

International *EUPOS*® Steering Committee



# Low cost GNSS applications

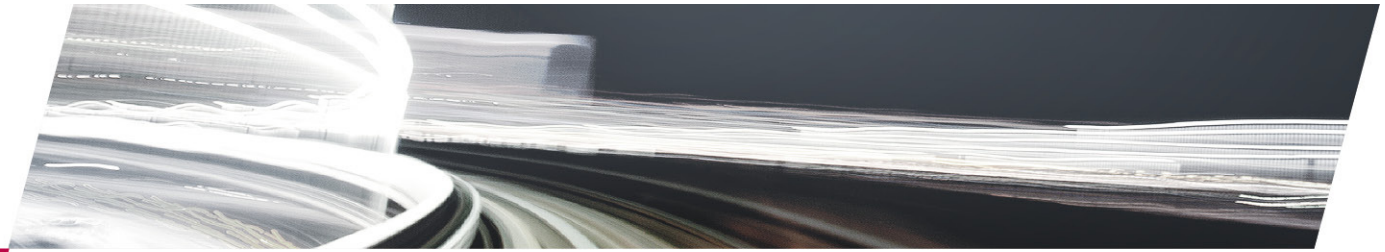
*United Nations/Latvia Workshop on the  
Applications of Global Navigation Satellite Systems*

The Latvian Geospatial Information Agency  
14 – 18 May 2012  
Riga, Latvia

Aus Daten werden Lösungen.

**EUPOS**

European Position Determination System



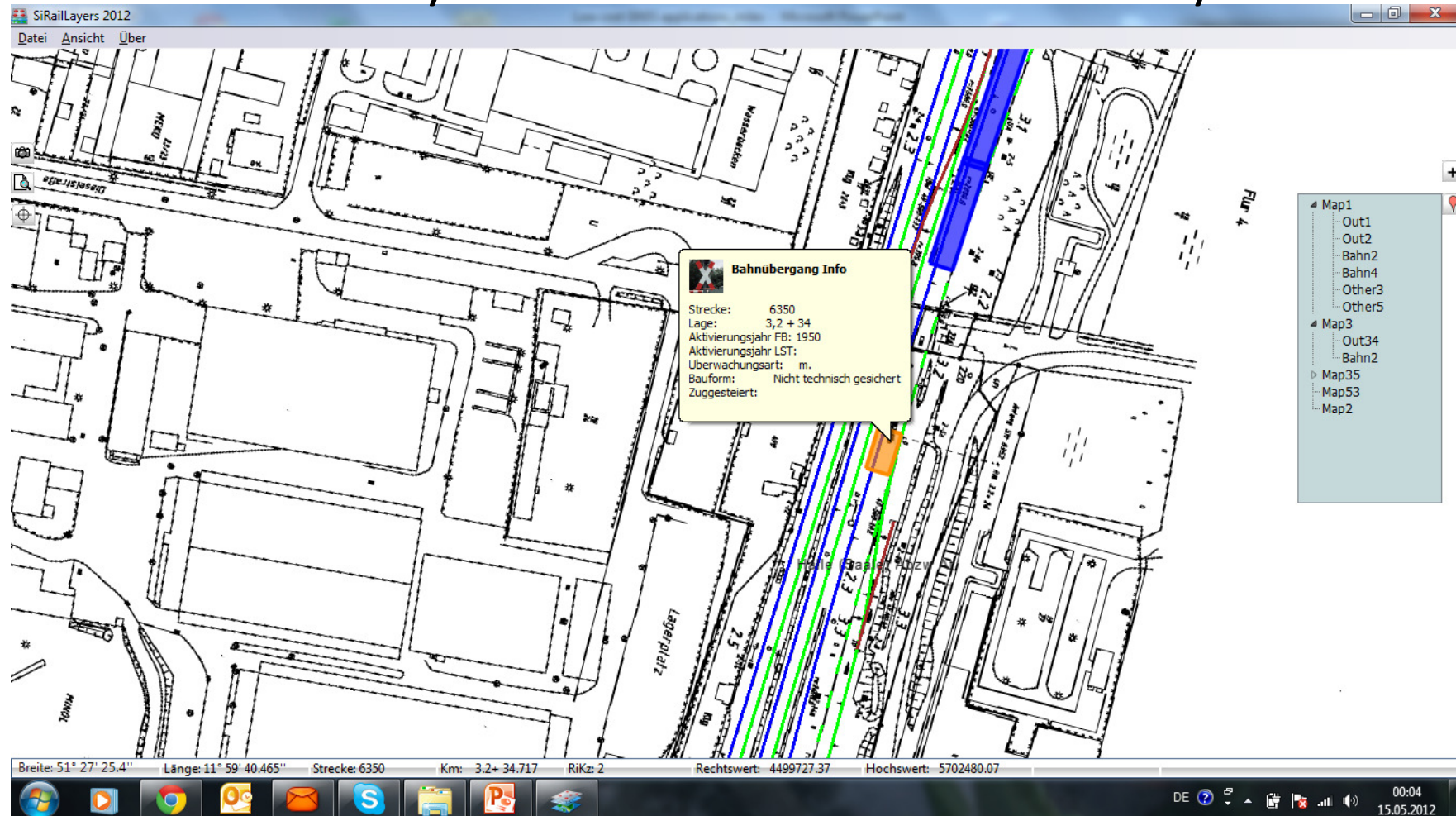
## Low cost Applications

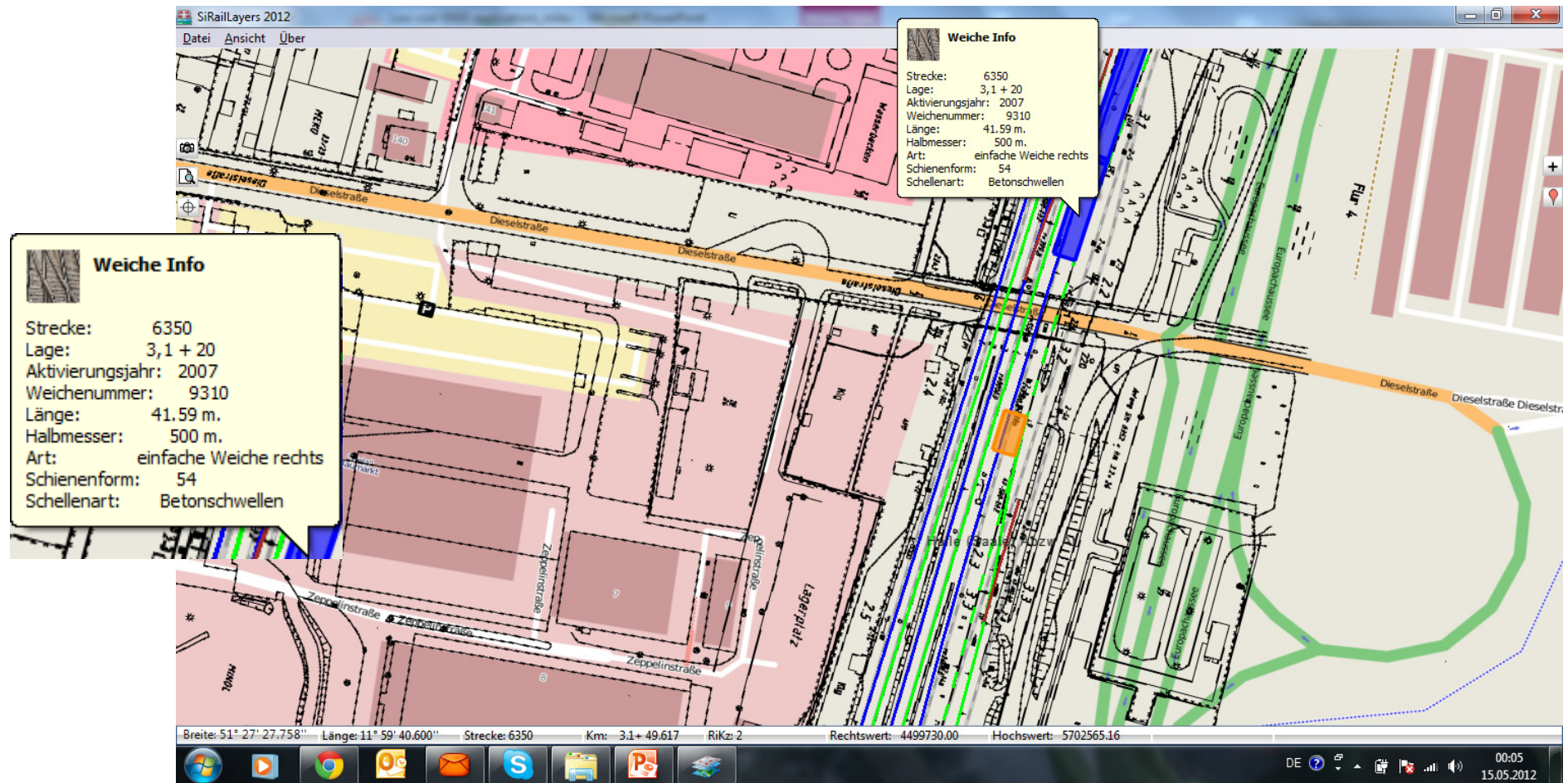
- Definition of a low cost GNSS application
- Comparison between the recorded data and real environment
- Checking some parameters against the planned position, dimension
- Status of the facilities – used or not used, conditions good or bad
- Should be simple and be used by people without special surveyor education.

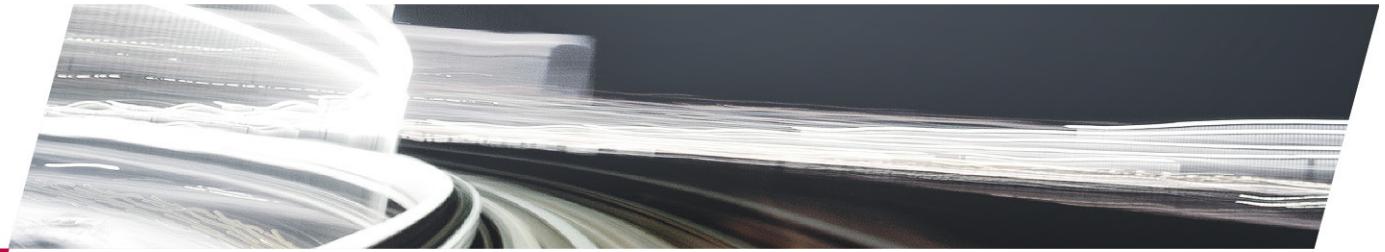
Field of use:

- Railways
- Roads
- Power supply companies

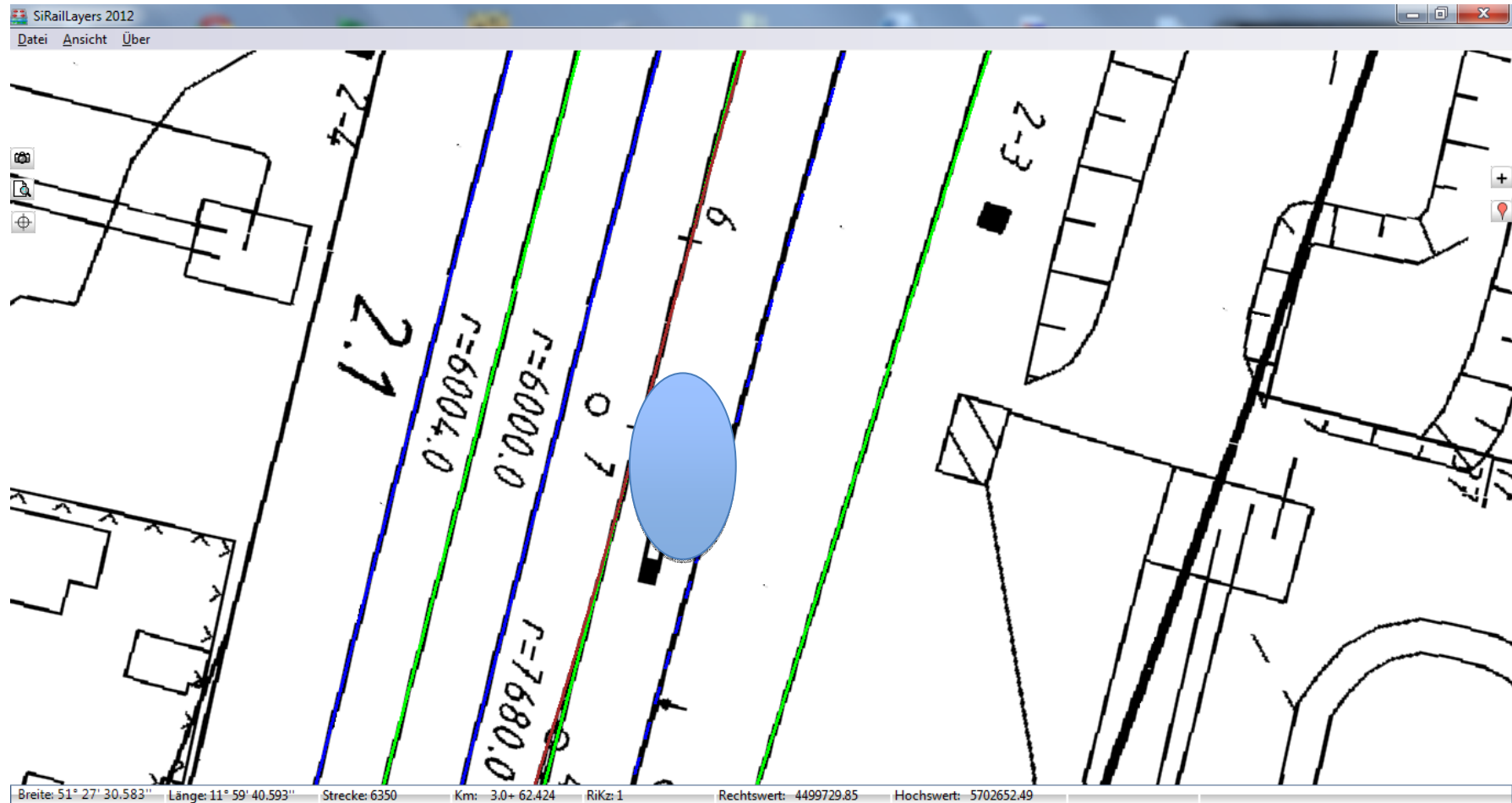
## Synchronization with the master system

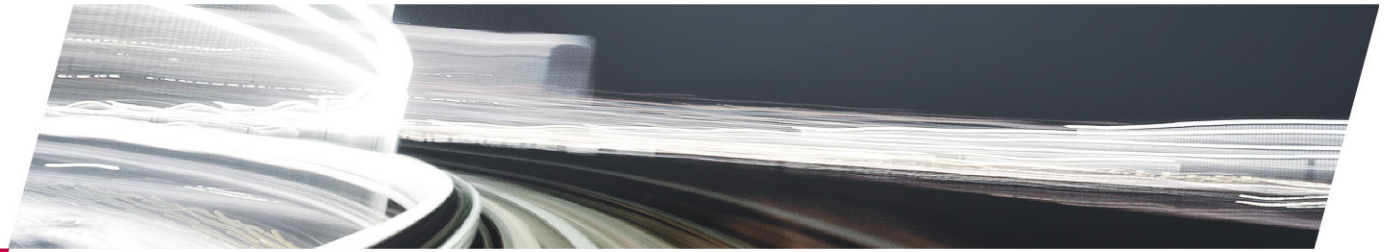




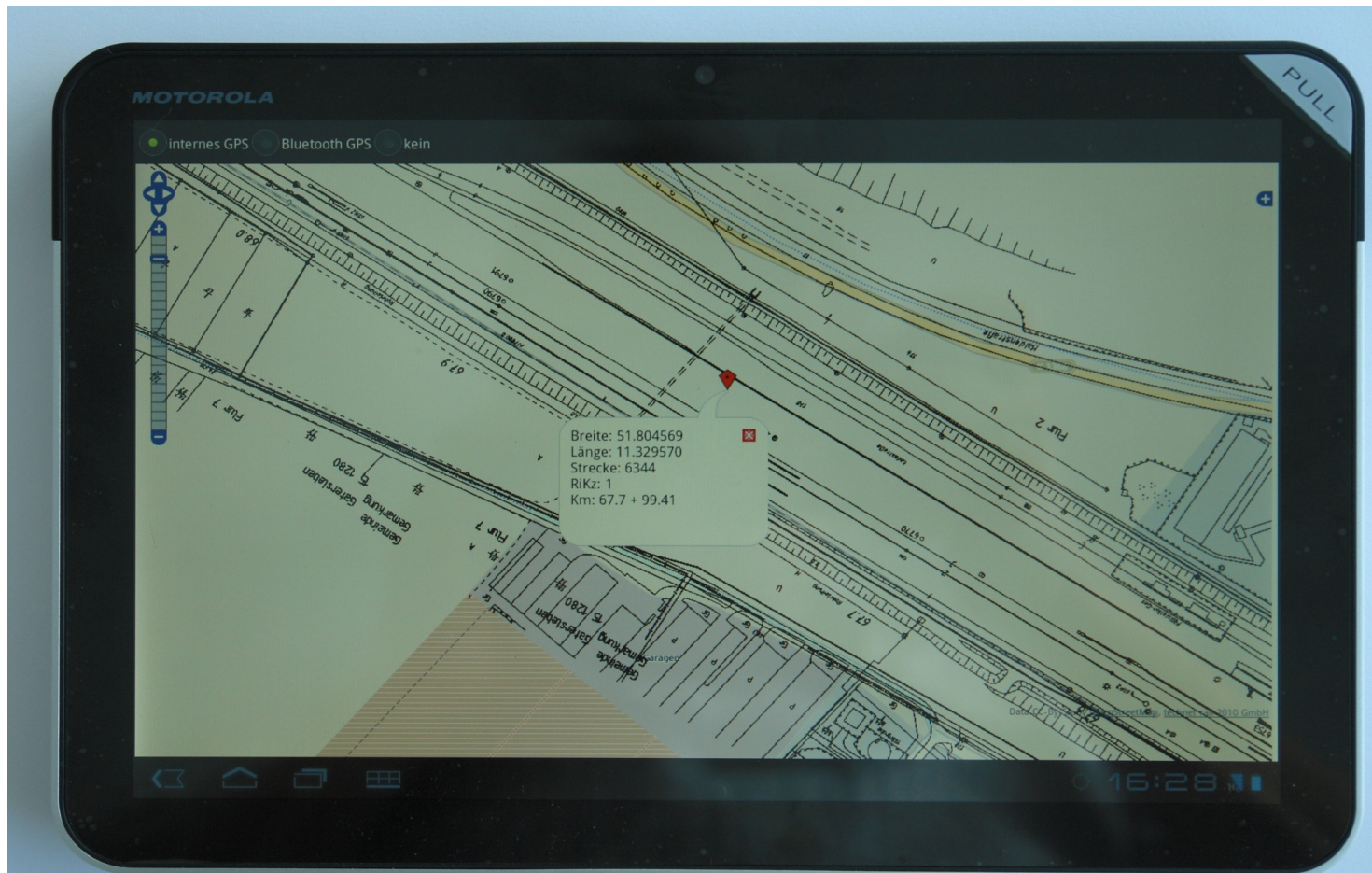


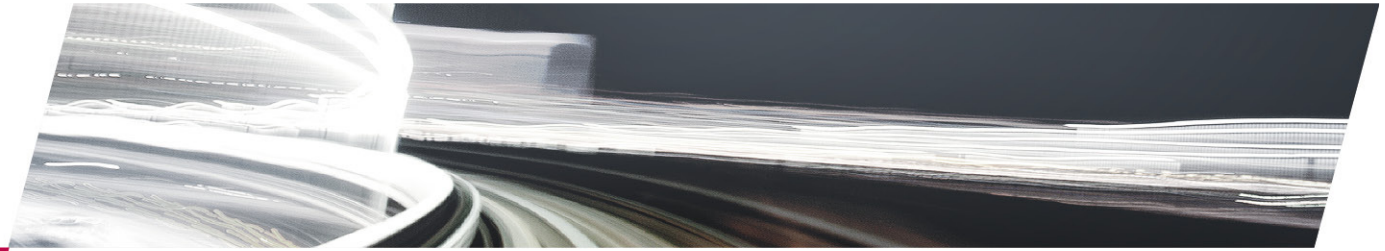
## Recording new properties or the changes



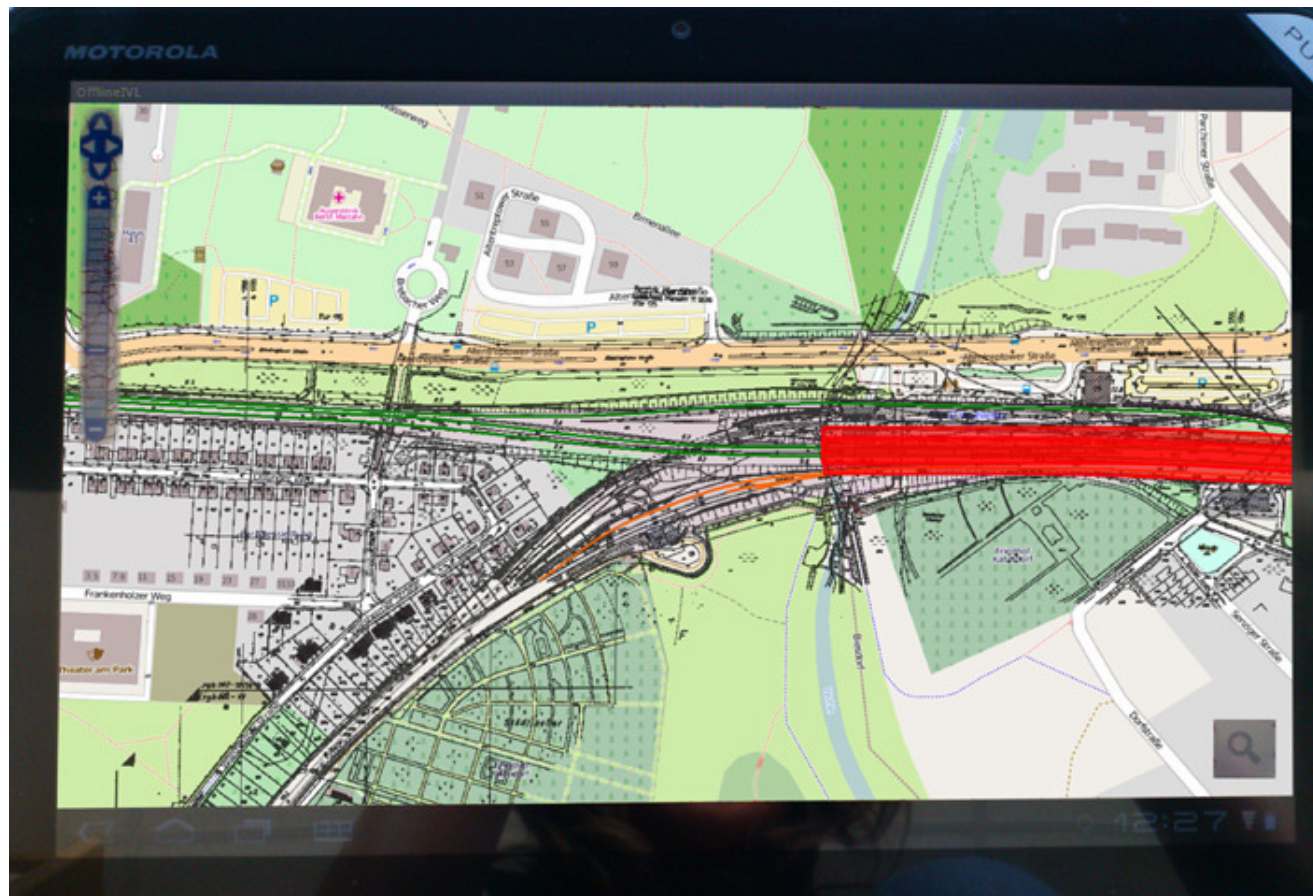


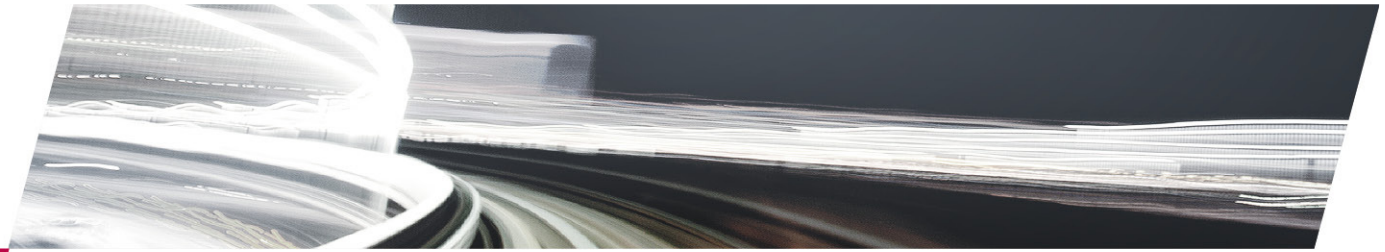
## Android based Tablet Solution





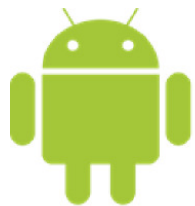
## Environmental natural preservation regions - layer





## Characteristics

- Stand-Alone Applications (App)
- Whole rail network can be stored on the SD card 32 GB
- Visualizing objects as example Crossings, Bridges, Tunnels, Switches can be addressed online but also offline
- Online und Offline Versions!



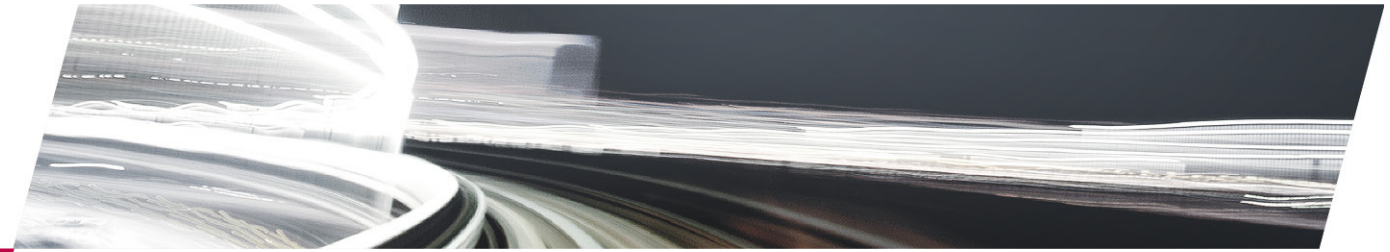
3.2 Honeycomb

4.0 Ice Cream Sandwich



## Functionality for Railway App's

- Visualizing the whole German railway network with drawings 65 000 km
- Shows the current position
- Settings for points of Interest
- Displays track and chainage or/and Coordinates
- Navigation based on maintain unit, track + chainage or Coordinate
- Extendable functionality



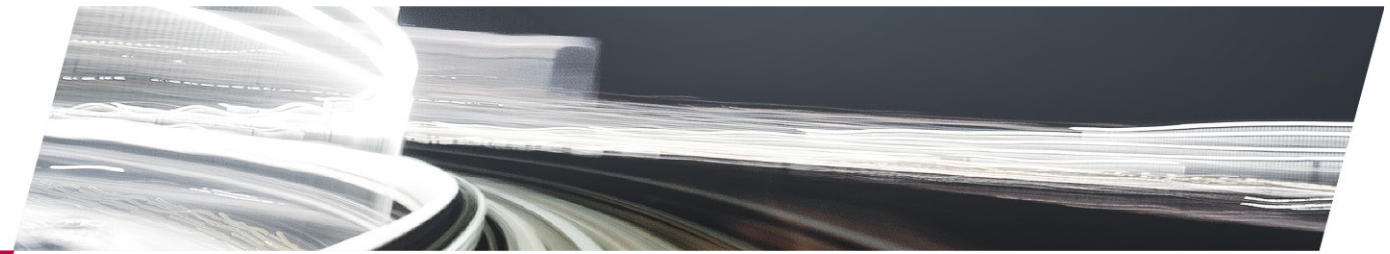
## Components

- Android unit with Application
- GNSS sensor
- Upgraded GNSS sensor
- Antenna
- Upgraded antenna



## Upgrade standard units





## Multi platform multi sensor but low cost

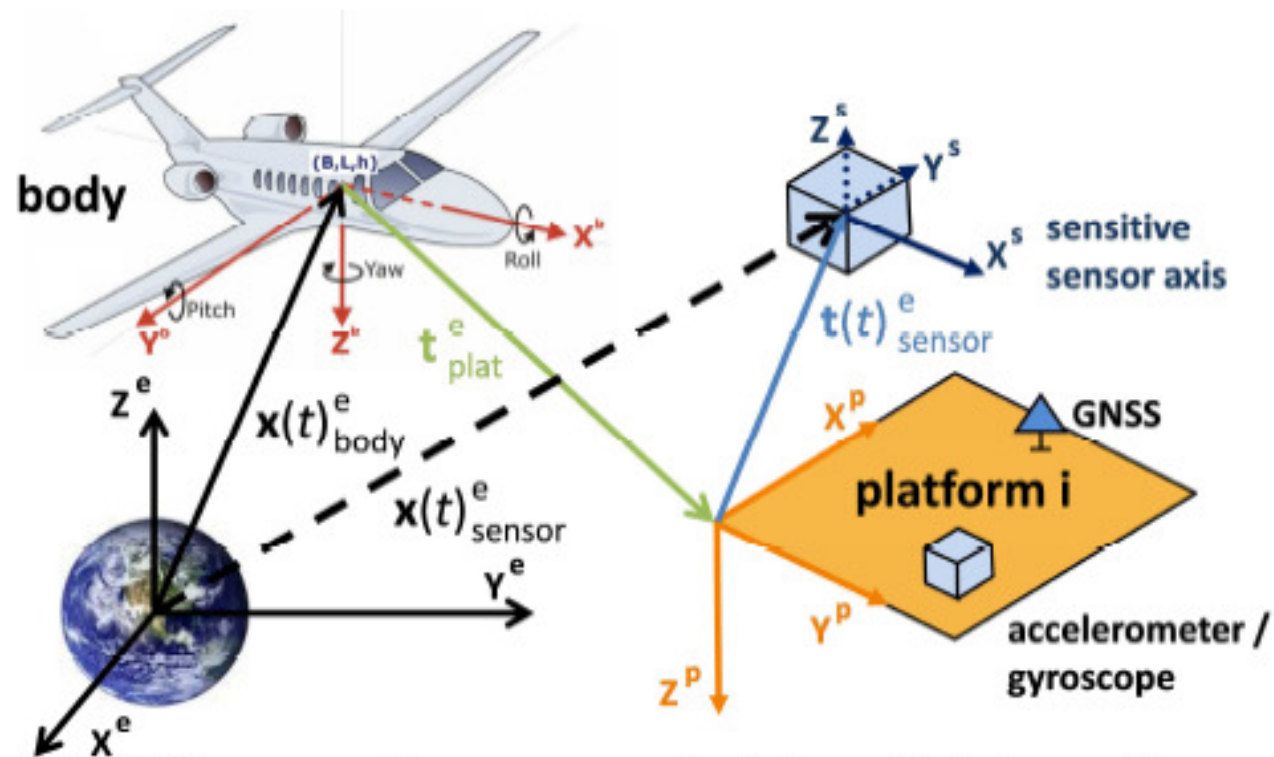
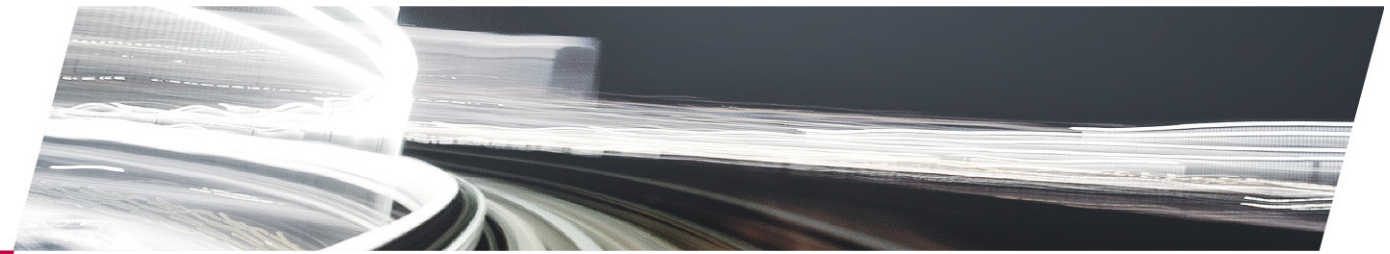
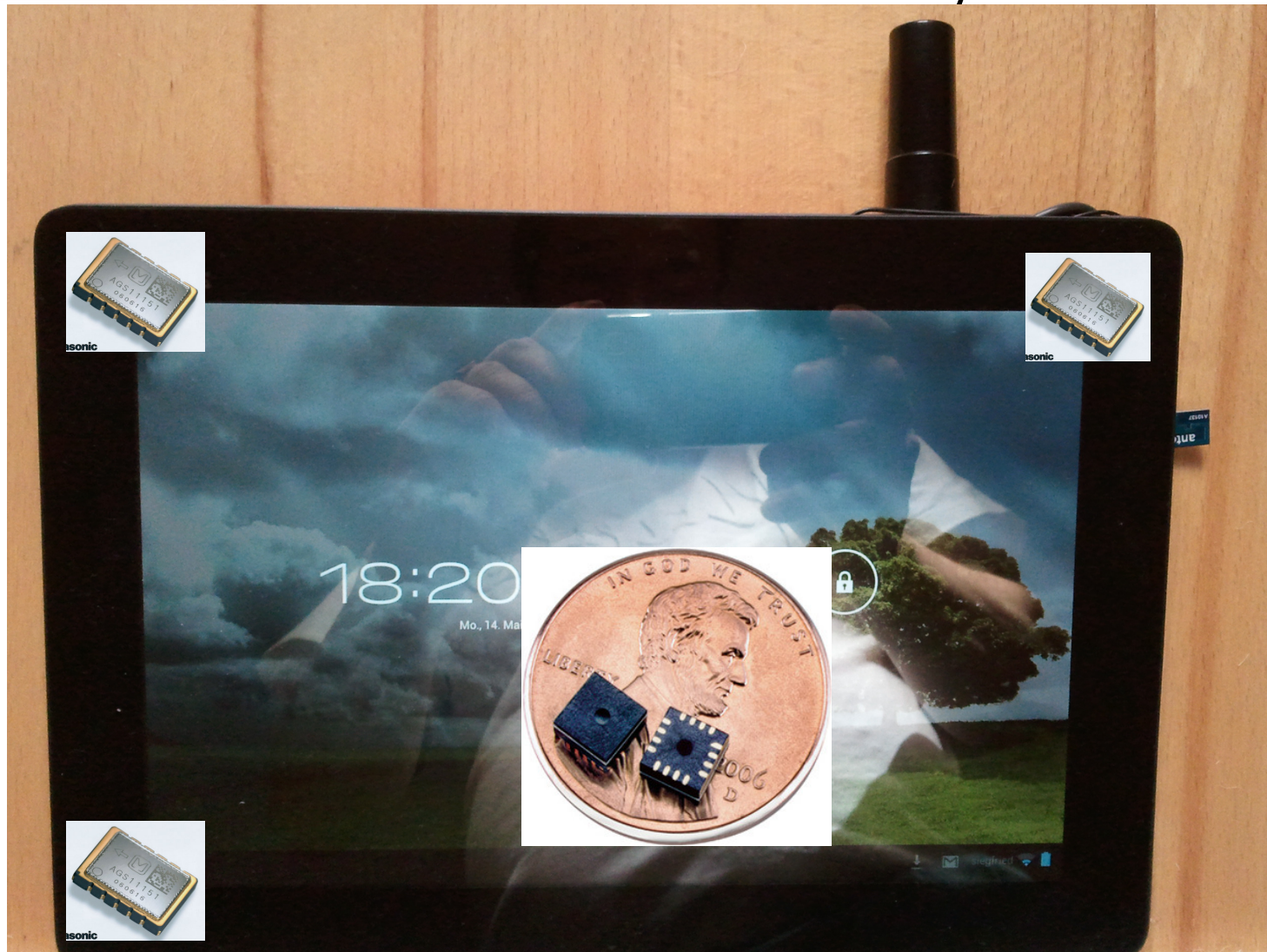
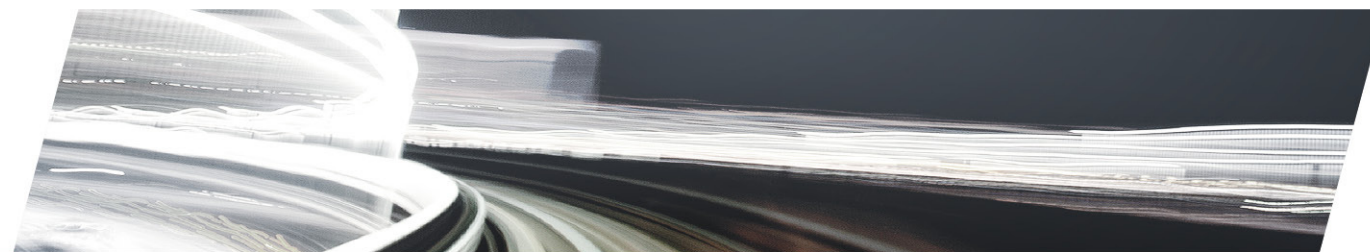


Figure 2: Geometry and lever arm parametrization in a multi-platform-multi-sensor navigation design



## Micro-Electronic-Mechanical System



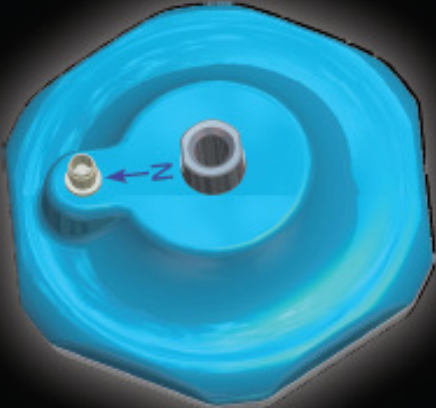


## Low cost receiver






## Low cost antenna



**3G+C**

Four Constellation GNSS Antenna  
 GALILEO | GPS | GLONASS + COMPASS



**navXperience**

FREQUENCY

E1, E2, E4, E5, E6, L1,  
 L2, L5, G1, G2  
 (GALILEO, GPS,  
 GLONASS, COMPASS)  
 1164 - 1300 MHz  
 1525 - 1610 MHz

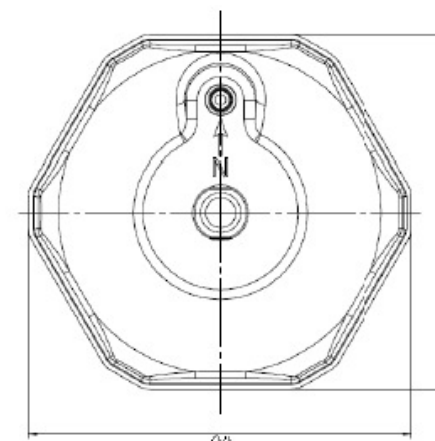
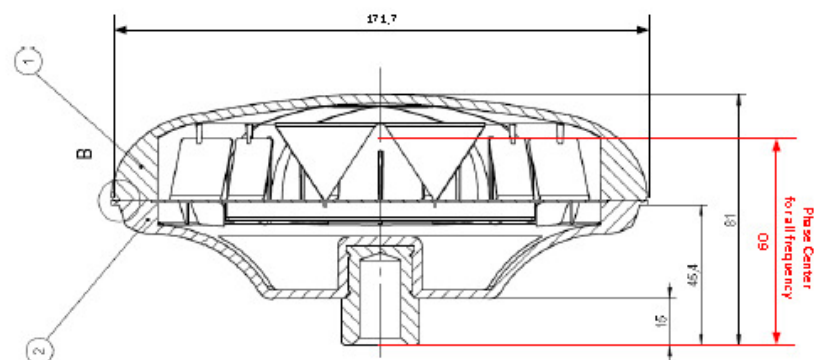


## Single Layer Technology





## 3G+C Antenna Phase Center

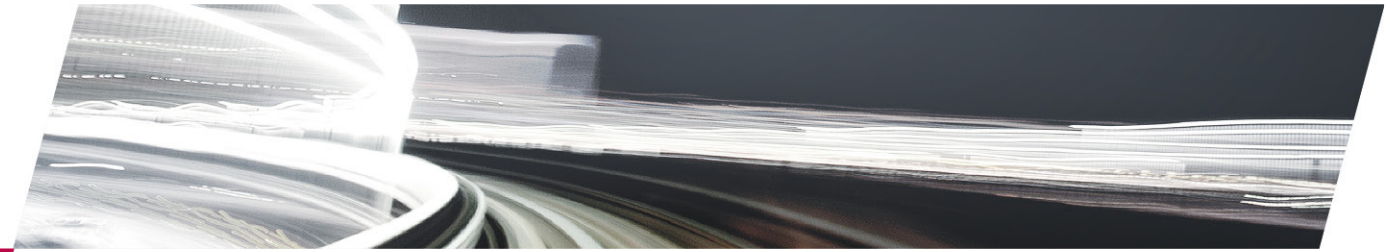


Results of the typical calibration file

IGS-Name: vxp3g+c\_\_\_\_\_none

All units in GRAD and mm

																					Phase Center		
																					North	East	Height
GPS L1	90°	85°	80°	75°	70°	65°	60°	55°	50°	45°	40°	35°	30°	25°	20°	15°	10°	5°	0°	Elevation	North	East	Height
	0.00	-0.04	-0.14	-0.25	-0.31	-0.27	-0.13	0.06	0.20	0.19	-0.01	-0.36	-0.69	-0.82	-0.59	-0.02	0.63	0.92	0.35	Offset			
GPS L2	90°	85°	80°	75°	70°	65°	60°	55°	50°	45°	40°	35°	30°	25°	20°	15°	10°	5°	0°	Elevation	North	East	Height
	0.00	-0.05	-0.19	-0.40	-0.69	-1.04	-1.45	-1.83	-2.06	-1.94	-1.37	-0.40	0.68	1.43	1.45	0.70	-0.29	-0.46	1.44	Offset			
GLONASS L1	90°	85°	80°	75°	70°	65°	60°	55°	50°	45°	40°	35°	30°	25°	20°	15°	10°	5°	0°	Elevation	North	East	Height
	0.00	-0.03	-0.12	-0.23	-0.31	-0.31	-0.22	-0.03	0.18	0.28	0.19	-0.09	-0.43	-0.65	-0.54	-0.03	0.66	1.08	0.62	Offset			
GLONASS L2	90°	85°	80°	75°	70°	65°	60°	55°	50°	45°	40°	35°	30°	25°	20°	15°	10°	5°	0°	Elevation	North	East	Height
	0.00	-0.06	-0.30	-0.58	-0.91	-1.24	-1.60	-1.98	-2.28	-2.32	-1.96	-1.16	-0.14	0.68	0.85	0.21	-0.83	-1.24	0.30	Offset			



Low cost  $\neq$  Low quality

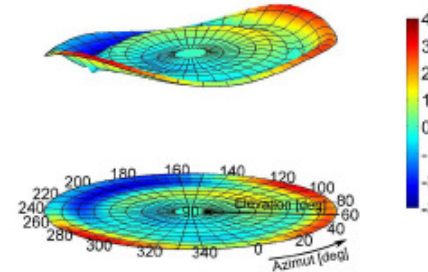
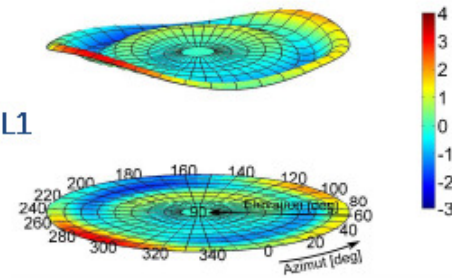
Plots



GPS

GLONASS

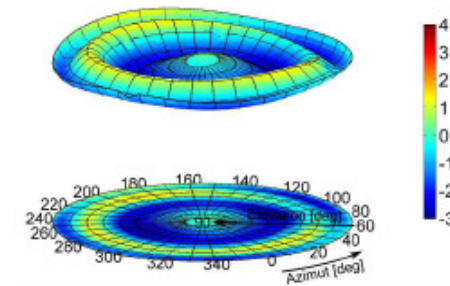
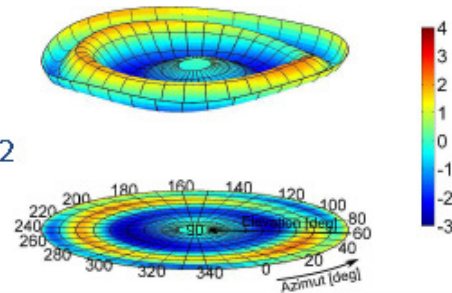
L1



These plots show the phase center variation for GPS and Glonass L1 and L2.

All Units mm

L2





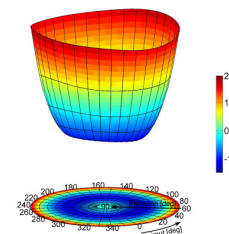
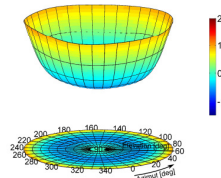
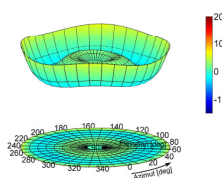
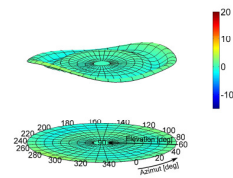
3g+C\_ (NAX3G+C)

Leica\_AR25\_(LEIAR25)

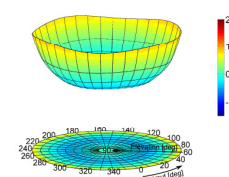
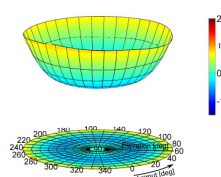
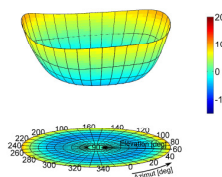
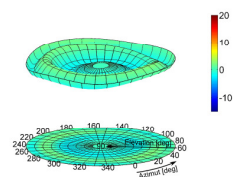
Trimble\_Chokering\_antenne\_(TRIM59900.00)

Topcon\_CR-G3\_(TPSCR.G3)

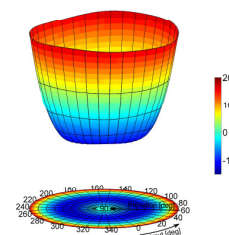
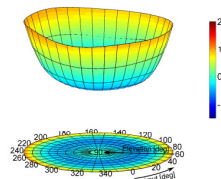
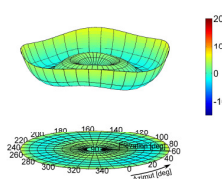
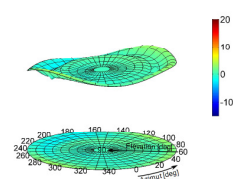
G01\_L01



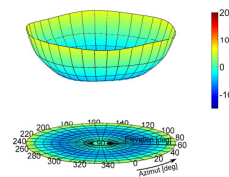
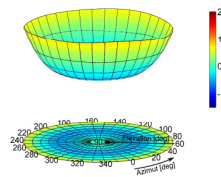
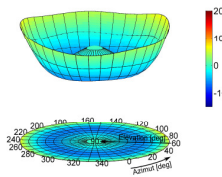
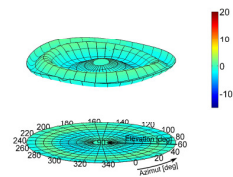
G02\_L02



R01\_G1



R02\_G2





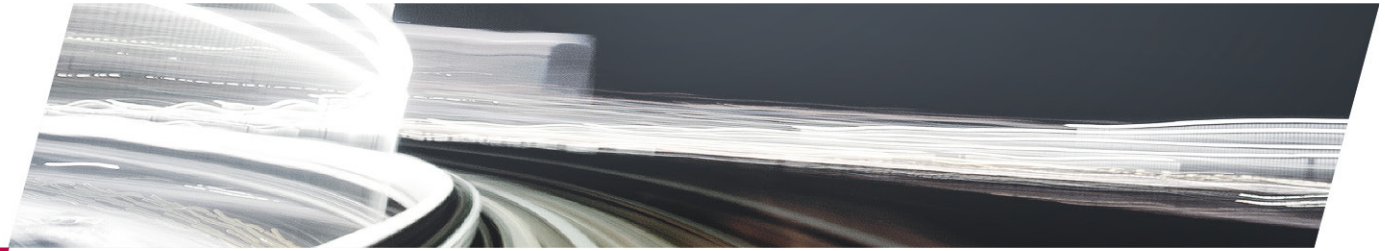
### Сельское хозяйство

В сельском хозяйстве нужны устойчивые к внешним воздействиям антенны. Отличающаяся высокой прочностью антенна „3G+C“ - идеальный выбор. Возможность приема всех сигналов ГНСС и их коррекции SBAS, WAAS, EGNOS, Omnistar и Beacon сделали антенну „3G+C“ универсальной для точного земледелия. Все сказанное в предыдущих разделах относительно положительных свойств антенны „3G+C“ применительно и к использованию в сельском хозяйстве.



### Машинное управление

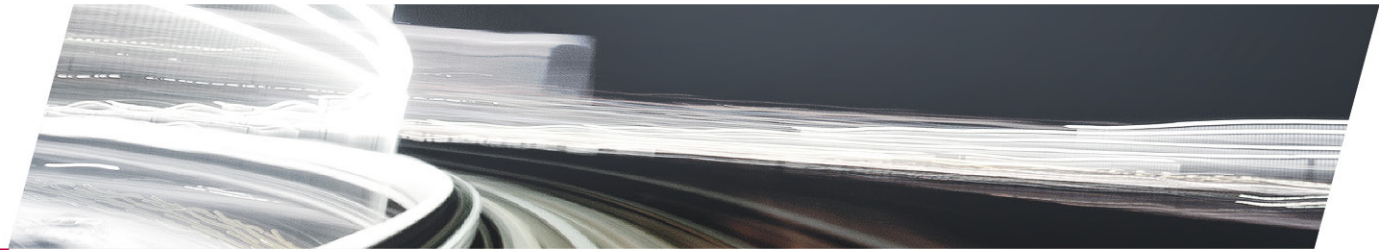
Антенна „3G+C“ весом всего 380 г способна безотказно работать в самых экстремальных условиях. Она стойка к вибрациям, ударам и случайным ускорениям. Установлена ли антенна „3G+C“ на грейдере, экскаваторе или гусеничном тракторе - всегда можно быть уверенным в стабильной работе антенны. Антенна „3G+C“ прошла аттестацию на давление до 2,5 бар. Проникание влаги и пыли абсолютно невозможно.



## Program design

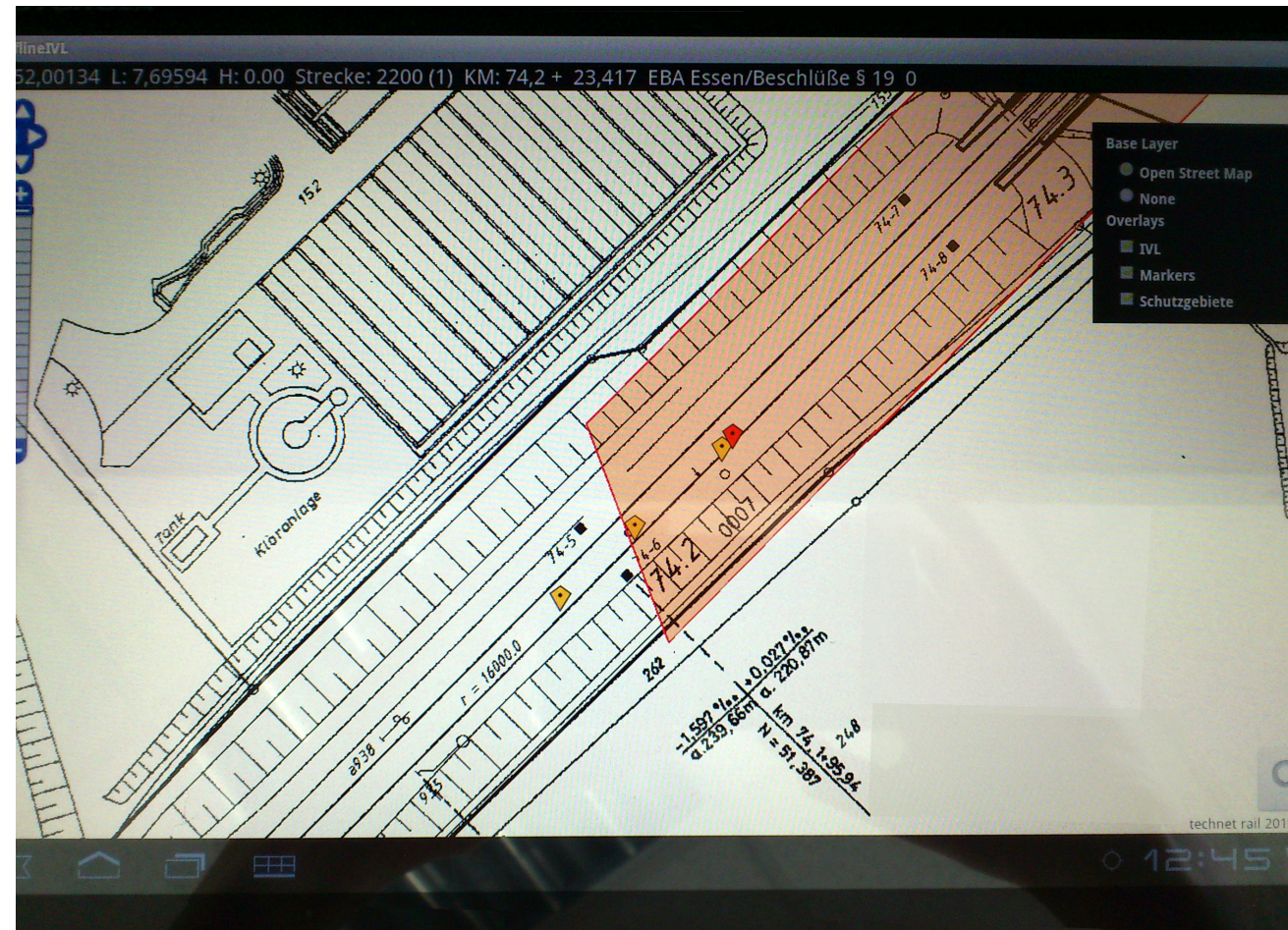
- Base-Map Layer
- Shows main and railstation tracks  
Drawings
- Navigation

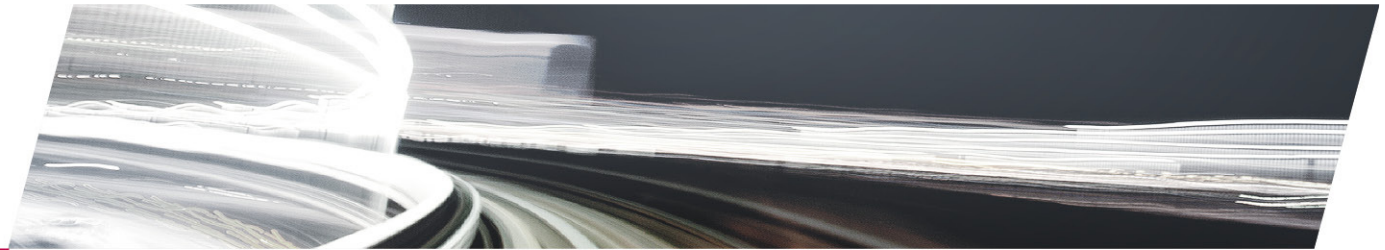




## Program level


- Displays the position with a marker
- Information about track and chainage
- Displays environment protected areas








## Navigation

13,59754 H: 0.00 Strecke: 6007 (2) KM: 15,2 + 65,204

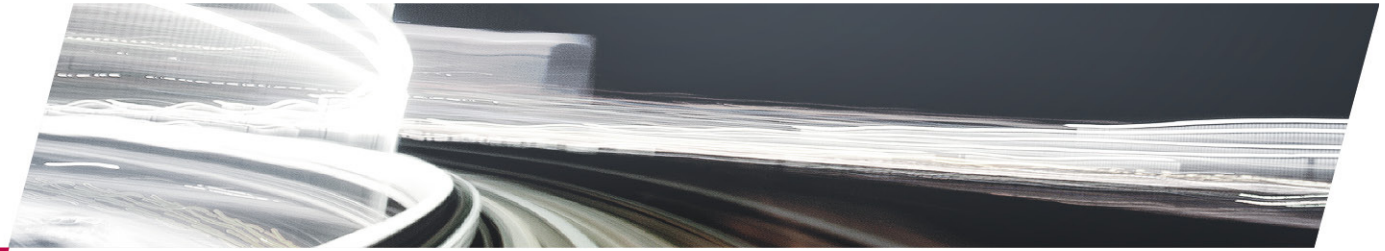
Betriebsstelle:  

Breite:  

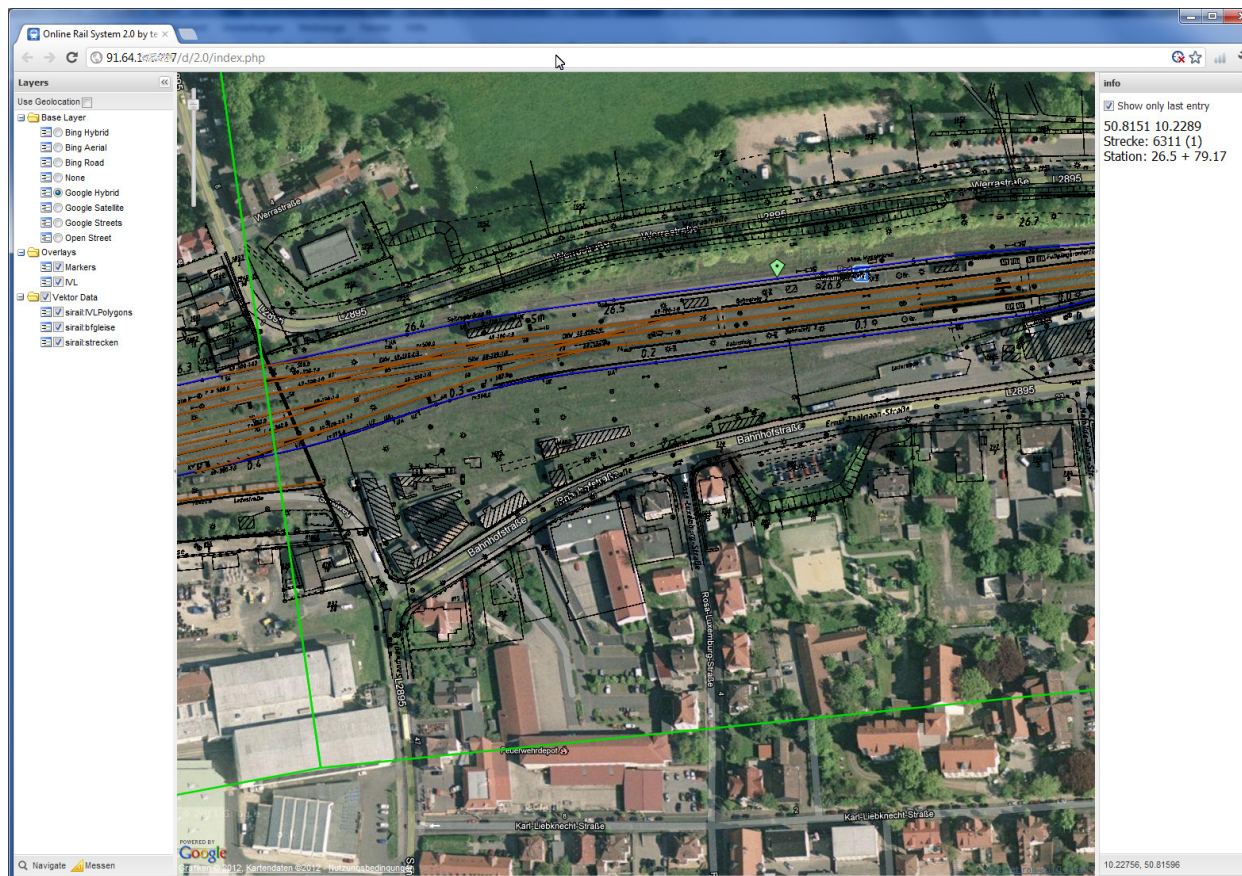
Länge:  

Strecke:  KM:  

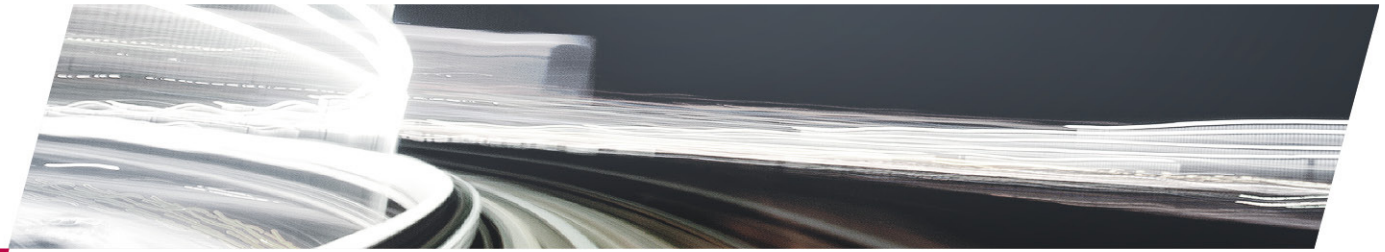
1 2 3



## Web-Solution



- Different Basis-Layer
- IVL Drawings
- Track data
- Navigation
- Points of Interest
- Mesuring fuction  
distances and area



## Conclusions

- Using the App architecture becomes most popular
- Different strategy of development as the high end program systems
- Low cost Multi-sensor systems
- Low cost App's are the future for personal devices
- Off and Online versions – as example SBAS for corrections



Thank You!

Aus Daten werden Lösungen.