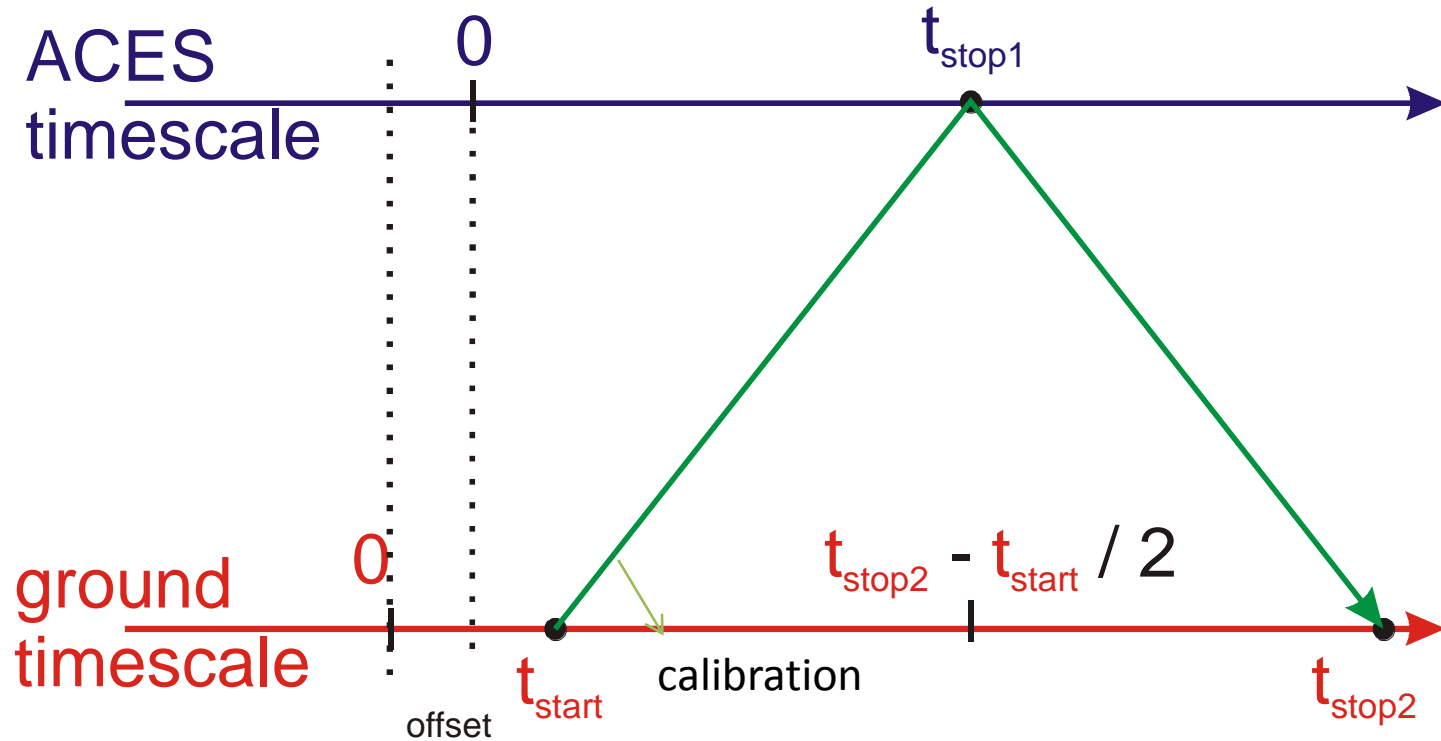


ELT-Data Center

Why do we put clocks in orbit?

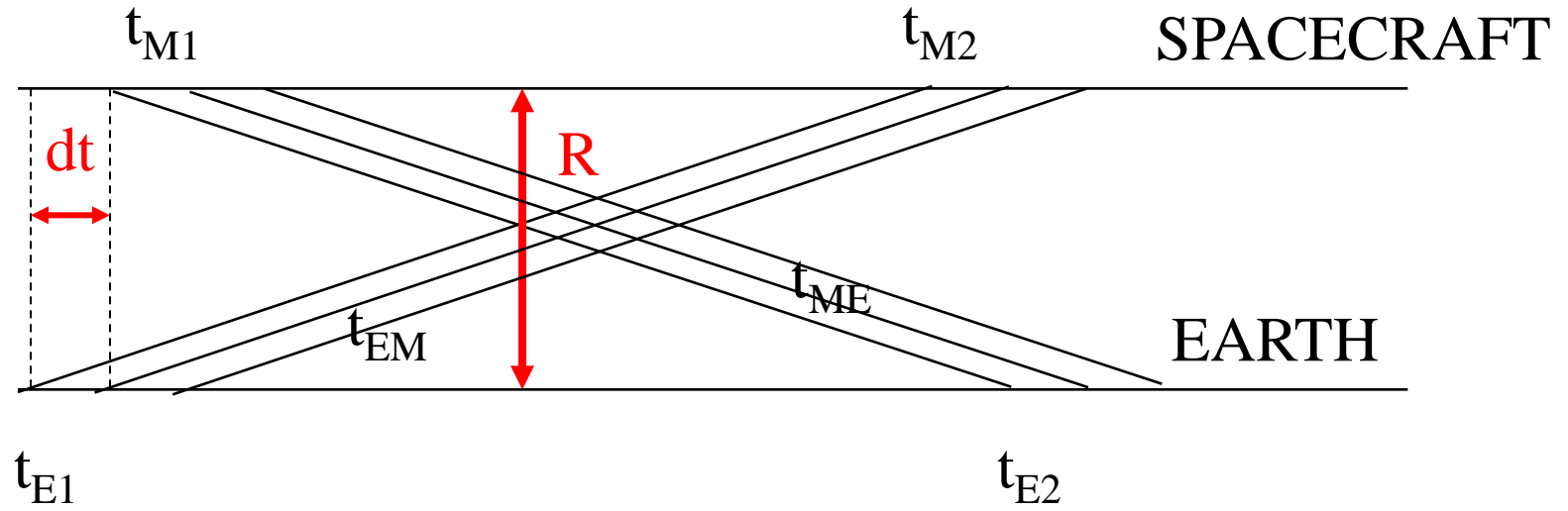
- **Fundamental physics:** ACES, (STE-QUEST, ...)
- **Transponder:** LRO, Messenger
- **Navigation:** GPS, GLONASS, QZSS, BeiDou, Galileo, DORIS
- **Global time scale:** clock in GEO/Lagrange(/GNSS)

Measurement principle ELT



Coupled two-way / one-way ranging

Measurement MWL / Transponder / LCT



Coupled one-way / one-way ranging

Calibration

- Regular calibration of 2-way ranging
- Singular calibration of 1-way ranging
- Regular calibration of connection to „local time“

Requirements Due to Time Transfer

- Crd format for full-rate data
- Start time in ps resolution
- Start time for every laser fire
- Hydrogen maser

- Definition and regular calibration of reference point in time and relation to GPS and SLR
- Calibration from Eventtimer to invariant point we do once
- Calibration from time reference point to GPS-„phase center“ and Eventtimer

Requirements Due to ISS

1. Laser safety
2. go/nogo flag from EDC
3. Predictions every 90 min from EDC password protected
calculated by DLR on GNSS data
to the reference point of time
4. Tracking capability for low-orbiting satellites

Requirements Due to Detector Design

1. Gate window 200ns synchronous to on board time (50ns to UTC)
 - > laser response to trigger \ll 50ns uncertainty
 - > station time offset to UTC \ll 50ns uncertainty
 - > calculate laser fire time with correction of TB, UTC, 1-way calibration, laser fire response, measured offset, ...
 - > programmable laser fire trigger in steps of 50ns
2. Single photon mode
 - > tuning of sending signal (divergence, ...)
 - > link budget calculation with attenuation 10^{13}
 - > single photon mode on ground or compensated diode
3. Laser wavelength 532nm

Offer: Quicklook response about success if crd-fullrate-file at least within 60 min

Products

Quick look

For each ELT station sending high accuracy fullrate data an analysis of time triples and a detection rate.
Warning for not being in single photon mode!!

Space-ground-TTF

Common-View TTF

Per-revolution Non-Common-View TTF

Once per revolution of the ISS a clock offset between all the stations successfully tracked ACES is calculated.

Longtime Non-Common-View TTF

For monitoring ground clocks the time evolution of the time-offset to ACES timescale is calculated.

MWL calibration

Signal delays MWL-ELT for atmospheric analysis

Remarks

- We need mobil systems for collocation.
- We need T2L2 data center.