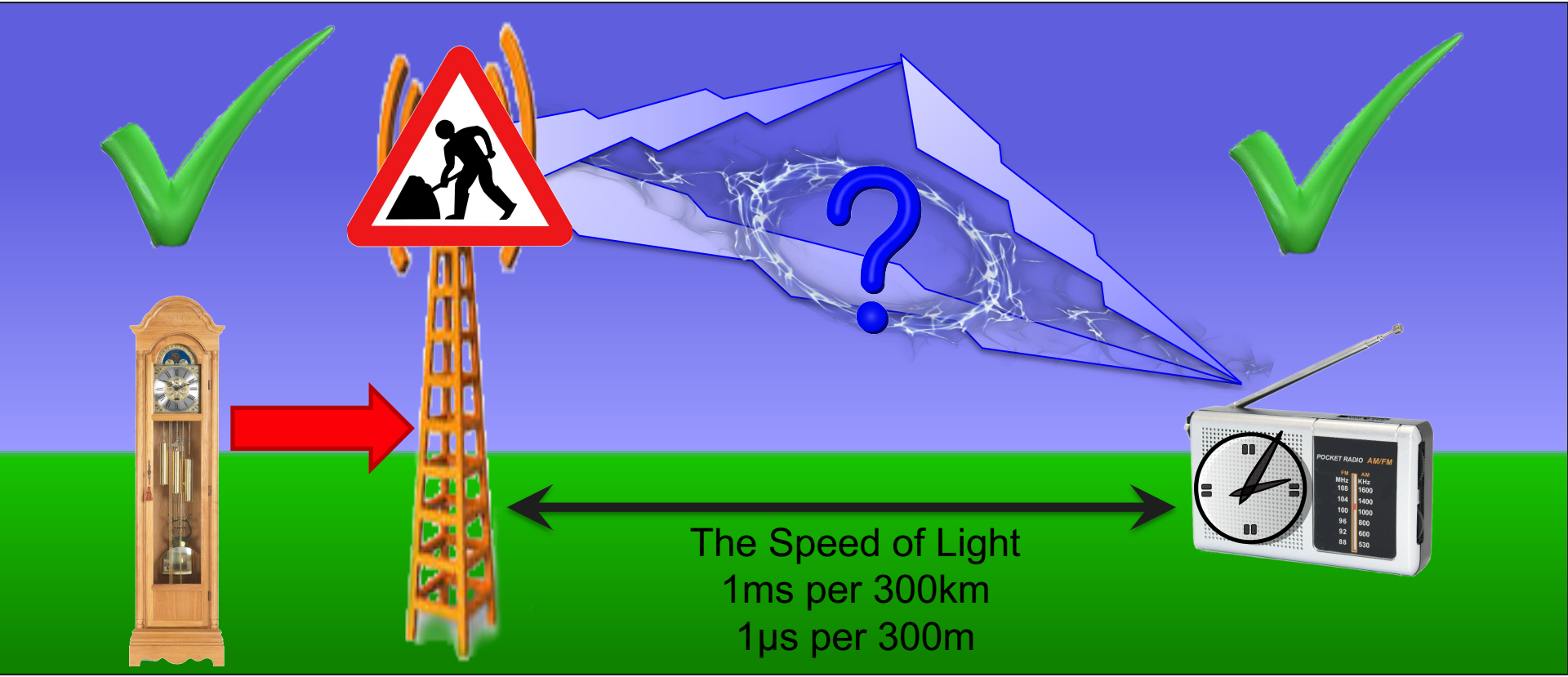
PTP – A (VERY) SIMPLIFIED OVERVIEW



LONGWAVE SERVICE COVERAGE



Time Transfer Fundamentals



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The Kairos unit

The Kairos unit – and Arqiva / Chronos / Tryo collaboration

Receives three GNSS constellations independently

Uses voting to decide which (if any) constellation to use

Provides standard 10MHz and 1PPS to external equipment

Reports to centralised management centre

Has space for a terrestrial receiver in the future

Technical Work

Research work

- From carrier recovery
- To time/data data block recovery
- To precise time recovery

Theoretical work

- Precision corrections for ground conductivity

Field work

- Signal strength measurements

Commercial Work

Who wants it?

- Finance
- Air Traffic Control
- Power utilities
- Mobile phone companies

What requirements?

- Accuracy
- Location

What is it worth?

- What are they prepared to pay?

Safeguard the service

- How long will the service be needed for?
- How can we manage future upgrades/maintenance?

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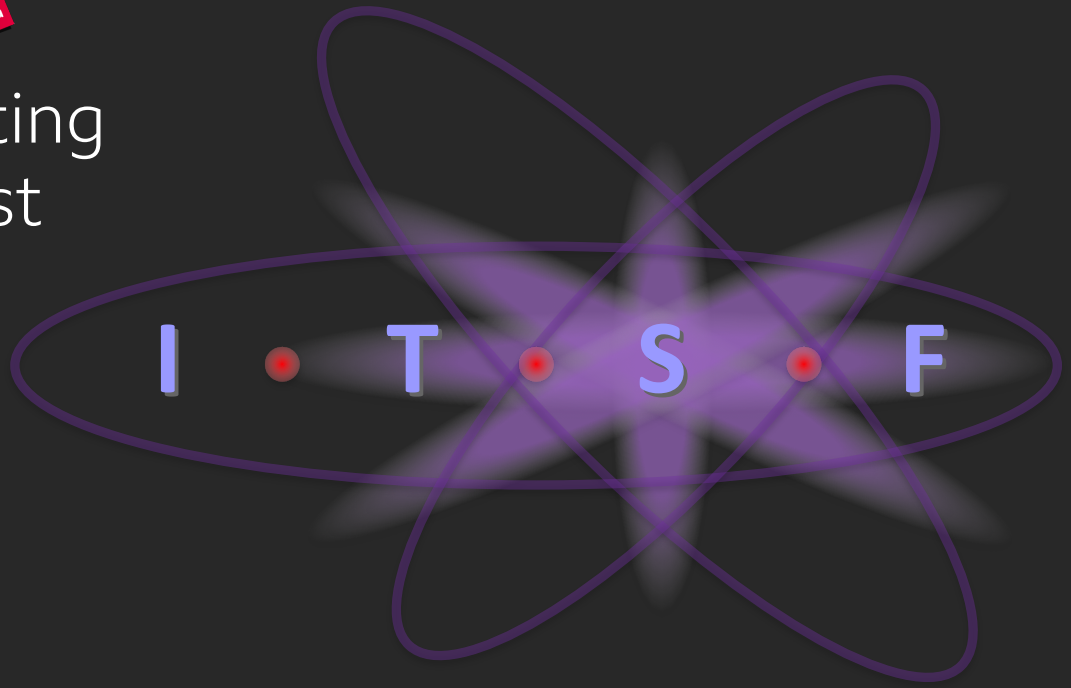

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