Institut für Erdmessung

Leibniz Universität Hannover

Wegweisend!?

Mein Smartphone weiß, wo ich bin!

Lange Nacht die Wissen Schafft! 2018

Dr.-Ing. Tobias Kersten

Smartphone

Arbeiten, Organisieren, ...

Schutz, Sicherheit

Zeit und Navigation

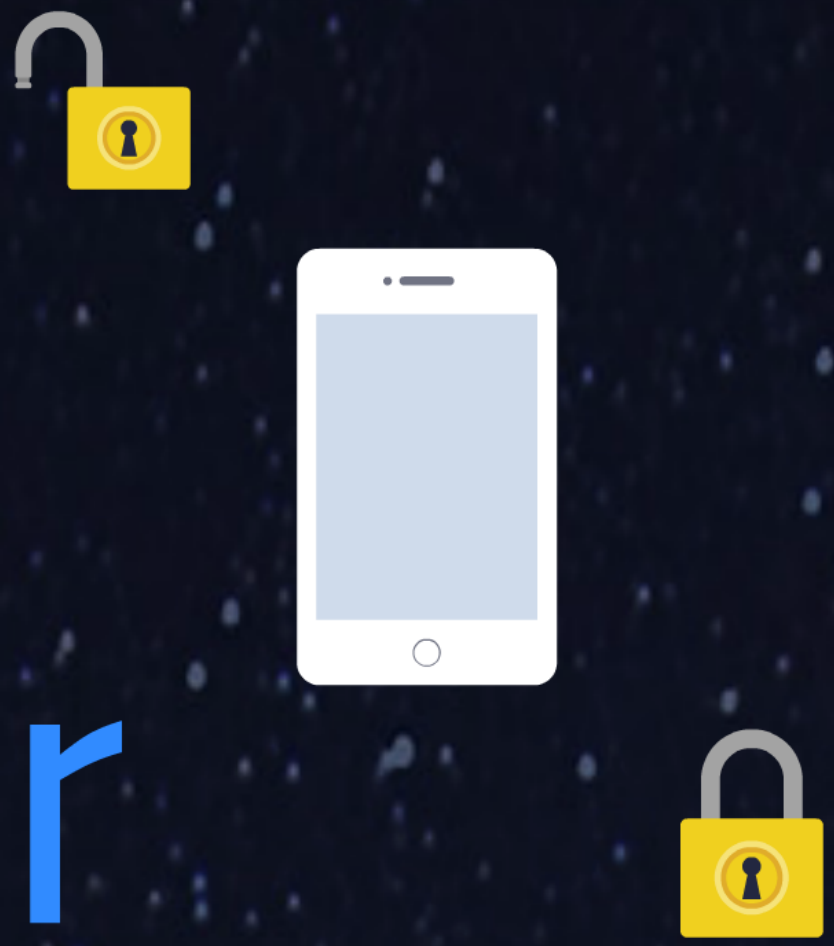
Kreativität, Freizeit, ...

Lifestyle, ...

Digitale Verantwortung

1000/s f2.8
+2..1..0..1..2-
Unheimlich
Praktisch

Schützen und Respektieren

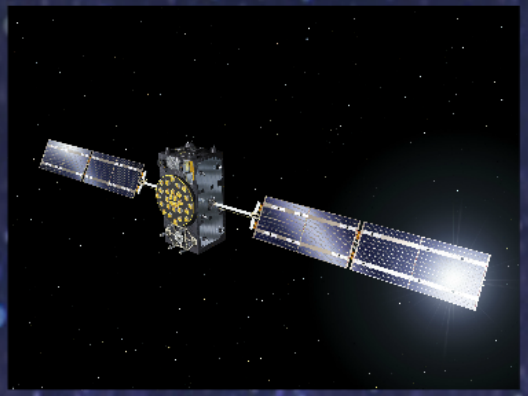


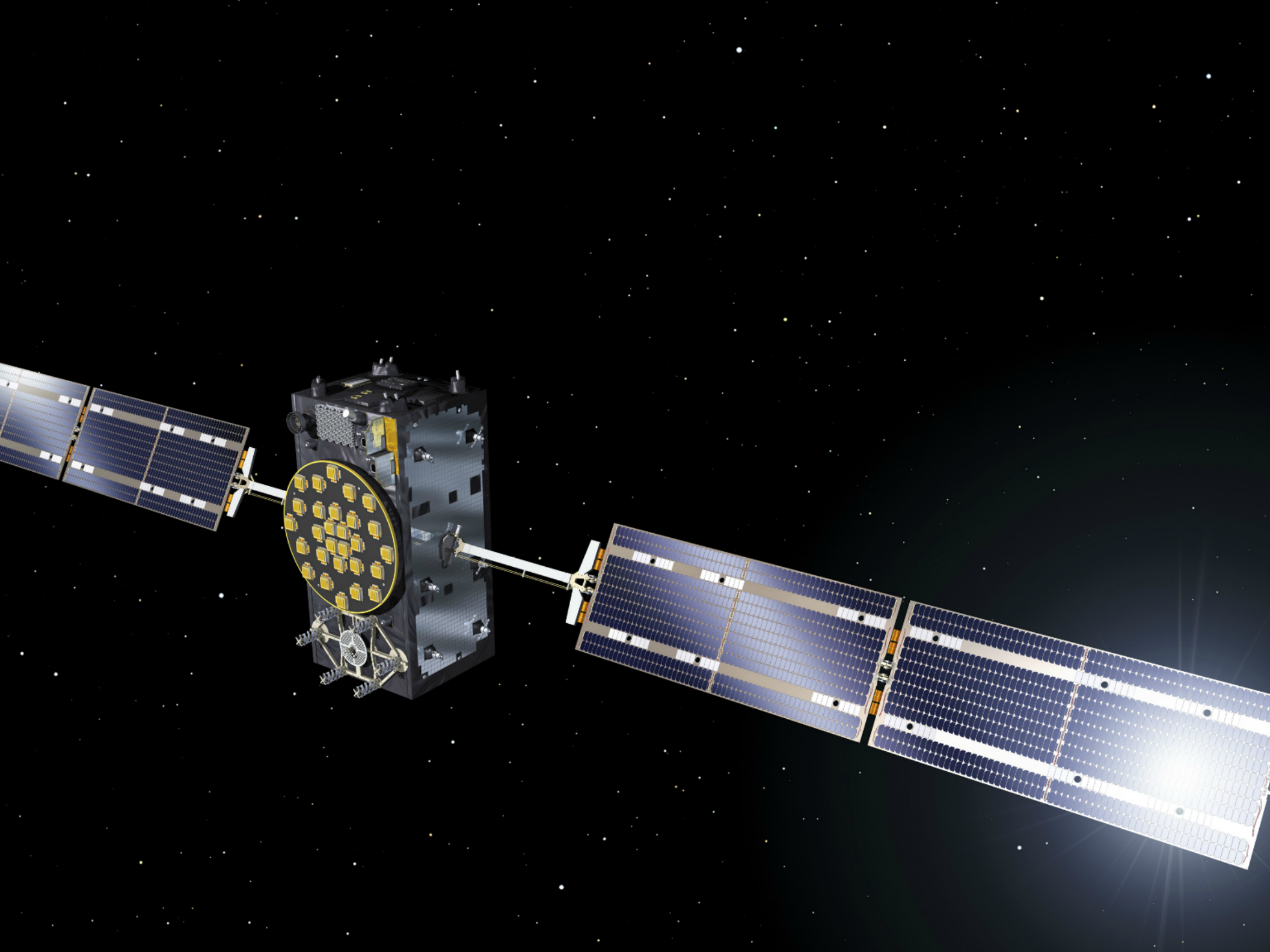
Nutzer Sicherheit

Positionierung und Navigation mit dem Smartphone

Standortzugriff auf verschiedenen Ebenen

- GPS, WLAN, mobile Netzwerke
- WLAN und mobile Netzwerke
- Nur GPS





GPS ? GNSS ? Multi-System?

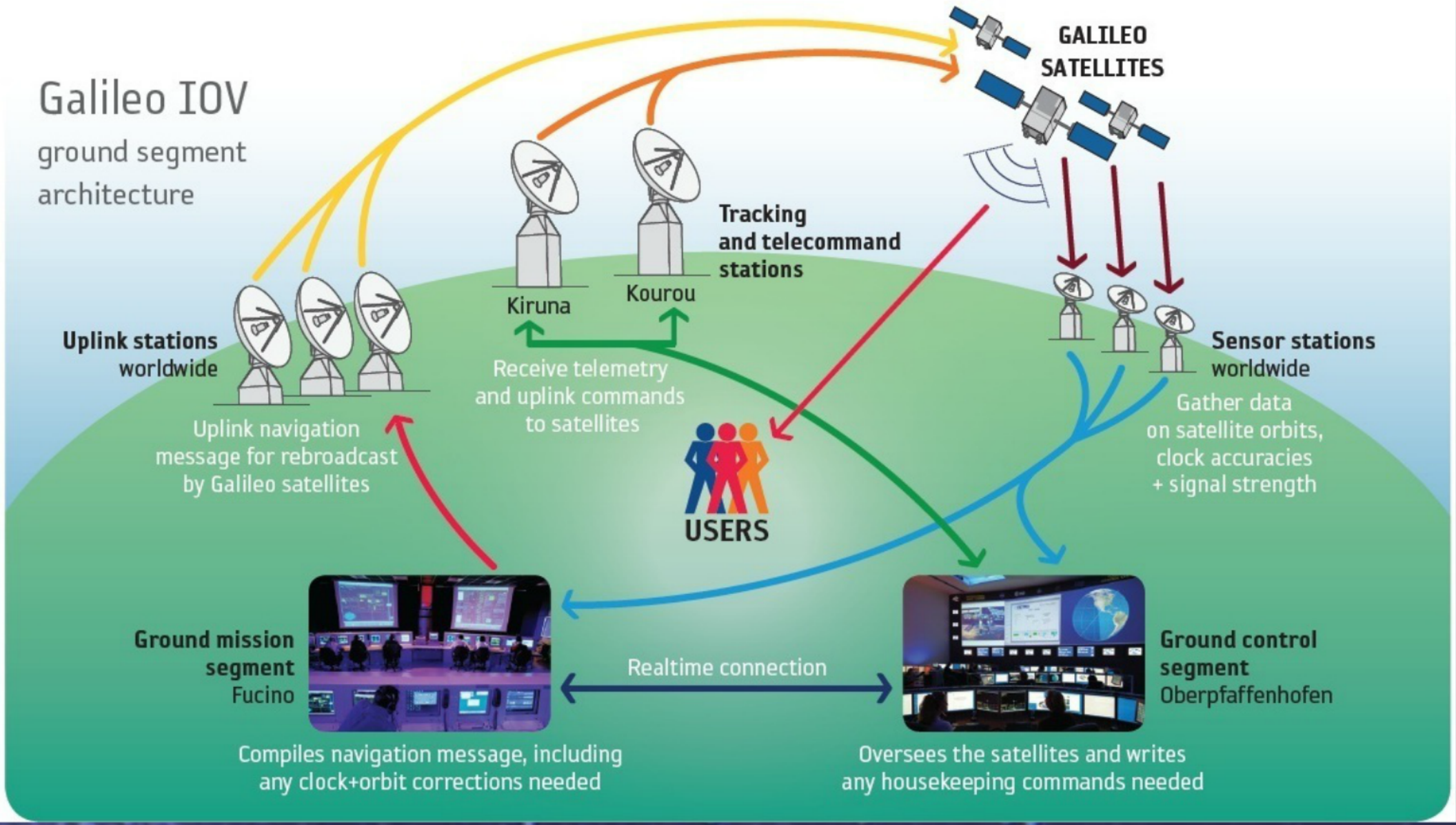
GPS

GLONASS

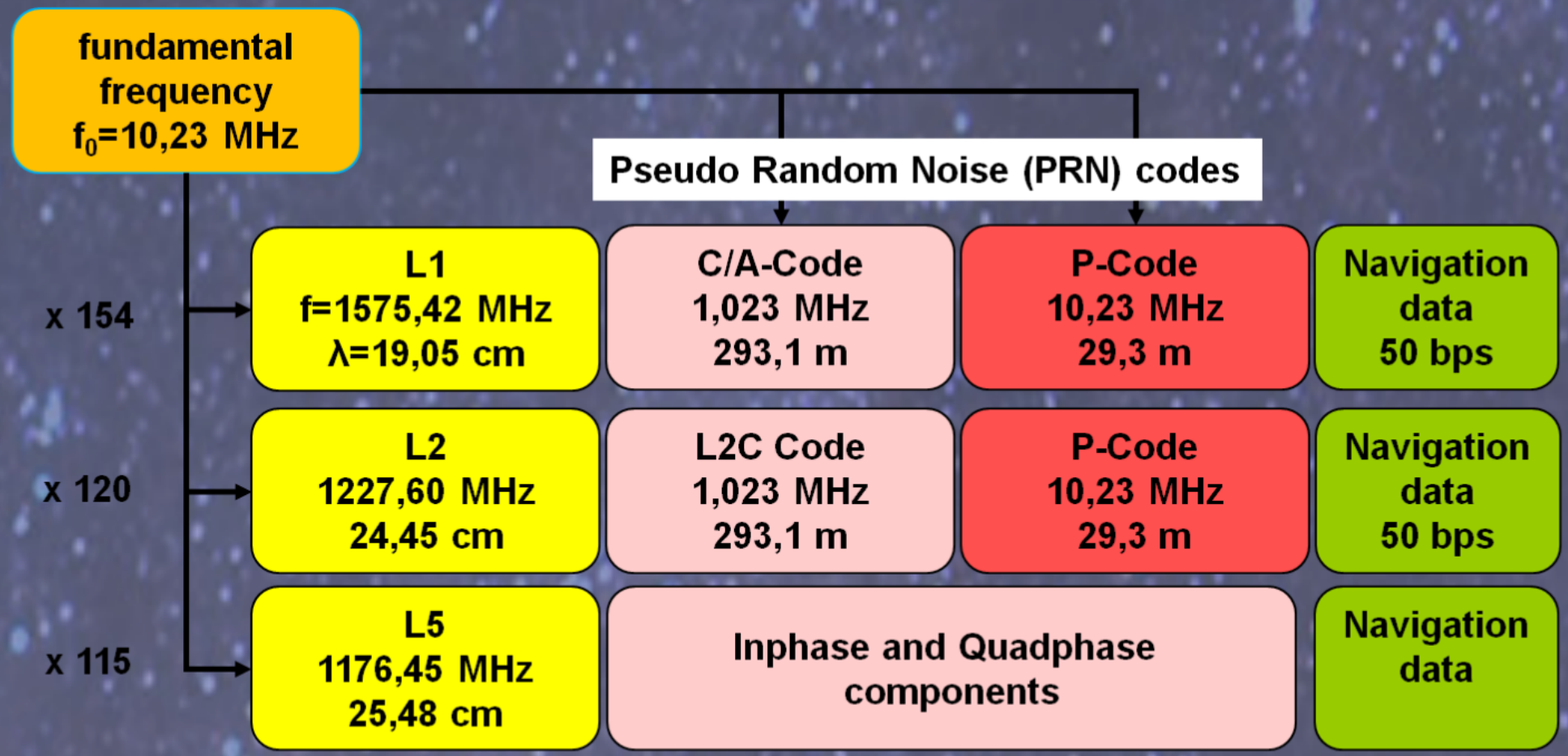
GALILEO

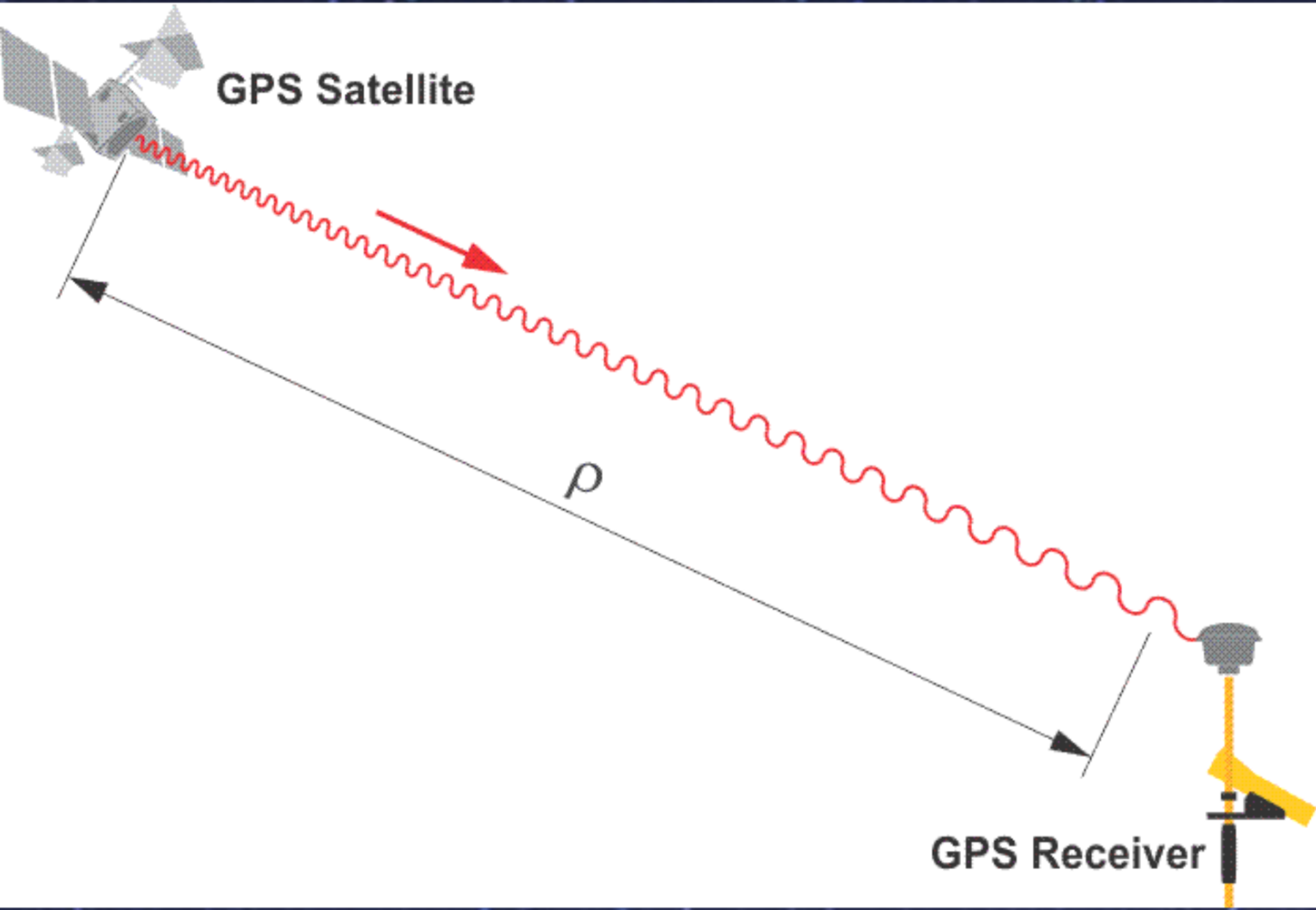
IRNSS

QZSS

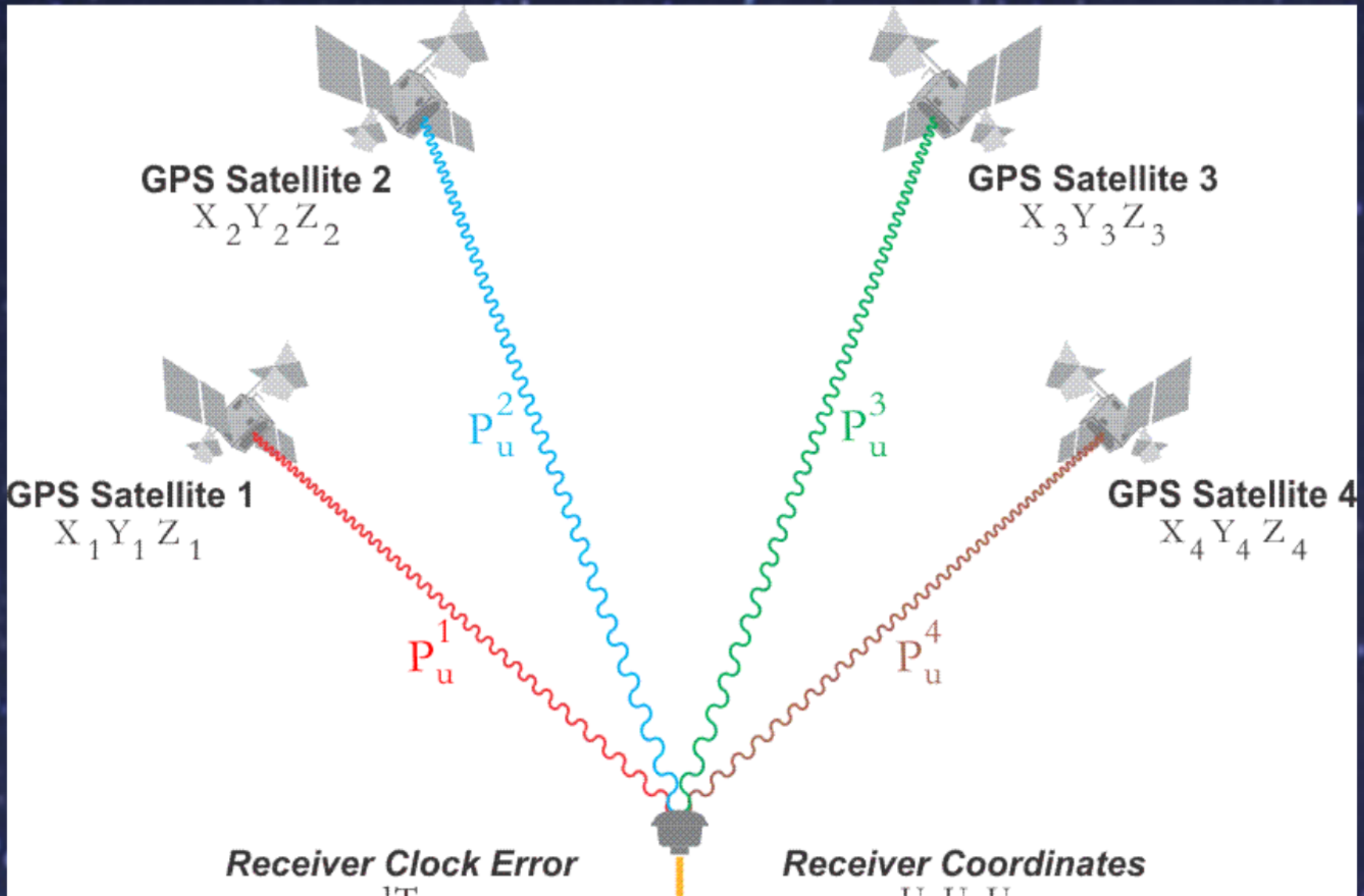

Galileo IOV
ground segment
architecture
GALILEO
SATELLITES
Tracking
and telecommand
stations
Kiruna
Kourou
Uplink stations
worldwide
Receive telemetry
and uplink commands
to satellites
Sensor stations
worldwide
Gather data
on satellite orbits,
clock accuracies
+ signal strength
Uplink navigation
message for rebroadcast
by Galileo satellites
USERS
Ground mission
segment
Fucino
Realtime connection
Ground control
segment
Oberpfaffenhofen
Compiles navigation message, including
any clock+orbit corrections needed
Oversees the satellites and writes
any housekeeping commands needed

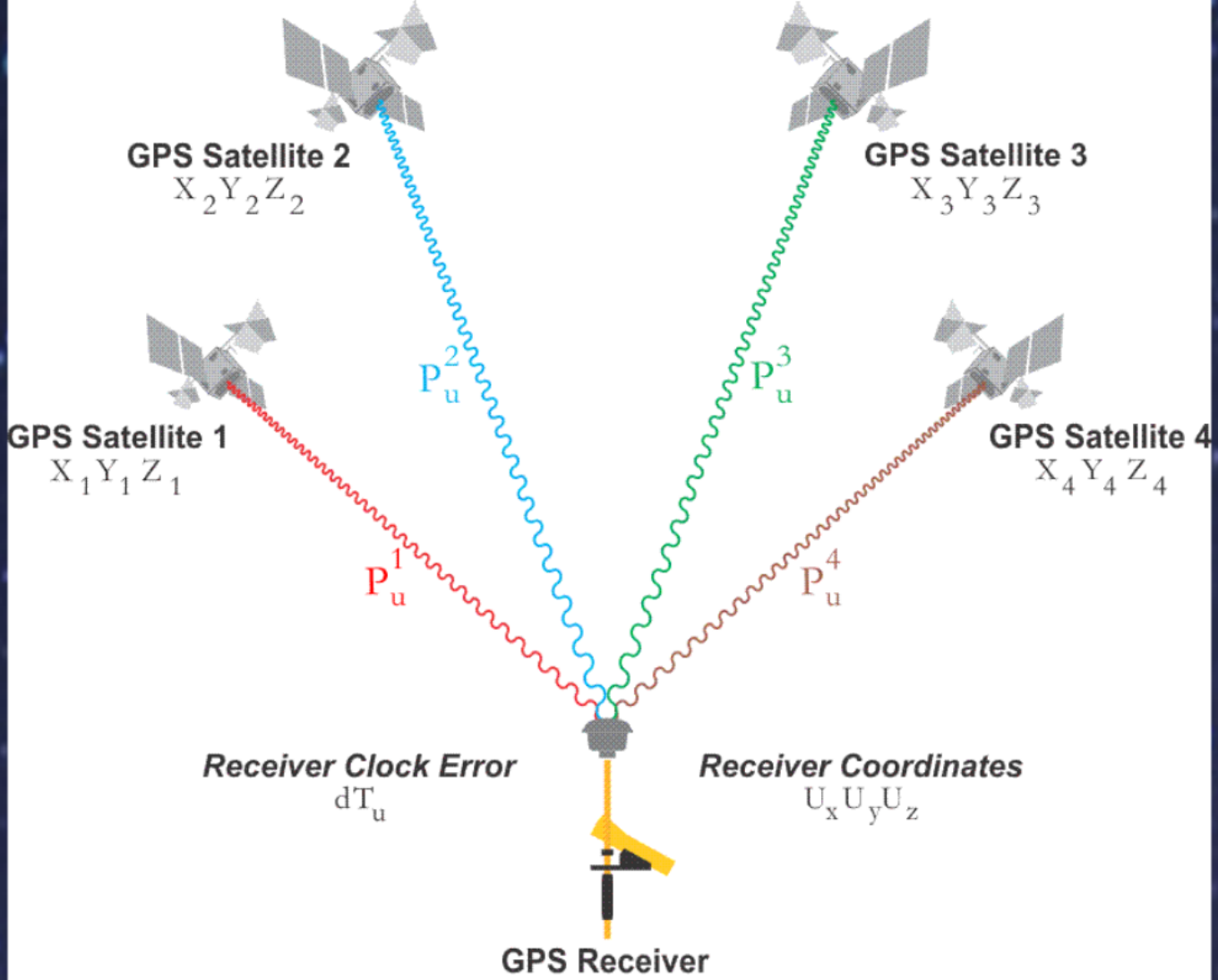
GPS-Signalstruktur




GPS Satellite
ρ
GPS Receiver

Prinzip der Ortung mit GPS/GNSS





$$p_u^1 = \sqrt{(X_1 - U_x)^2 + (Y_1 - U_y)^2 + (Z_1 - U_z)^2} + c(dT_u)$$

$$p_u^2 = \sqrt{(X_2 - U_x)^2 + (Y_2 - U_y)^2 + (Z_2 - U_z)^2} + c(dT_u)$$

$$p_u^3 = \sqrt{(X_3 - U_x)^2 + (Y_3 - U_y)^2 + (Z_3 - U_z)^2} + c(dT_u)$$

$$p_u^4 = \sqrt{(X_4 - U_x)^2 + (Y_4 - U_y)^2 + (Z_4 - U_z)^2} + c(dT_u)$$

Einflussfaktoren der Ortung

Satellit

Ionosphäre

Troposphäre

Empfangsantenne

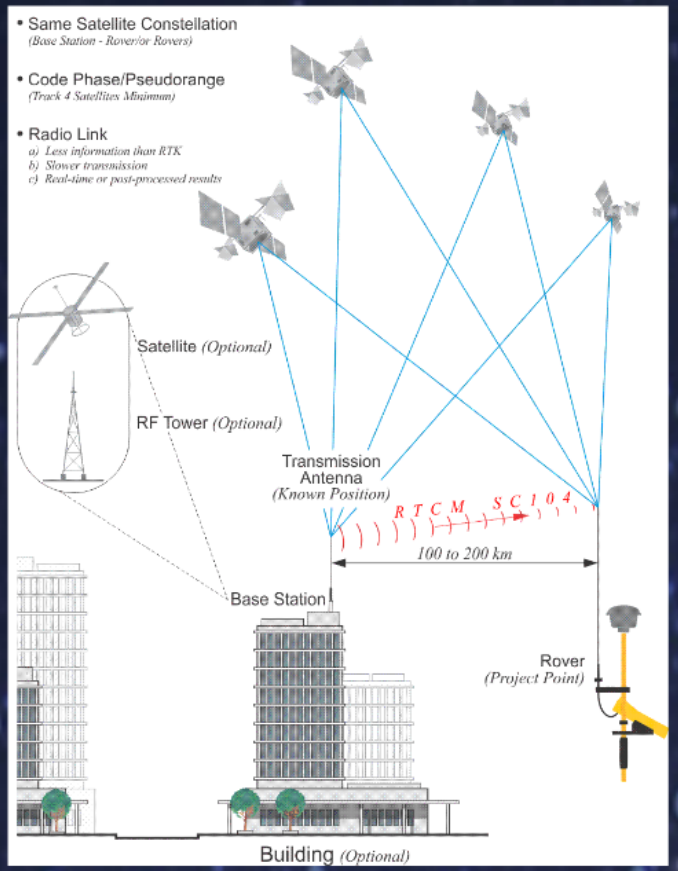
Assisted GPS (A-GPS)

GPS / GNSS Einzellösung plus zusätzliche Daten aus dem Mobilfunknetz oder WLAN

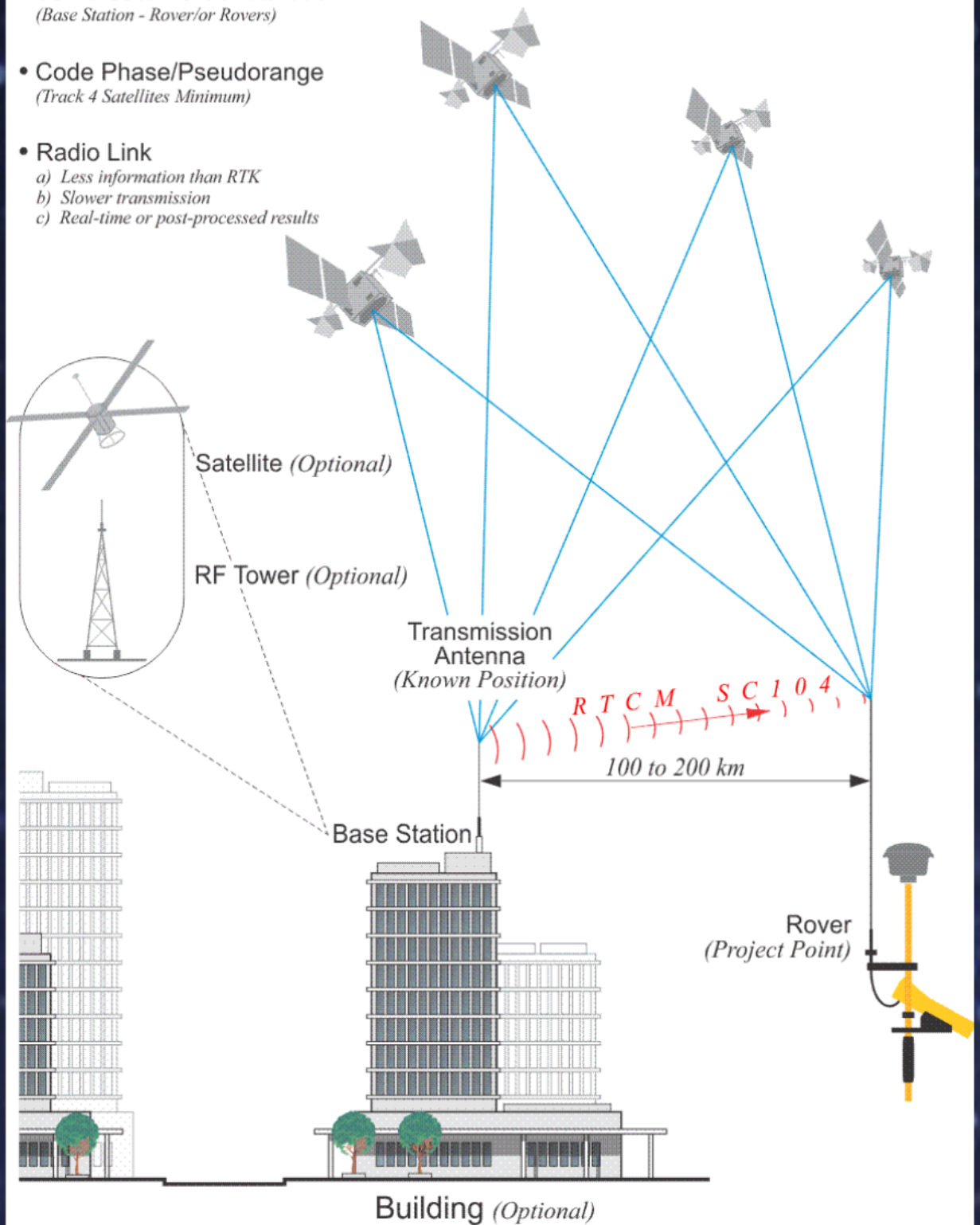
Apps zum Arbeiten mit Smartphones

- AndroiTS GPS Test
- GPSTest
- RTKGPS+
- Geo++ RINEX Logger

Realtime-Kinematic (RTK)



- Same Satellite Constellation
  (Base Station - Rover/or Rovers)
- Code Phase/Pseudorange
  (Track 4 Satellites Minimum)
- Radio Link
  a) Less information than RTK
  b) Slower transmission
  c) Real-time or post-processed results

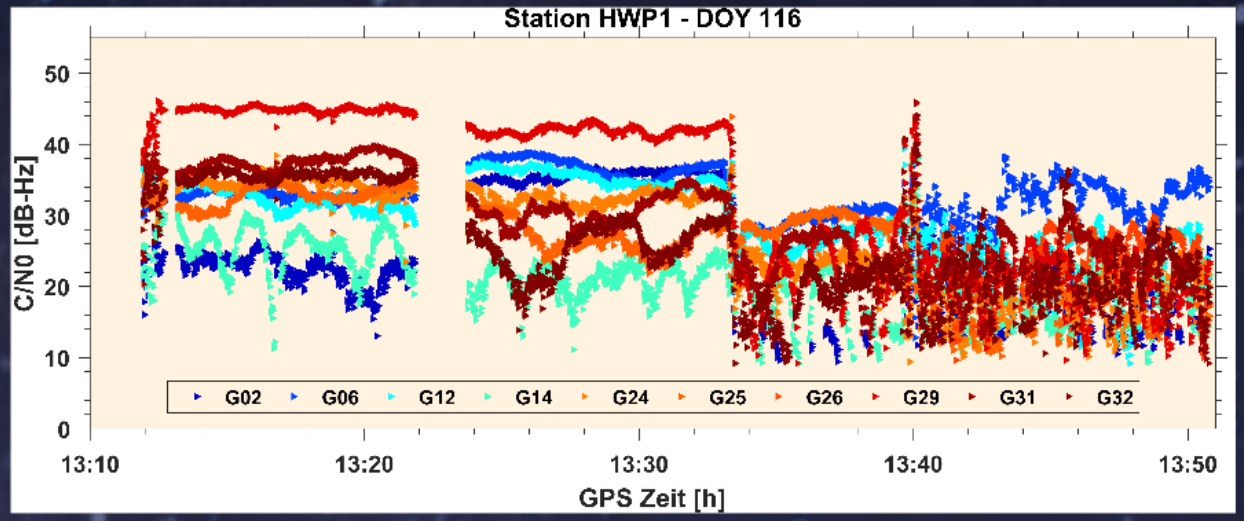


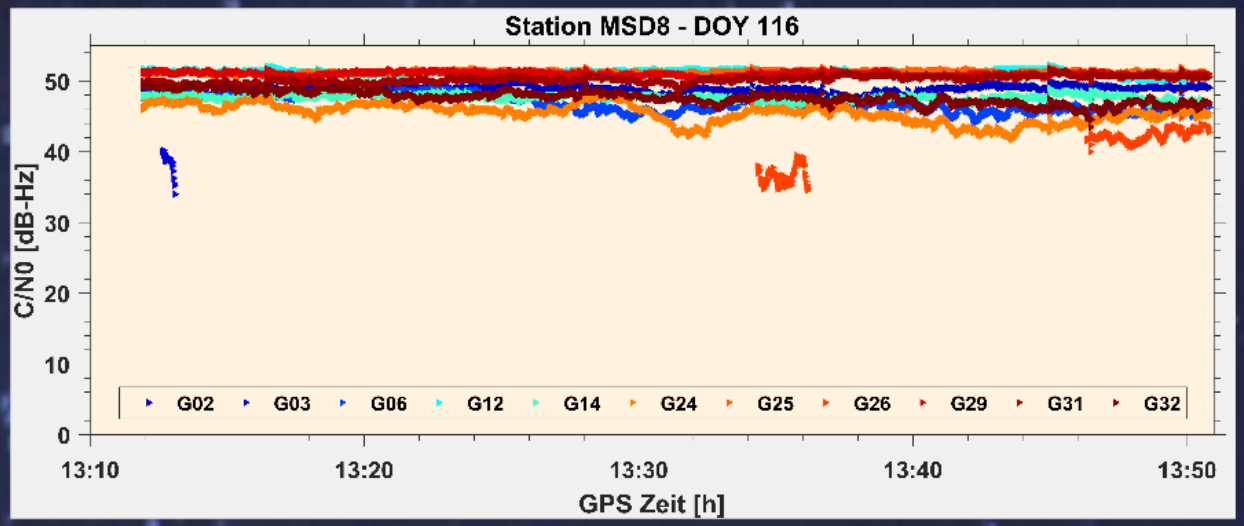
Apps zum Arbeiten mit Smartphones

- AndroiTS GPS Test
- GPSTest
- RTKGPS+
- Geo++ RINEX Logger

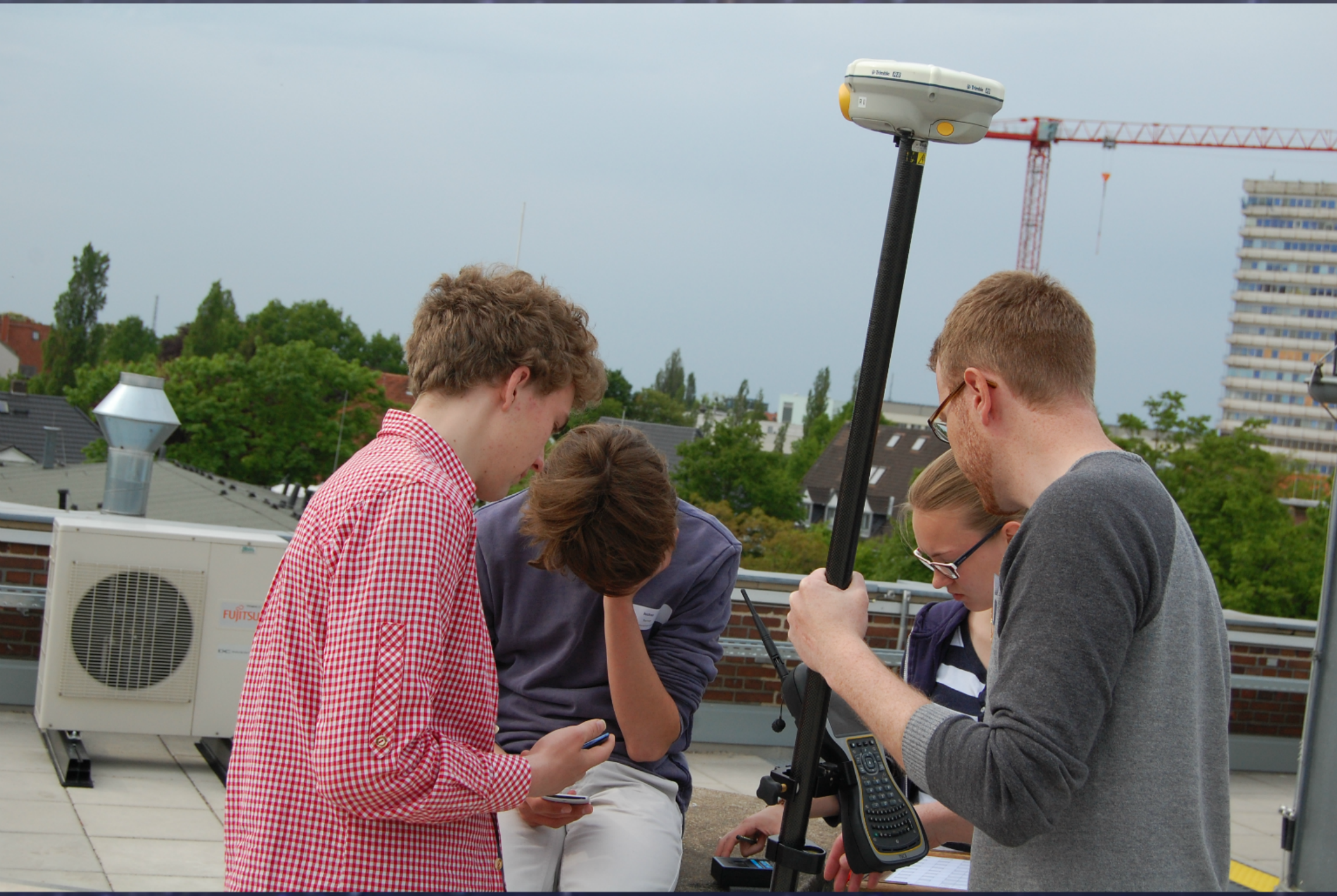
Androids in der Lehre

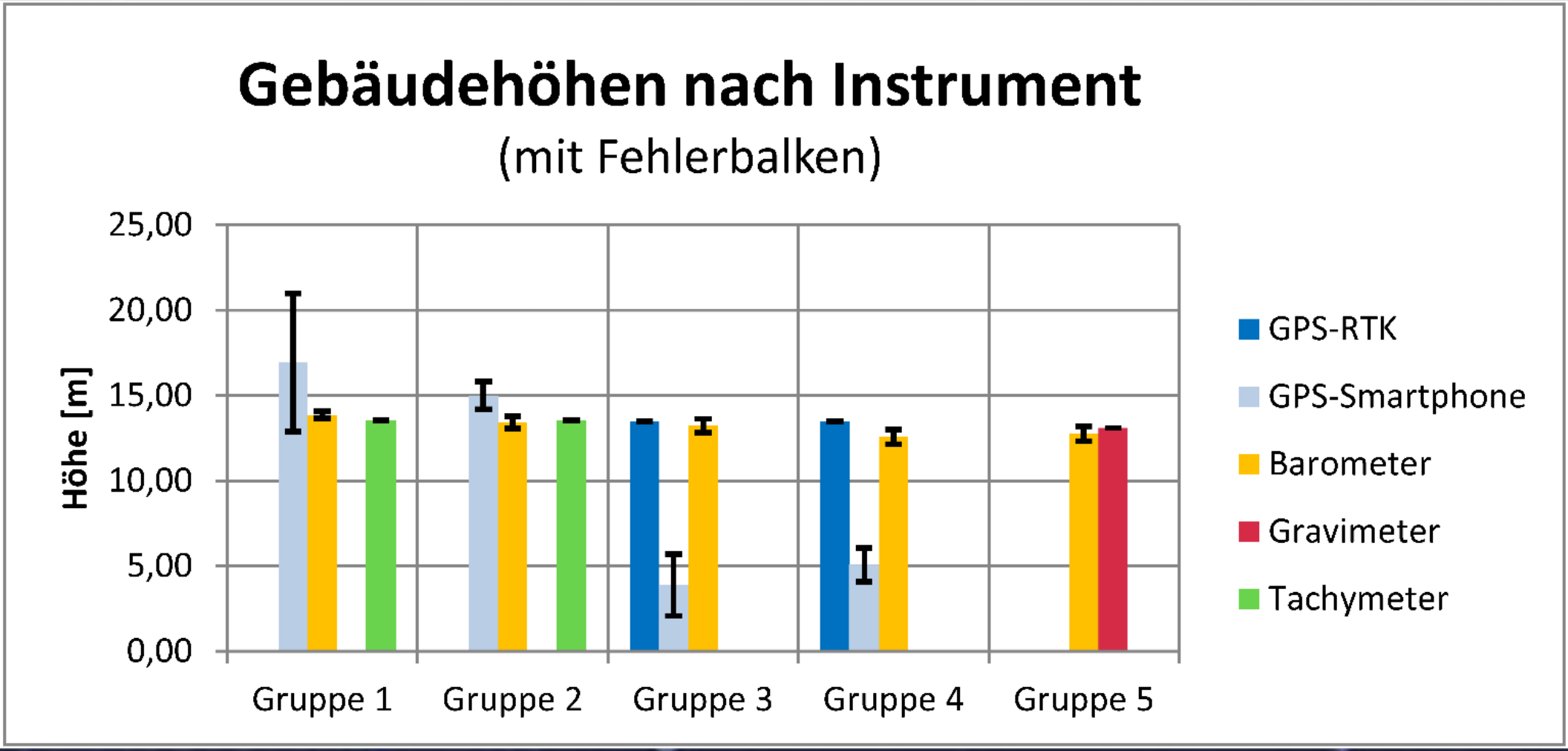
29
ZÜRI 17


Station HWP1 - DOY 116
C/N0 [dB-Hz]
0
10
20
30
40
50
13:10
13:20
13:30
13:40
13:50
GPS Zeit [h]
G02
G06
G12
G14
G24
G25
G26
G29
G31
G32


Station MSD8 - DOY 116
C/N0 [dB-Hz]
0
10
20
30
40
50
13:10
13:20
13:30
13:40
13:50
GPS Zeit [h]
G02
G03
G06
G12
G14
G24
G25
G26
G29
G31
G32

Schülertalent Akademie Geodäsie (STAG)


FUJITSU


Gebäudehöhen nach Instrument
(mit Fehlerbalken)
Höhe [m]
25,00
20,00
15,00
10,00
5,00
0,00
Gruppe 1
Gruppe 2
Gruppe 3
Gruppe 4
Gruppe 5
GPS-RTK
GPS-Smartphone
Barometer
Gravimeter
Tachymeter

App-Programmierung mit Androids

- Blog über Globale Navigations-Satellitensysteme (BlackDot)
- Android-Rohdaten Programmierung (Android Developer Network)
- European GNSS Agency
- GPS World

Dr.-Ing. Tobias Kersten
kersten@ife.uni-hannover.de

Material zum Vortrag: www.ife.uni-hannover.de/ndw2018

c:2018, Institut für Erdmessung