

SAPOS®

A modern Reference- Network System An example for Europe



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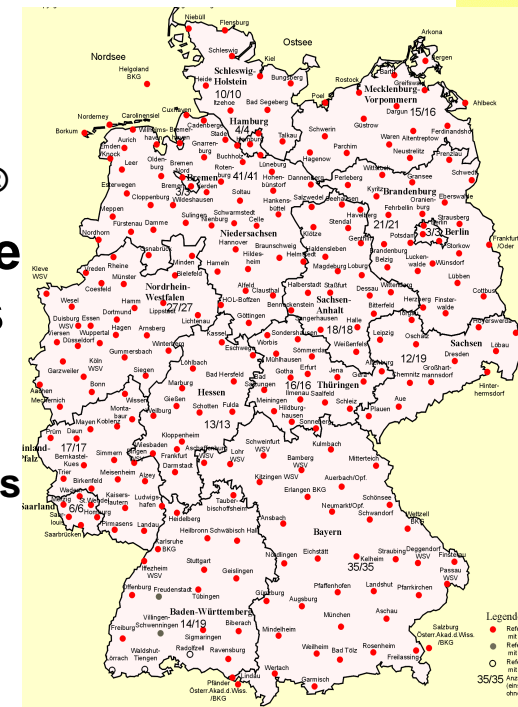
- Central bureau SAPOS®
- SAPOS® as active Reference-System
- Traditional or active Reference-System
- System definition and Services
- Technical issues
- User benefits, Costs
- Conclusions

Central Bureau SAPOS®

- Partner for customers working German country far
- Located in Hannover, Lower Saxony
- Collecting and providing Data
- Co-ordination (marketing)
- Data-Exchange between the states
- International collaboration (RTCM SC 104)

SAPOS® reference stations

250 stations



SAPOS® System Definition



3D active reference system

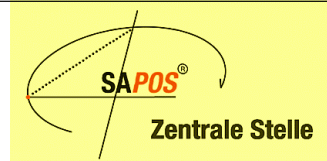
- Substitute for terrestrial network
- User accuracy 1-2 cm
- Defined reference frame (ETRS89)
- Overall coverage
- Realtime and Post-Processing
- Full 24-hour Service
- Replacement of the Users Base-Receiver

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Traditional or active Reference-System



Traditional network

- 6 to 10 points per km²
- For a state with 50000 km²
 - 300000 - 500000 points
 - Costs per point in Germany 500 €
 - Investment > 200 million €
- Not included: controlling and maintenance

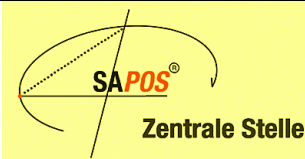


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Traditional or active Reference-System



Active Reference-System

- Investment of less the 1 / 10
- Cheaper controlling and maintenance
- Step into the digital age
- High accuracy in all areas
- 3D System

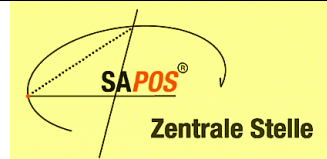


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The SAPOS® - Services



| | |
|-------------|---|
| EPS | Real-time Positioning Service Accuracy 1-3 m; real-time applications |
| HEPS | High Precision Real-time Positioning Service Accuracy 1-2 cm; real-time applications |
| GPPS | Geodetic Precision Positioning Service Accuracy 1 cm; post-processing applications |
| GHPS | Geodetic High Precision Positioning Service Accuracy < 1 cm; post-processing applications |

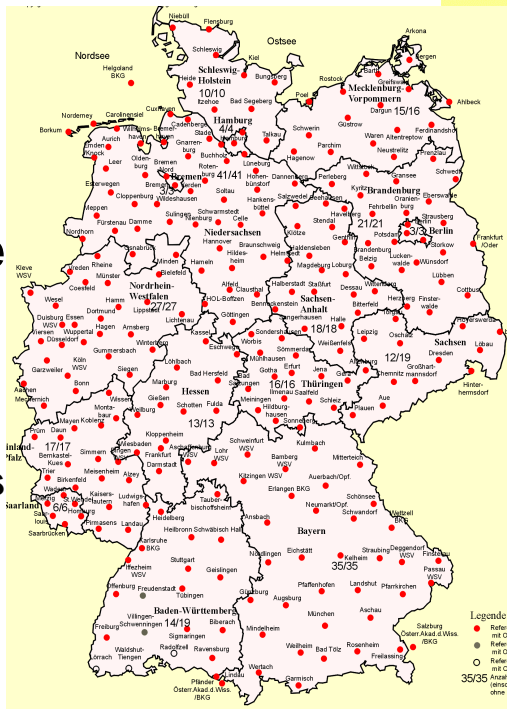
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SAPOS® reference stations

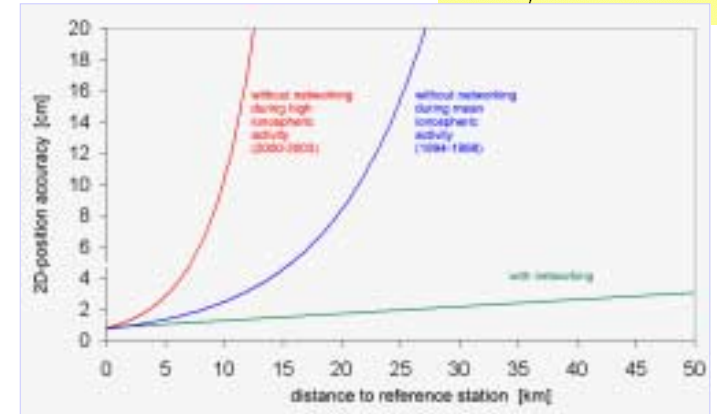
250 stations



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Networking



Realtime
Network
Computation

- Orbits
 - Ionosphere
 - Troposphere
- Quick initialization
 - High accuracy
 - Quality management

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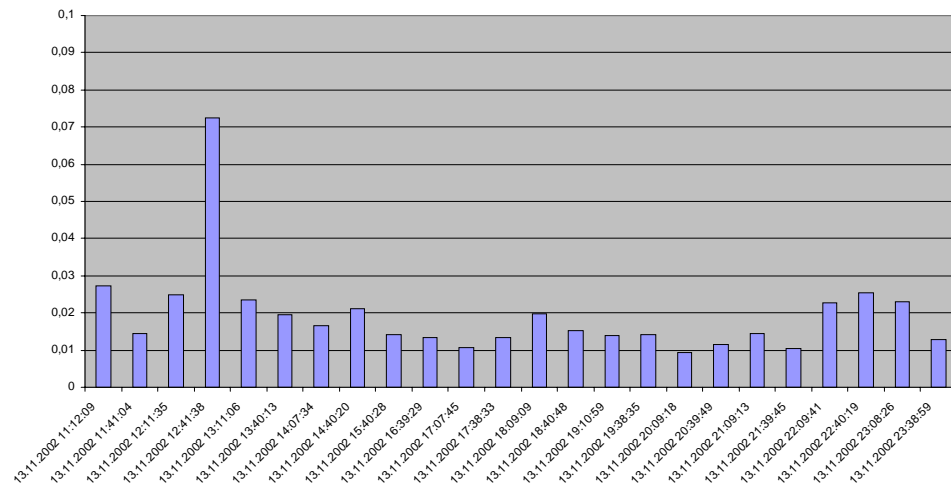
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Accuracy



mittl. dS Fix [m]



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SAPOS® Standards



- SAPOS® - Obligations
 - Realtime Networking
 - Transfer media: GSM
 - Data format: RTCM 2.3 (not encoded, uncompressed)
 - Area correction parameters (FKP)
- SAPOS® - Options
 - Transfer media: 2m Radio
 - Data format: RTCM-AdV (encoded, compressed)
 - Virtual reference station (VRS)

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SAPOS® customers



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Ship transfer on Ems river with SAPOS®



Reference System and Transformation



- Reference System of SAPOS®: ETRS 89
- The official state coordinate system today is not the same as the reference system of SAPOS®
- Spatial transformation parameters needed
 - The results have to be transformed
 - ➔ Pre-calculation is possible (due to well defined reference frame)
 - ➔ Physical heights are obtained by using Geoid models or local Transformation-Parameters

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User benefits



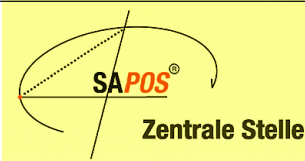
- Flexible measurement method
- Well defined coordinate-system
 - Transformation could be performed easily
 - Measuring of identical points unnecessary
- Coordinate-determination and peg out
- One man unit possible
- Gain of time and money

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Costs



Example 1 (One Point)

HEPS Costs

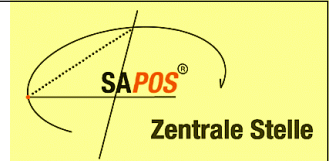
| Dienst | Taktrate | Einheit | Gebühren |
|-----------|--------------------------------------|----------------------|----------------------------------|
| EPS | 3 - 5 Sekunden 1 Sekunde | entfällt 1 Jahr | einmalig bei Gerätekauf 150 € |
| HEPS | 1 Sekunde | 1 Minute | 0,10 € |
| GPSS/GHPS | 1 - 15 Sekunden kleiner 1 Sekunde | 1 Minute 1 Minute | 0,20 € 0,80 € |

1 Minute per Initialization → 0.10 €
 x 6 → 0.60 €
 = 0.60 €

GSM-Costs

0.0639 €/Min. x 6 → 0.38 €
 One Point 0.98 € ≈ 1 €

Costs



| Dienst | Taktrate | Einheit | Gebühren |
|-----------|--------------------------------------|----------------------|----------------------------------|
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| HEPS | 1 Sekunde | 1 Minute | 0,10 € |
| GPSS/GHPS | 1 - 15 Sekunden kleiner 1 Sekunde | 1 Minute 1 Minute | 0,20 € 0,80 € |

Example 2 (Continues Measurement)

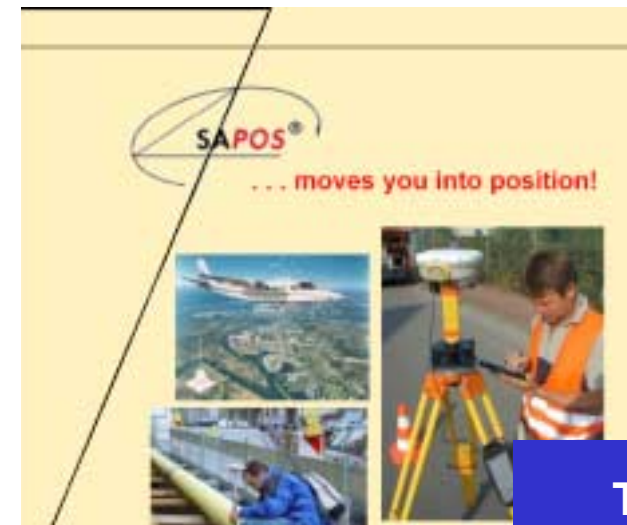
1 hour SAPOS®-HEPS

60 Minuten x 0,10 € => 6,00 € (+ GSM)

Conclusions



- SAPOS® is a model for Europe
- Relations to other european Countries are established
- Financial matters must be cleared
- International steering is necessary



**Thank you
for your attention**