

Erweitertes GNSS-Rohdatenformat für low-cost GNSS-Empfänger

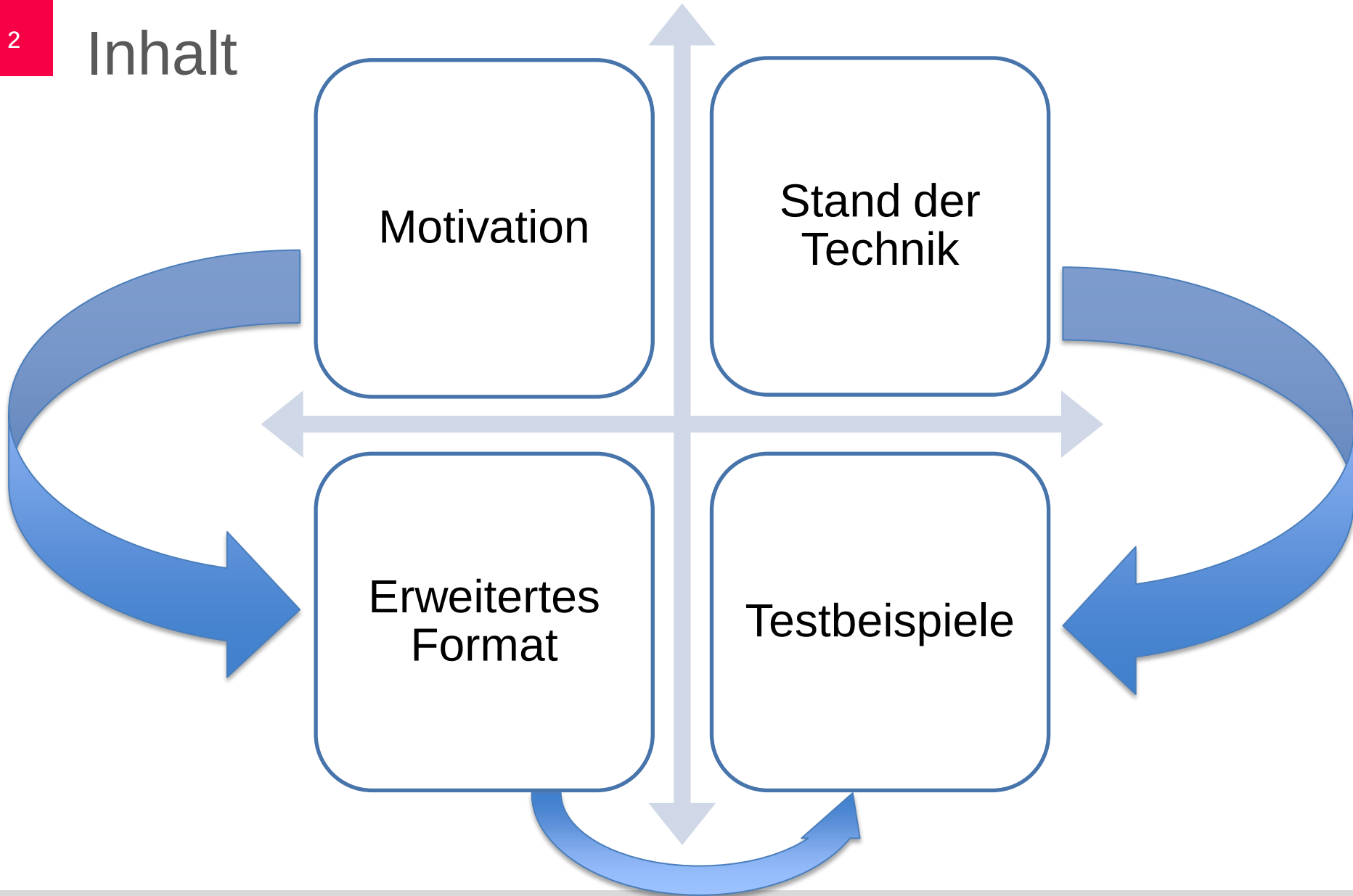
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Technische Universität Graz

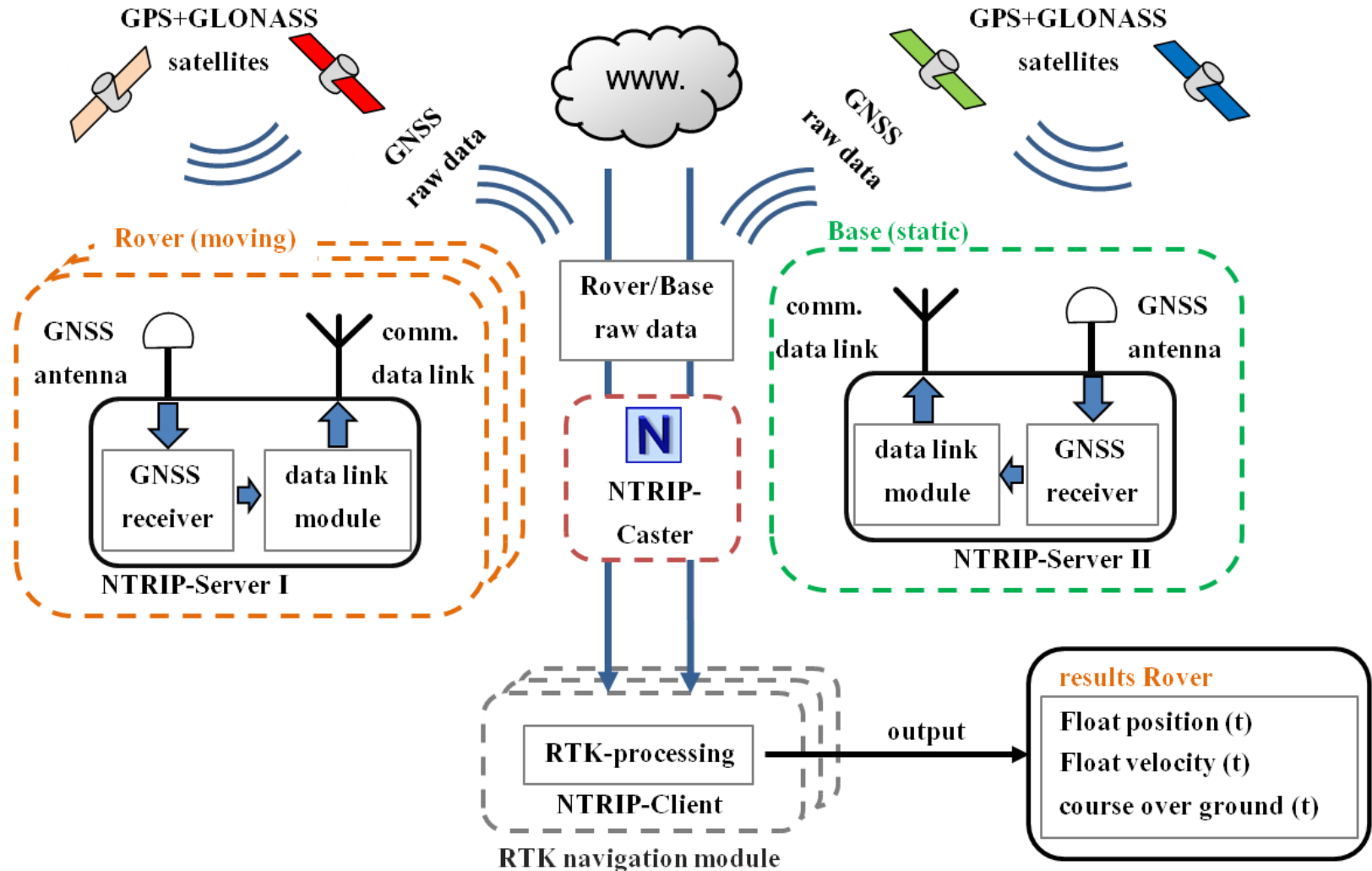


27. November 2015

Inhalt



Exkurs



Aktuelle Formate

RINEX 2.xx – 3.xx	RTCM 2.xx -3.xx
Postprocessing	Echtzeit
Phase, Code, Doppler	Korrekturdaten kein Doppler
SNR, LLI	SNR
standardisiert	standardisiert
obs, nav, Meteorologie	Frames
Rohdatenformate: ubx, nvs, tps	

Motivation

- Mehr Informationen
 - Rohdaten, Lock Time
 - Azimuth, Elevation
 - Cycle Slip Information
 - GDOP, Näherungsposition
- Empfängerabhängig (ublox Lea M8T)
 - Entwicklung eines eigenen Übertragungsformates



(c) www.u-blox.com

.gobs

Eigenes Format | gobs

- Einbindungen mehrere Daten → Genauigkeiten
- MultiGNSS

Time	GNSS-Info	Locktime LLI	Integrity	Code	Phase	Doppler	SNR	Std. Messung	Cycle Slip	Az El	Position
		645000	1 0				45		1 1	52 23	

%Start: 2015 05 27 09 48 09.000 End: 2015 05 27 10 44 39.000																								
1846	294488.99974518	05 0 1 00	64500	NaN	1 1	25398394.422	NaN	133469460.774	NaN	-3085.345	NaN	40.000	NaN	0.320	0.004	0.128	1 1 016	197	3	4195383.060	1159760.370	4646961.850	1.38	
1846	294488.99974518	11 0 1 00	64500	NaN	1 1	25047195.615	NaN	131623898.106	NaN	304.609	NaN	34.000	NaN	1.280	0.008	0.512	1 1 016	38	3	4195383.060	1159760.370	4646961.850	1.38	
1846	294488.99974518	12 0 1 00	64500	NaN	1 1	24497237.554	NaN	128733905.102	NaN	4105.278	NaN	42.000	NaN	0.320	0.004	0.128	1 1 016	224	8	4195383.060	1159760.370	4646961.850	1.38	
1846	294488.99974518	13 0 1 00	64500	NaN	1 0	20497689.598	NaN	107716082.354	NaN	-1615.285	NaN	49.000	NaN	0.320	0.004	0.128	1 1 016	155	61	4195383.060	1159760.370	4646961.850	1.38	
1846	294488.99974518	15 0 1 00	64500	NaN	1 1	20406974.746	NaN	107239369.724	NaN	441.556	NaN	48.000	NaN	0.320	0.004	0.128	1 1 016	261	69	4195383.060	1159760.370	4646961.850	1.38	
1846	294488.99974518	17 0 1 00	64500	NaN	1 1	22274703.258	NaN	117054356.373	NaN	2108.214	NaN	48.000	NaN	0.320	0.004	0.128	1 1 016	113	37	4195383.060	1159760.370	4646961.850	1.38	
1846	294488.99974518	18 0 1 00	64500	NaN	1 1	23846758.159	NaN	125315580.807	NaN	1231.024	NaN	42.000	NaN	0.320	0.004	0.128	1 1 016	307	18	4195383.060	1159760.370	4646961.850	1.38	
1846	294488.99974518	20 0 1 00	64500	NaN	1 1	24541101.468	NaN	128964356.149	NaN	-3011.296	NaN	39.000	NaN	0.320	0.004	0.128	1 1 016	212	10	4195383.060	1159760.370	4646961.850	1.38	
1846	294488.99974518	24 0 1 00	64500	NaN	1 1	22198004.647	NaN	116651310.251	NaN	2949.295	NaN	46.000	NaN	0.320	0.004	0.128	1 1 016	283	34	4195383.060	1159760.370	4646961.850	1.38	
1846	294488.99974518	28 0 1 00	64500	NaN	1 0	22122859.438	NaN	116256415.637	NaN	-2140.617	NaN	49.000	NaN	0.320	0.004	0.128	1 1 016	52	41	4195383.060	1159760.370	4646961.850	1.38	
1846	294488.99974518	30 0 1 00	0	NaN	0 0	24416345.290	NaN	128308760.333	NaN	-2791.876	NaN	25.000	NaN	5.120	0.060	2.048	1 0 016	88	11	4195383.060	1159760.370	4646961.850	1.38	

Eigenes Format | gobs

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$Start: 2015 05 27 09 48 09.000 End: 2015 05 27 10 44 39.000
1846 294488.99974518 05 0 1 00 64500 NaN 1 1 25398394.422 NaN 133469460.774 NaN -3085.345 NaN 40.000 NaN 0.320 0.004 0.128 1 1 016 197 3 4195383.060 1159760.370 4646961.850 1.38
1846 294488.99974518 11 0 1 00 64500 NaN 1 1 25047195.615 NaN 131623898.106 NaN 304.609 NaN 34.000 NaN 1.280 0.008 0.512 1 1 016 38 3 4195383.060 1159760.370 4646961.850 1.38
1846 294488.99974518 12 0 1 00 64500 NaN 1 1 24497237.554 NaN 128733905.102 NaN 4105.278 NaN 42.000 NaN 0.320 0.004 0.128 1 1 016 224 8 4195383.060 1159760.370 4646961.850 1.38
1846 294488.99974518 13 0 1 00 64500 NaN 1 0 20497689.598 NaN 107716082.354 NaN -1615.285 NaN 49.000 NaN 0.320 0.004 0.128 1 1 016 155 61 4195383.060 1159760.370 4646961.850 1.38
1846 294488.99974518 15 0 1 00 64500 NaN 1 1 20406974.746 NaN 107239369.724 NaN 441.556 NaN 48.000 NaN 0.320 0.004 0.128 1 1 016 261 69 4195383.060 1159760.370 4646961.850 1.38
1846 294488.99974518 18 0 1 00 64500 NaN 1 1 23846758.159 NaN 117054356.373 NaN 2108.214 NaN 48.000 NaN 0.320 0.004 0.128 1 1 016 113 37 4195383.060 1159760.370 4646961.850 1.38
1846 294488.99974518 20 0 1 00 64500 NaN 1 1 24541101.468 NaN 125315580.807 NaN 1231.024 NaN 42.000 NaN 0.320 0.004 0.128 1 1 016 307 18 4195383.060 1159760.370 4646961.850 1.38
1846 294488.99974518 24 0 1 00 64500 NaN 1 1 22198004.647 NaN 128964356.149 NaN -3011.296 NaN 39.000 NaN 0.320 0.004 0.128 1 1 016 212 10 4195383.060 1159760.370 4646961.850 1.38
1846 294488.99974518 28 0 1 00 64500 NaN 1 0 22122859.438 NaN 116651310.251 NaN 2949.295 NaN 46.000 NaN 0.320 0.004 0.128 1 1 016 283 34 4195383.060 1159760.370 4646961.850 1.38
1846 294488.99974518 30 0 1 00 0 NaN 0 0 24416345.290 NaN 116256415.637 NaN -2140.617 NaN 49.000 NaN 0.320 0.004 0.128 1 1 016 52 41 4195383.060 1159760.370 4646961.850 1.38
1846 294488.99974518 30 0 1 00 0 NaN 0 0 24416345.290 NaN 128308760.333 NaN -2791.876 NaN 25.000 NaN 5.120 0.060 2.048 1 0 016 88 11 4195383.060 1159760.370 4646961.850 1.38

```

week	seconds	SVID	Type	GNSS	Locktime	LLI	Flag C	Flag P
1846	294488.999	18	0	1	64500	NaN	1	1
1846	294488.999	20	0	1	64500	NaN	1	1
1846	294488.999	24	0	1	64500	NaN	1	1
1846	294488.999	28	0	1	64500	NaN	1	0
1846	294488.999	30	0	1	0	NaN	0	0

```

$Start: 2015 05 27 09 48 09.000 End: 2015 05 27 10 44 39.000
1846 294488.99974518 05 0 1 00 64500 NaN 1 1 25398394.422 NaN 133469460.774 NaN -3085.345 NaN 40.000 NaN 0.320 0.004 0.128 1 1 016 197 3 4195383.060 1159760.370 4646961.850 1.38
1846 294488.99974518 11 0 1 00 64500 NaN 1 1 25047195.615 NaN 131623898.106 NaN 304.609 NaN 34.000 NaN 1.280 0.008 0.512 1 1 016 38 3 4195383.060 1159760.370 4646961.850 1.38
1846 294488.99974518 12 0 1 00 64500 NaN 1 1 24497237.554 NaN 128733905.102 NaN 4105.278 NaN 42.000 NaN 0.320 0.004 0.128 1 1 016 224 8 4195383.060 1159760.370 4646961.850 1.38
1846 294488.99974518 13 0 1 00 64500 NaN 1 0 20497689.598 NaN 107716082.354 NaN -1615.285 NaN 49.000 NaN 0.320 0.004 0.128 1 1 016 155 61 4195383.060 1159760.370 4646961.850 1.38
1846 294488.99974518 15 0 1 00 64500 NaN 1 1 20406974.746 NaN 107239369.724 NaN 441.556 NaN 48.000 NaN 0.320 0.004 0.128 1 1 016 261 69 4195383.060 1159760.370 4646961.850 1.38
1846 294488.99974518 17 0 1 00 64500 NaN 1 1 22274703.258 NaN 117054356.373 NaN 2108.214 NaN 48.000 NaN 0.320 0.004 0.128 1 1 016 113 37 4195383.060 1159760.370 4646961.850 1.38
1846 294488.99974518 18 0 1 00 64500 NaN 1 1 23846758.159 NaN 125315580.807 NaN 1231.024 NaN 42.000 NaN 0.320 0.004 0.128 1 1 016 307 18 4195383.060 1159760.370 4646961.850 1.38
1846 294488.99974518 20 0 1 00 64500 NaN 1 1 24541101.468 NaN 128964356.149 NaN -3011.296 NaN 39.000 NaN 0.320 0.004 0.128 1 1 016 212 10 4195383.060 1159760.370 4646961.850 1.38
1846 294488.99974518 24 0 1 00 64500 NaN 1 1 22198004.647 NaN 116651310.251 NaN 2949.295 NaN 46.000 NaN 0.320 0.004 0.128 1 1 016 283 34 4195383.060 1159760.370 4646961.850 1.38
1846 294488.99974518 28 0 1 00 64500 NaN 1 0 22122859.438 NaN 116256415.637 NaN -2140.617 NaN 49.000 NaN 0.320 0.004 0.128 1 1 016 52 41 4195383.060 1159760.370 4646961.850 1.38
1846 294488.99974518 30 0 1 00 0 NaN 0 0 24416345.290 NaN 128308760.333 NaN -2791.876 NaN 25.000 NaN 5.120 0.060 2.048 1 0 016 88 11 4195383.060 1159760.370 4646961.850 1.38

```

S _{code}	S _{phase}	S _{dop}	Half cycle	Cycle slip	Leap s	Az.	El.	X	Y	Z	S _{pos}
0.320	0.004	0.128	1	1	016	307	18	4195383.060	1159760.370	4646961.850	1.38
0.320	0.004	0.128	1	1	016	212	10	4195383.060	1159760.370	4646961.850	1.38
0.320	0.004	0.128	1	1	016	283	34	4195383.060	1159760.370	4646961.850	1.38
0.320	0.004	0.128	1	1	016	52	41	4195383.060	1159760.370	4646961.850	1.38
5.120	0.060	2.048	1	0	016	88	11	4195383.060	1159760.370	4646961.850	1.38

Aktuelle Formate - RINEX

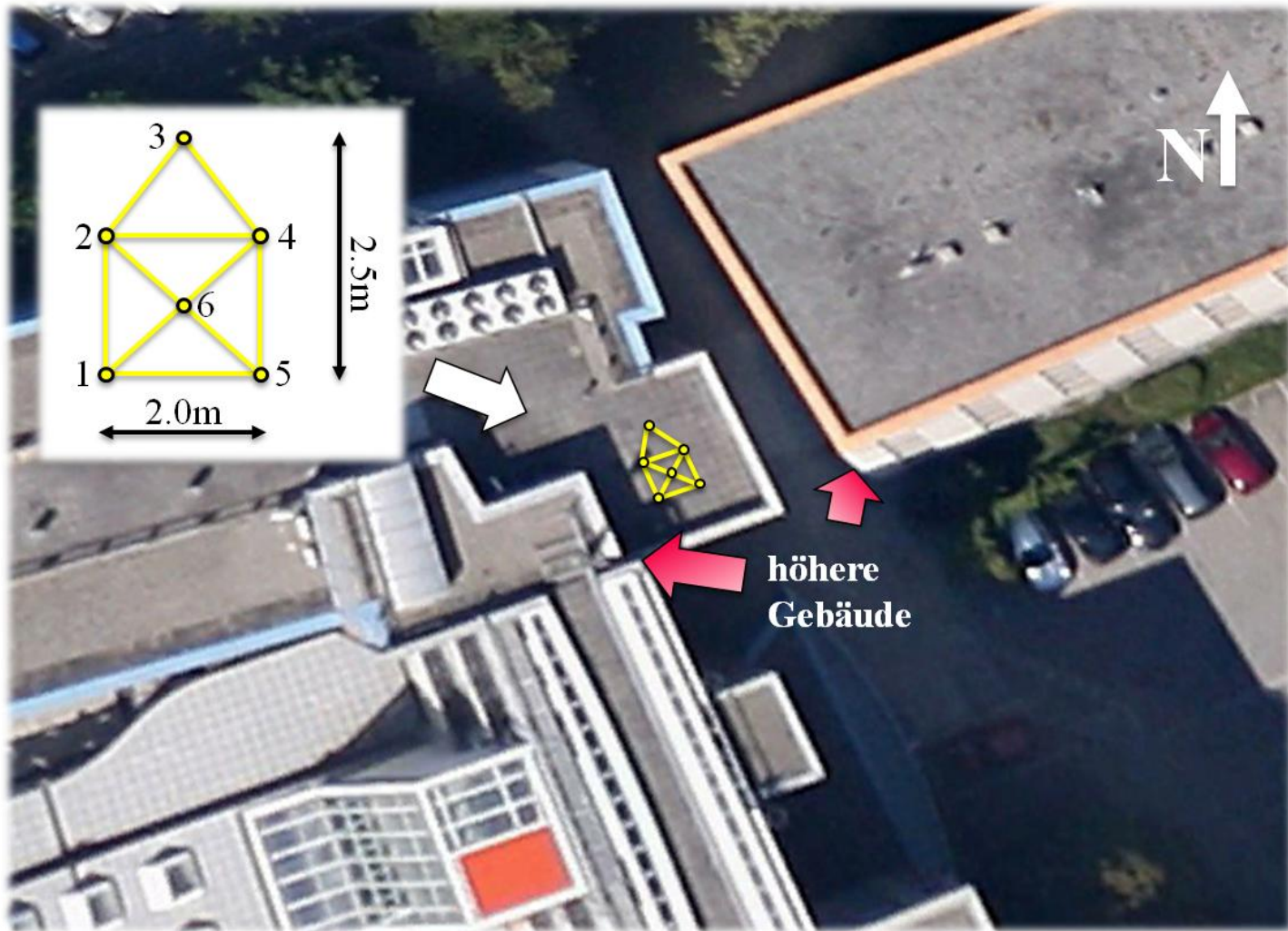
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3.00          OBSERVATION DATA    M: Mixed          RINEX VERSION / TYPE
RTKCONV 2.4.3          20151020 085738 UTC PGM / RUN BY / DATE
log: E:\01_TUG\06_GNSS Measurements\CPS_RealTimeTests\Solu COMMENT
format: u-blox COMMENT
MARKER NAME
MARKER NUMBER
MARKER TYPE
OBSERVER / AGENCY
REC # / TYPE / VERS
ANT # / TYPE
APPROX POSITION XYZ
ANTENNA: DELTA H/E/N
SYS / # / OBS TYPES
SYS / # / OBS TYPES
TIME OF FIRST OBS
TIME OF LAST OBS
END OF HEADER

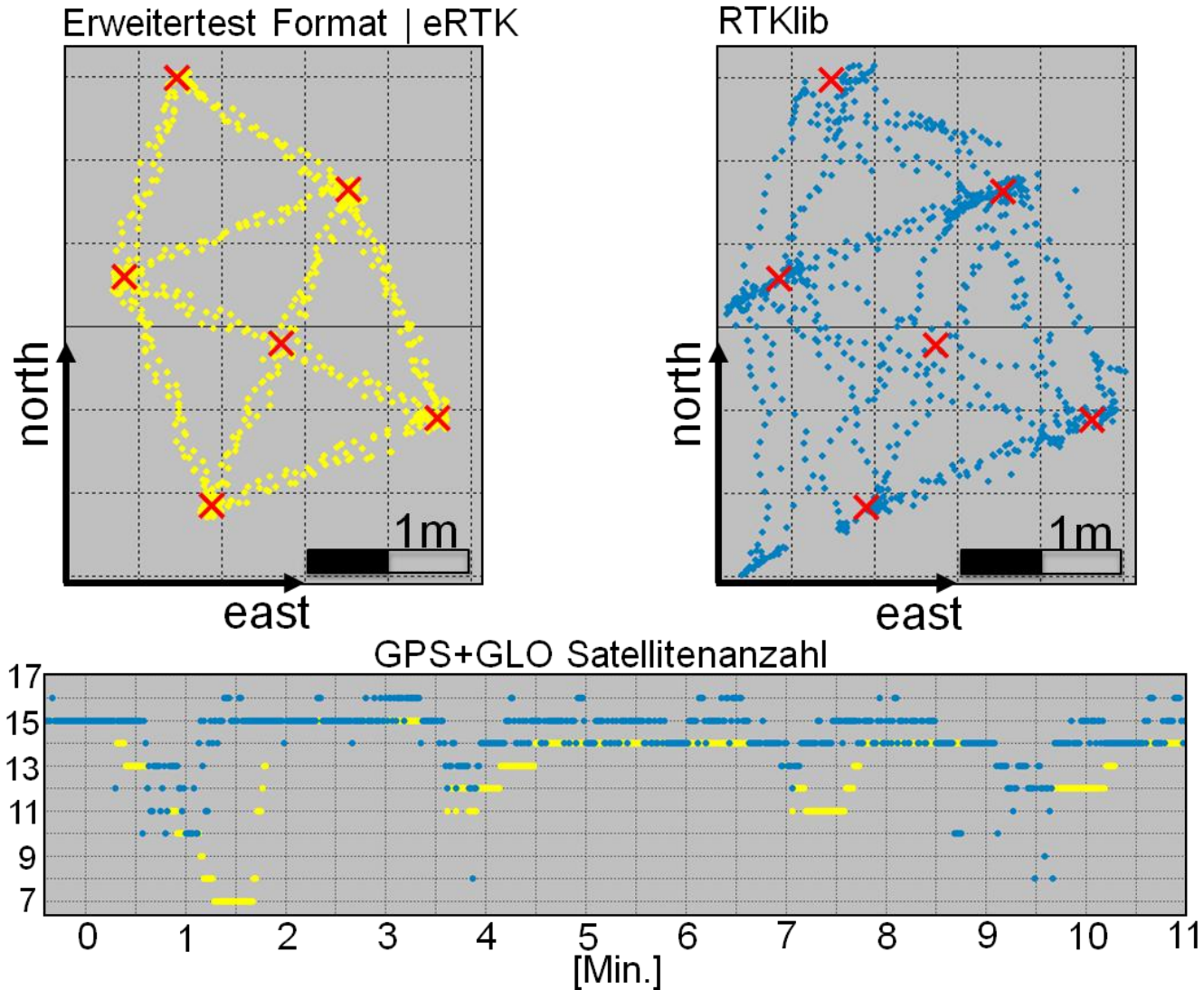
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R 8 21506093.284 115164162.711 1995.234 48.000
G 5 25161945.498 132226890.384 -2700.880 33.000
G16 21107283.438 110919532.014 2002.990 41.000
G20 21940526.397 115298247.290 -361.984 41.000
G21 20891858.022 109787446.576 -27.637 39.000
G25 25535959.269 -3568.523 26.000
G26 20363700.152 107011954.848 56.667 45.000
G29 22407556.547 117752478.283 -2387.560 44.000
R13 22283705.440 118993744.0811 -4091.656 26.000
R 1 23165573.236 123833442.208 4396.189 46.000
G22 24840878.043 3757.904 22.000
R14 20067036.791 106968645.940 -889.157 40.000
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Testmessung | eRTK - RTKlib

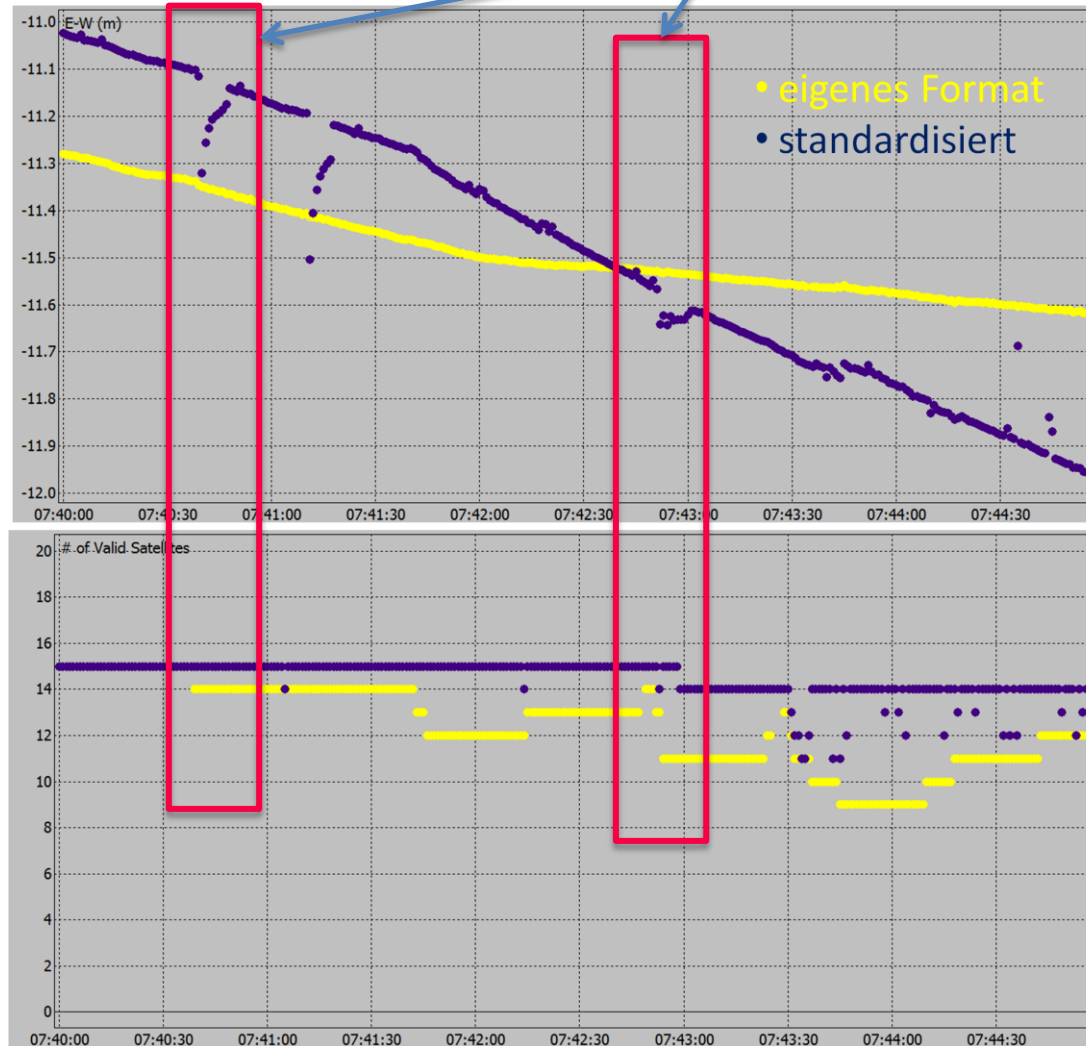


Testmessung | Lage



Testmessung (2)

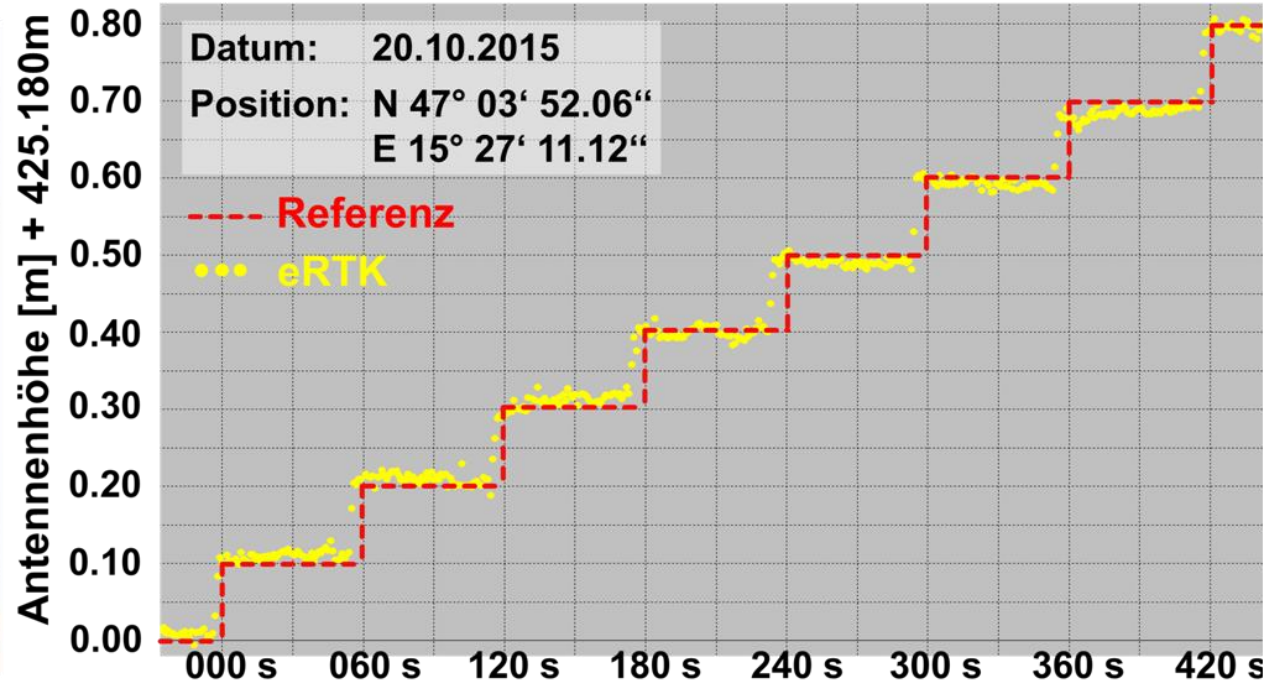
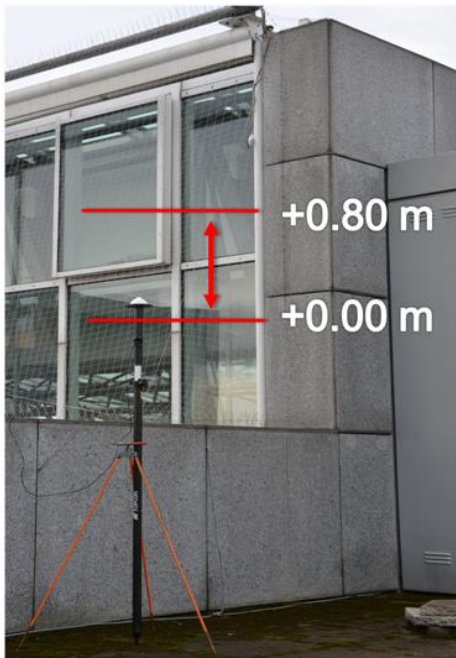
Fehlerhafte Messungen



east-west

Satelliten

Testmessung | Höhe



- RTKlib mit hohen Abweichungen
- Locktime bzw. Cycle Slip Parameter → Lösung

Probleme bei Verwendung

- Receiver-Abhängigkeit
- mehr Daten
- Dekodierung
- Interoperabilität

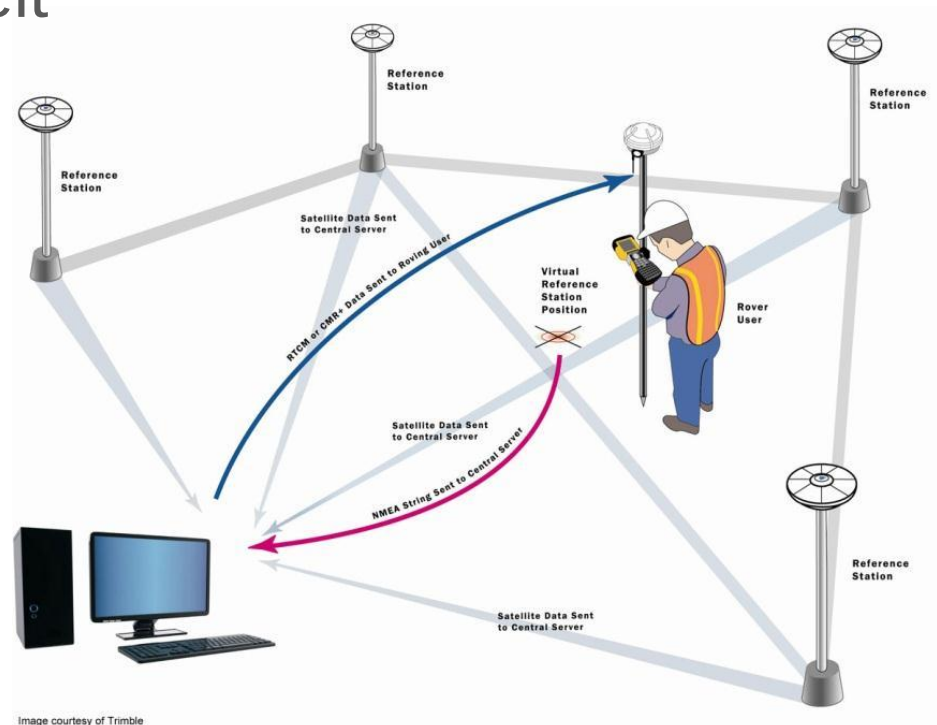


Image courtesy of Trimble

(c) Trimble

Ausblick

- Masterarbeit, Institut für Geodäsie
 - eigene NTRIP-Struktur, Synchronisierung
 - “mobile” Anwendung, Raspberry PI
 - Inertiale-Messungen
 - GALILEO und Beidou Tests



Tests neuer Hardware, C-Implementierung

Fazit

Mehr Daten

Robuste Navigation

Multi-GNSS

Analyse

Erweitertes GNSS-Rohdatenformat für low-cost GNSS-Empfänger

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27. November 2015