

Some remarks from SAPOS® Operators using

# GPSNet

of the representatives of state survey authorities

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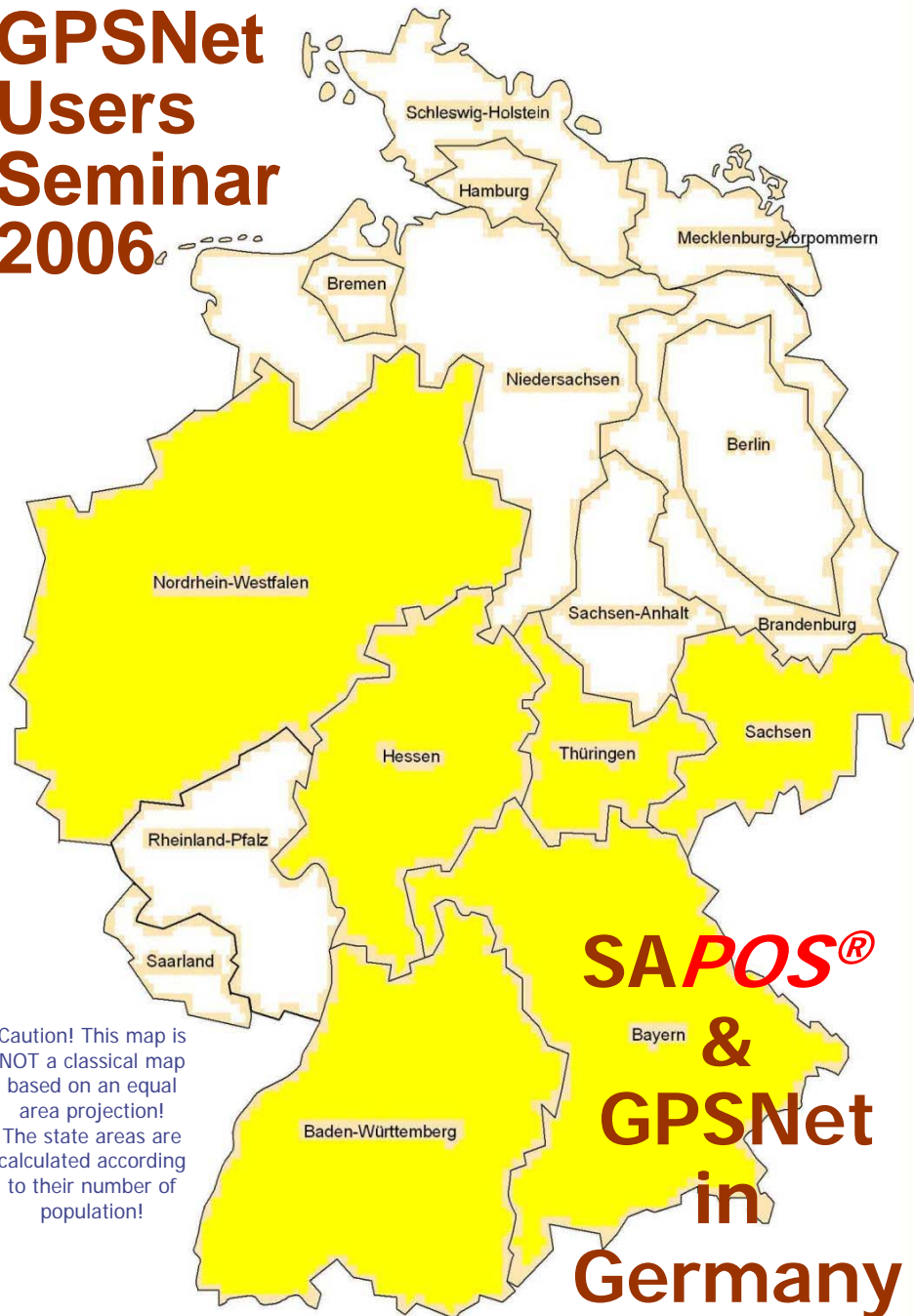
**Christian Trautvetter**, Thüringen (TH),

**Grit Moosdorf**, Sachsen (SN)

**Trimble GPSNet Users Seminar**

**Munich, May 30-31, 2006**

# GPSNet Users Seminar 2006



Caution! This map is NOT a classical map based on an equal area projection! The state areas are calculated according to their number of population!

## The Satellite Positioning Service **SAPOS®**

- is a joint project of the Working Committee of the Surveying Authorities of the 16 responsible States of the F.R.G. (**AdV**)
- since 1996
- for nationwide provision and marketing of **SAPOS®** data the so called “Central Bureau **SAPOS®**” in Hannover was established in 2003

## **SAPOS®** product description

- enables the states to provide a unique service

## **SAPOS®** GPSNet Users

- cover  
55% of the area of Germany  
65% of the population of Germany

# AdV politics

## current resolutions

- Ntrip will become a SAPOS<sup>®</sup> standard
  - ◆ recommended as test installation
  - ◆ is offered already today by most states
- RTCM 3.1 will become a SAPOS<sup>®</sup> standard
  - ◆ with network message 1014 – 1017 (MAC)
  - ◆ with Non-physical reference station 1005, 1006 (former VRS)
- Ntrip and RTCM 3 will be introduced combined in one go to reduce the diversity of service variants
- RTCM 3 + Transformation Message

## future plans

- improvement of rover performance by use of external information
  - ◆ ionosphere, troposphere



# Transformation packages of the 16 states

## ◆ the states offer own modules

- BY:  
every new customer purchases the „LSKS/Geoid-Modul“
- BW, HE, RP and SL:  
DFHRS (Digital Finite Element Height Reference Surface) und ggf. DFCRS / CoPaG (Digital Finite Element Coordinate Reference System / Continuously Patched Georeferencing) of the University of Applied Science Karlsruhe
- NW, SN, TH:

## ◆ AdV prepares an unique module

- ◆ a unique AdV module with decimeter accuracy in an array of 10 x 10 km is in preparation, will be available by Zentrale Stelle SAPOS®





# Future GNSS integration: Galileo

- ◆ AdV has installed a project group which deals with SAPOS® and Galileo
  - SAPOS® will be open to all GNSS
    - ◆ GPS, Galileo, GLONASS
  - participation in Galileo Testbed GATE
    - ◆ research and tests
  - early acquisition of receivers
  - the conditions under which Galileo signals can be processed and resold by position services like SAPOS® are yet to be defined
  
- Nutzung weiterer GNSS-Signale (GPS/L2C und L5, Glonass und natürlich Galileo)
- Irsen liefert Infos





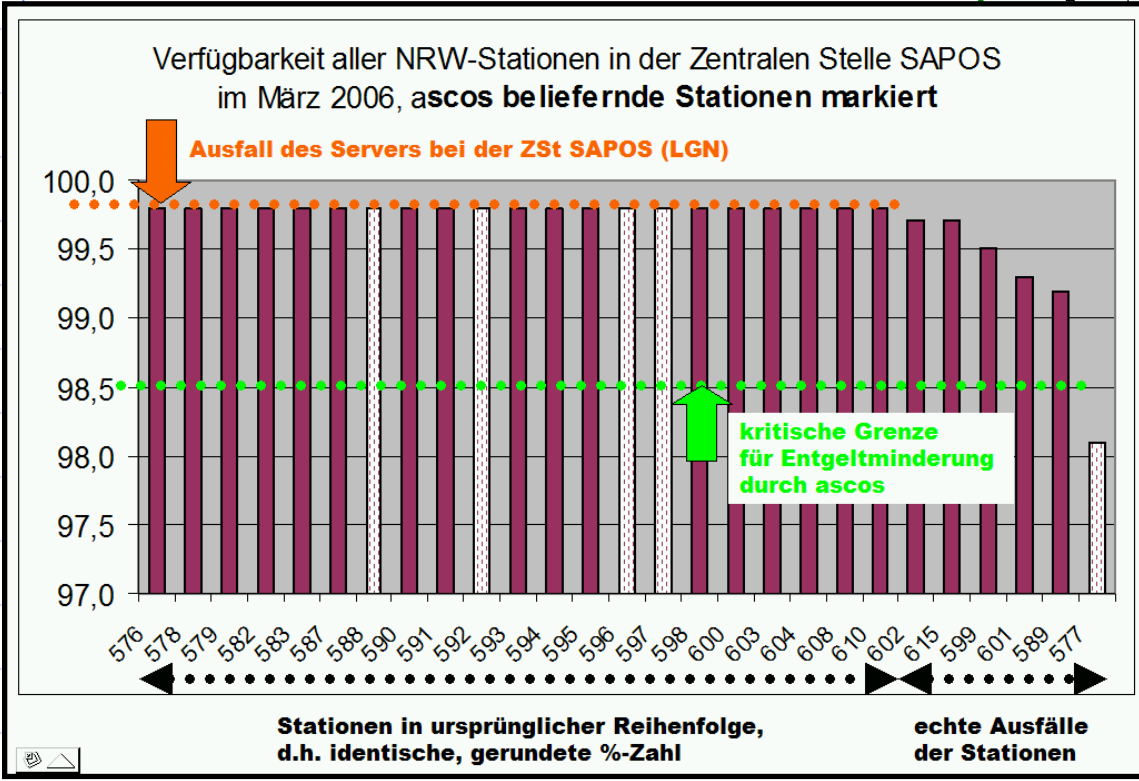
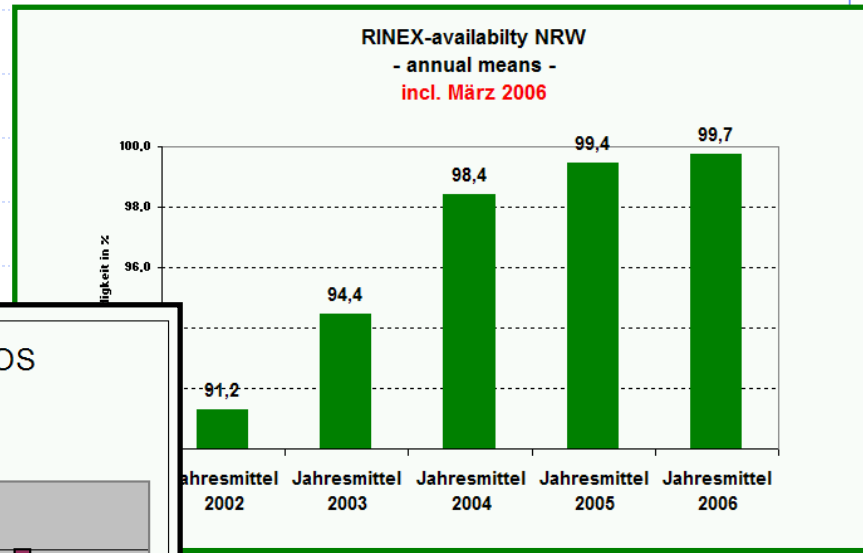
# System availability improvement

- ◆ redundant servers
- ◆ line relay
- ◆ backup connections
- ◆ alarming functions
- ◆ storage integrity

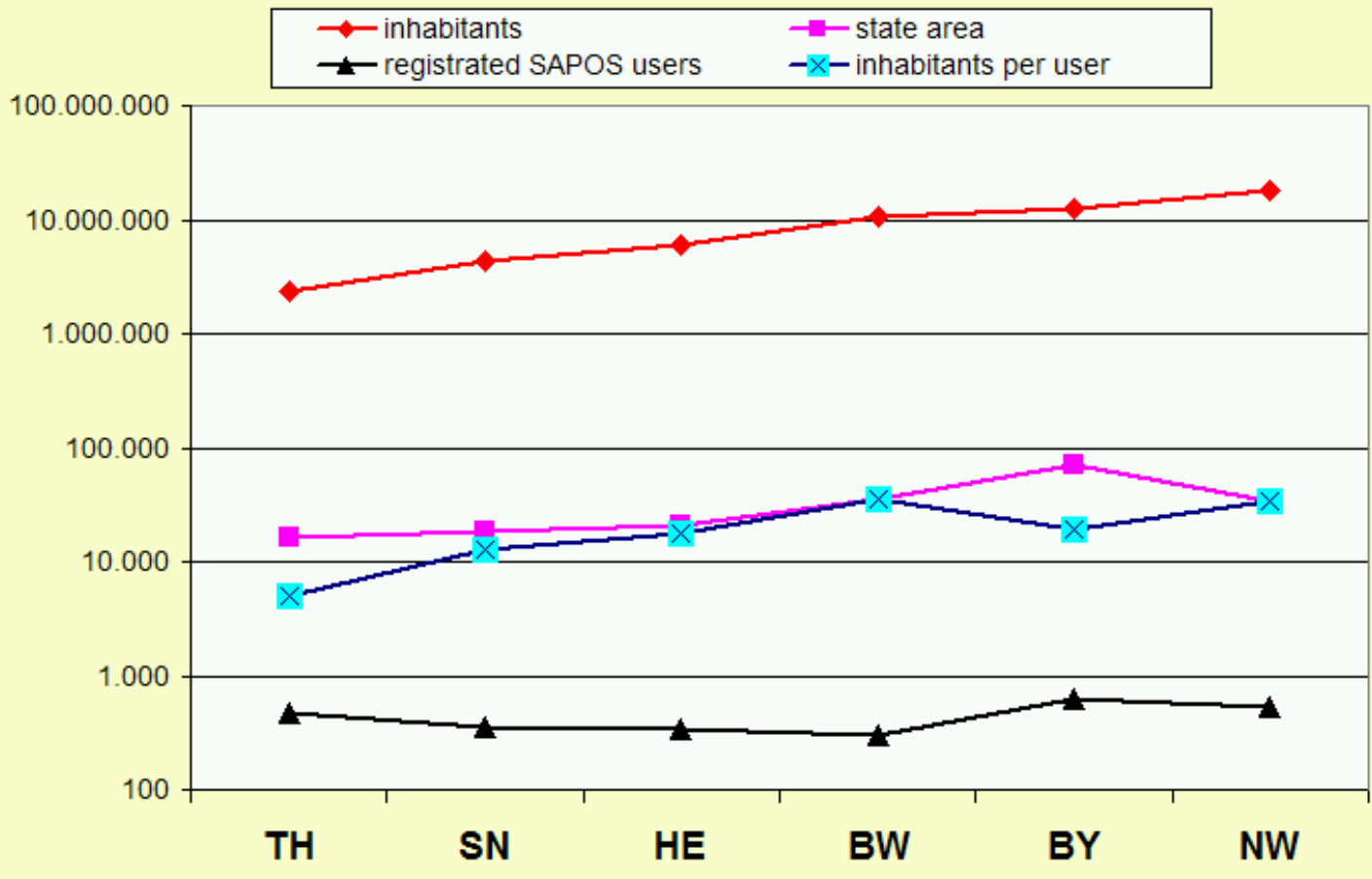


# System availability improvement

◆ high availability proved by statistics



## Population, state area, registered SAPOS users



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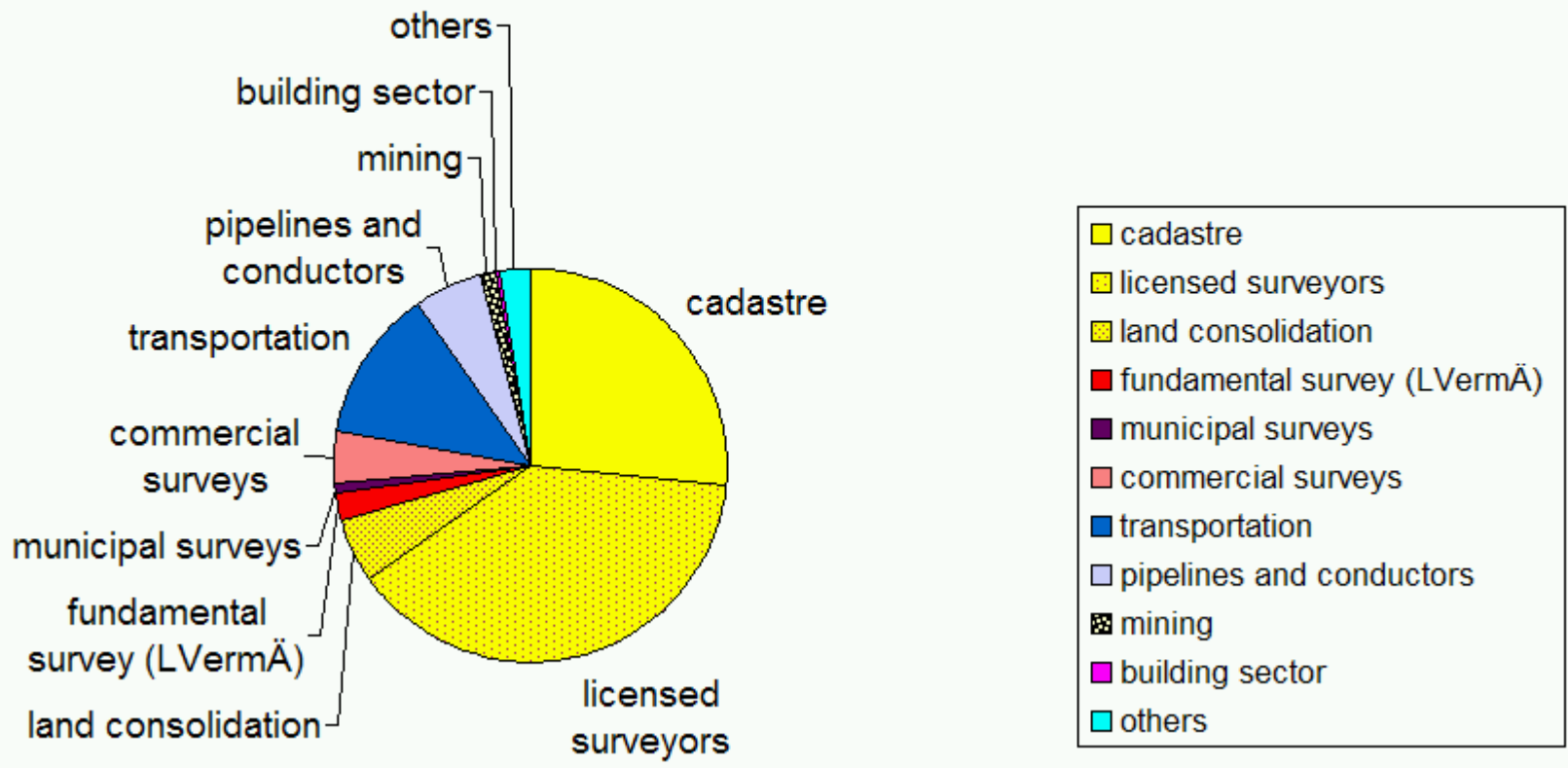




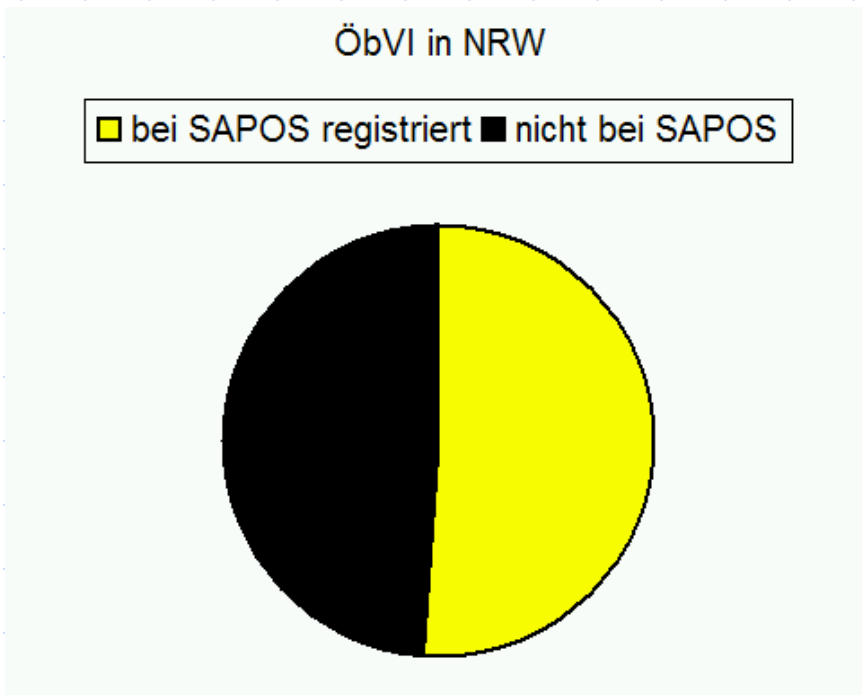


# SAPOS® users

## Customers of real time service SAPOS NRW HEPS 2005



- ◆ percentage of registered licensed surveyours (Öffentlich bestellte Vermessungsingenieure ÖbVI)

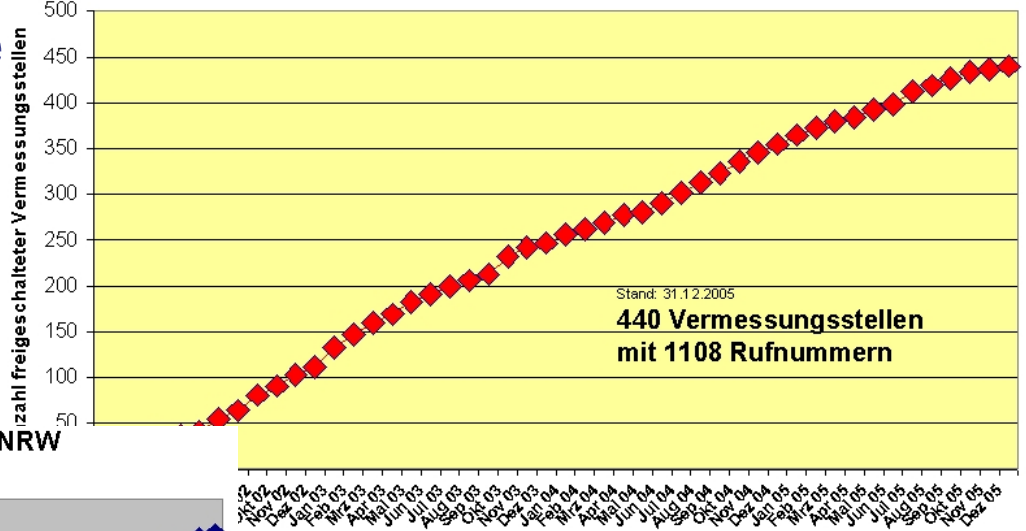




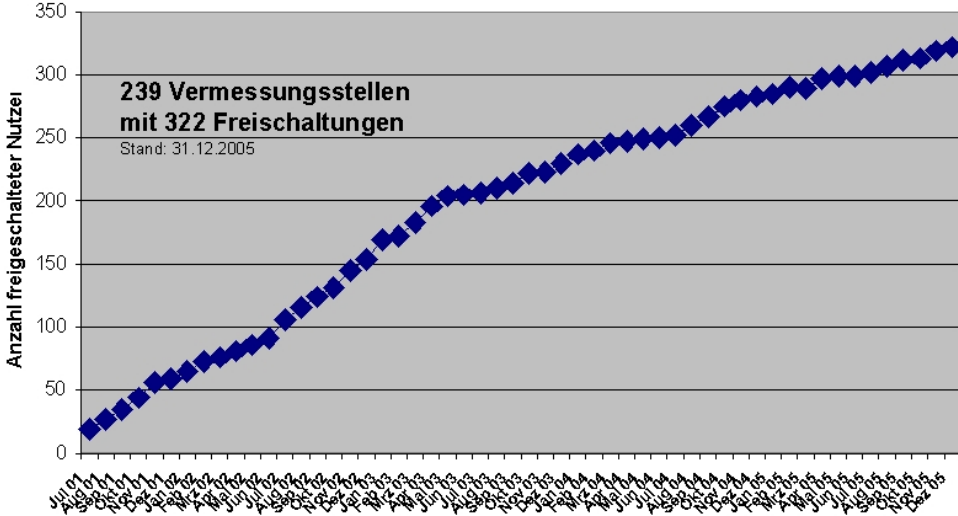
# SAPOS® user numbers over years

◆ Real Time Service (HEPS) RTCM 2.3

Registrierte HEPS - und EPS - Nutzer in NRW



Registrierte Webserver - Nutzer ( GPPS ) in NRW



◆ Post Processing Service (GPPS) RINEX



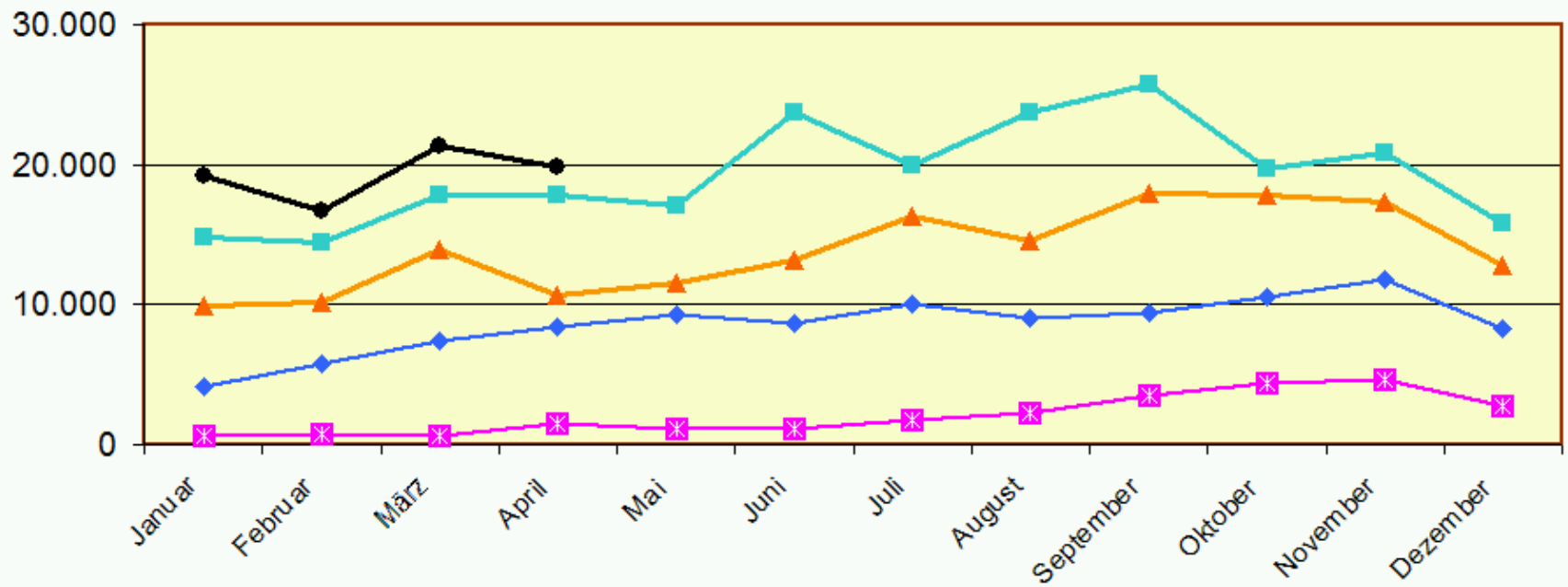
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# SAPOS® user numbers over years

## Access to the real time service SAPOS-HEPS in NRW

2002 2003 2004 2005 2006



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# SAPOS® Ntrip test installation

## ◆ BY

- real time service HEPS with Ntrip (additional to GSM) offered since summer 2004
- increase in user access to Ntrip from
  - 2,5 % (oct 05) to
  - 5,2 % (apr 06)

## ◆ NW

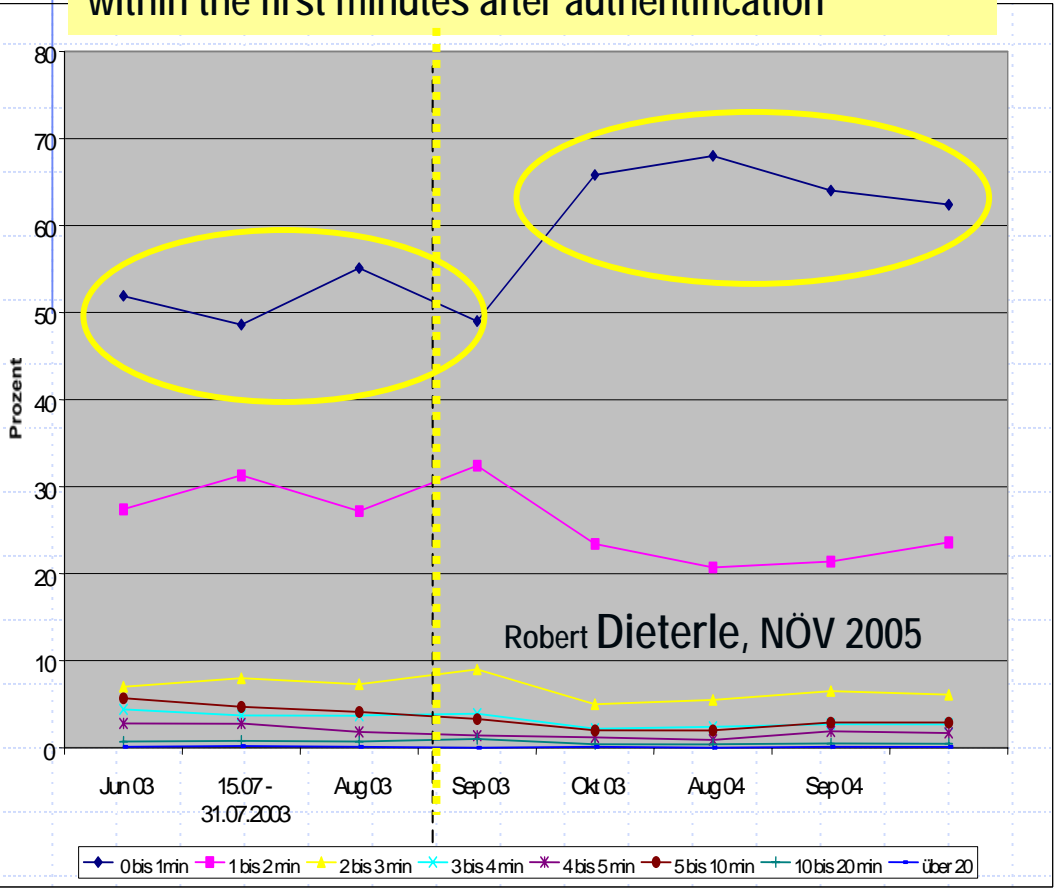
- real time service HEPS with Ntrip (additional to GSM) offered since december 2005
- in jan, feb and mar 06 the share of Ntrip users was 0,7 % of the HEPS data volume





# Rover solution performance after coordinate improvement

## percentage of fixed solutions within the first minutes after authentication



Robert Dieterle, NÖV 2005

- improvement of solution velocity after introduction of more accurate station coordinates max 2 cm horizontal, 5 cm vertical (ETRS89 → ETRS89(2003)) in September 2003

- 80.000 logins analysed
- before: 50 % of TTF within minute 1
- after: 65 % of TTF within minute 1

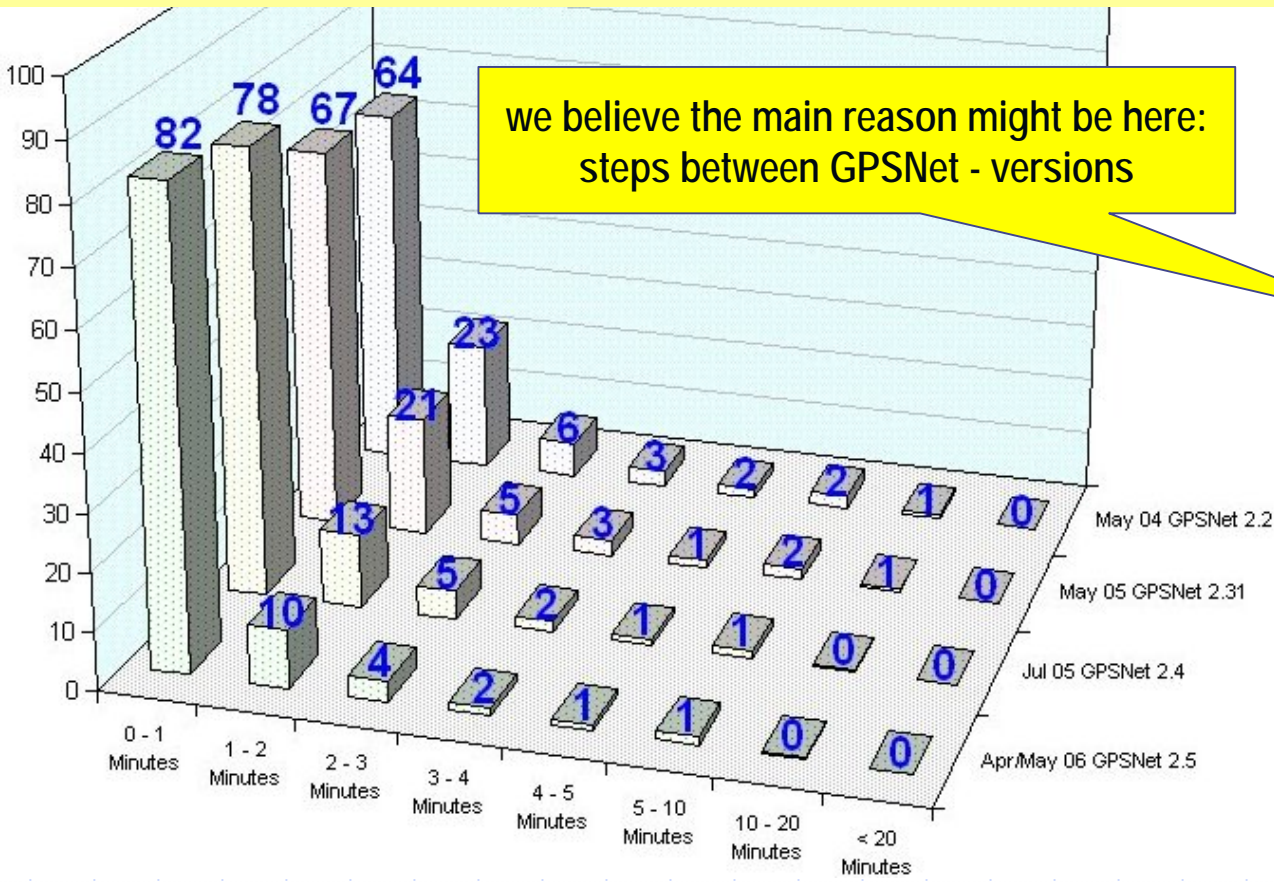




# Rover solution performance

percentage of fixed solutions within the first minutes after authentication

- 4 epochs in comparison: may 04, may 05, july 05, apr/may 06 (10-20,000 measurements per month)
- clear improvement to apr/may 06



we believe the main reason might be here: steps between GPSNet - versions

- reasons for differences
- multipath
  - receivers
  - networking
  - ionosphere
  - topography
  - applications
- GPSNet-release**
- data link availability
  - changes in hardware
  - customer experience (greenhorn / old hand)

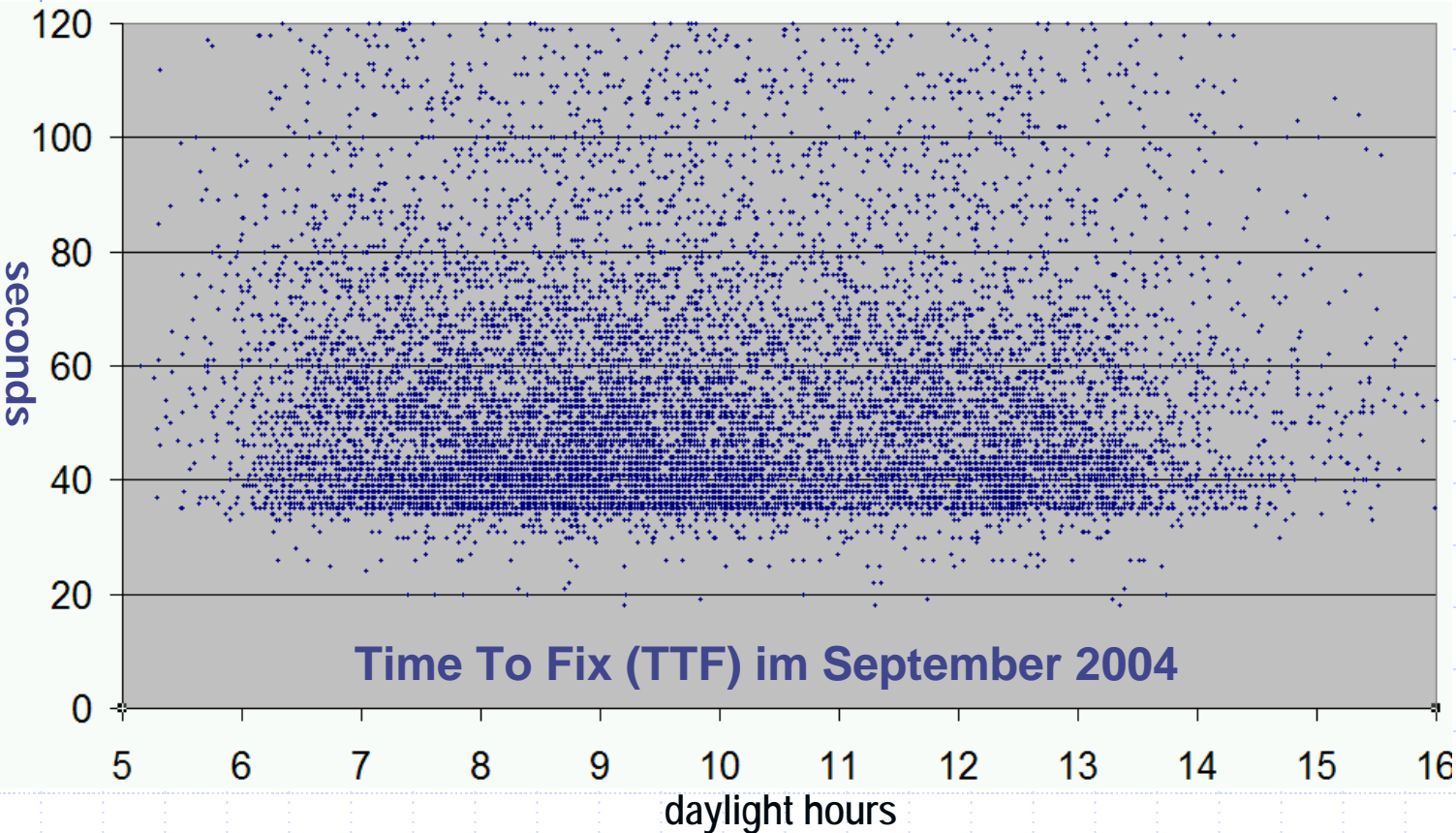




# Rover solution performance

## time delay of fixed solutions all users in NW in September 2004

- distributed over daylight hours





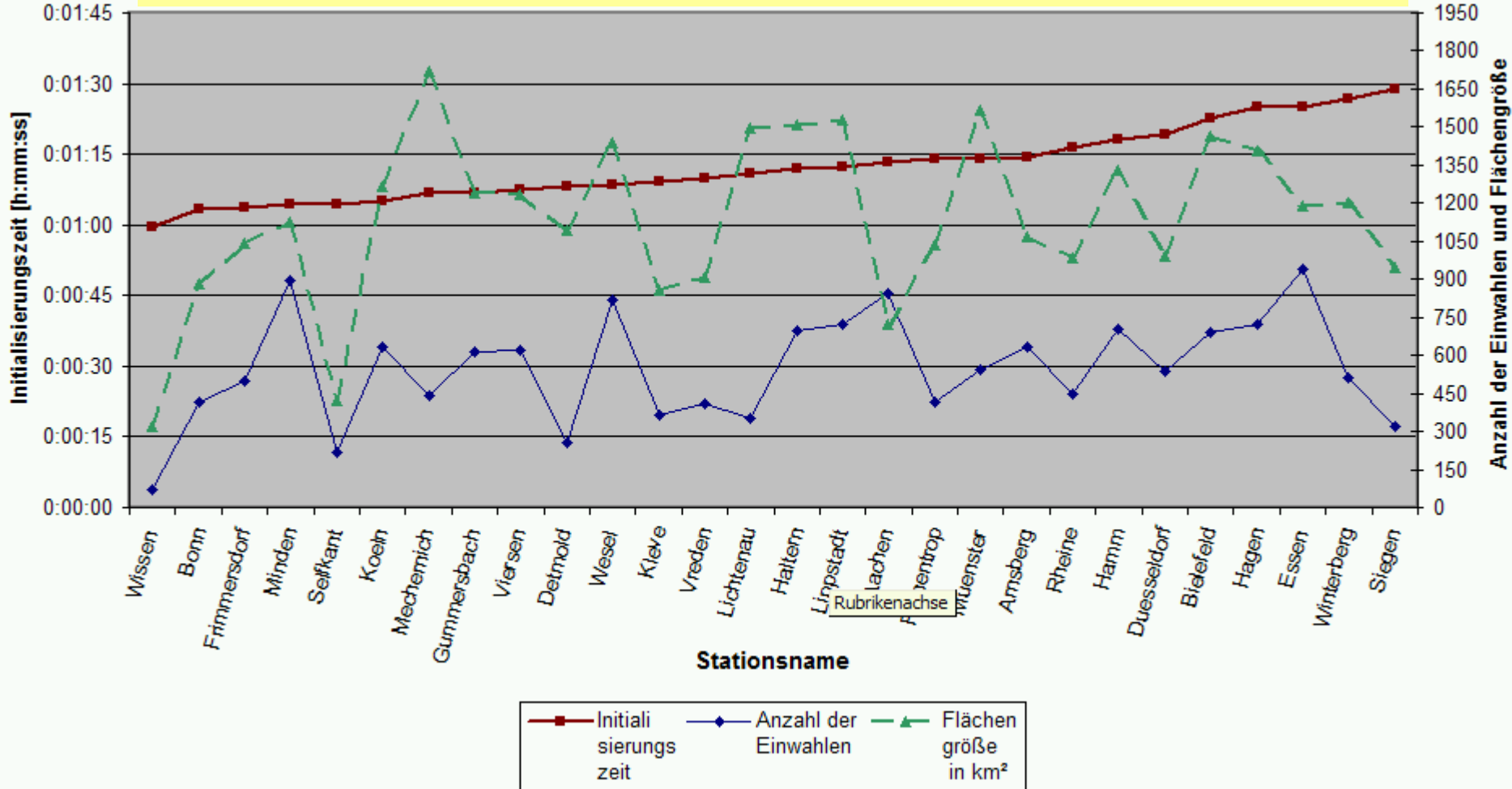


# Rover solution performance

- is reference station dependent !

## TTF charts of 28 SAPOS NRW reference stations

based on 230.000 real time users from january 2005 to december 2005



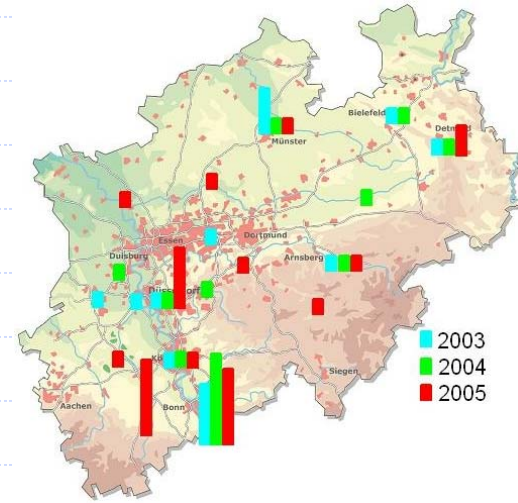


# SAPOS® customer care

## ◆ arrangements

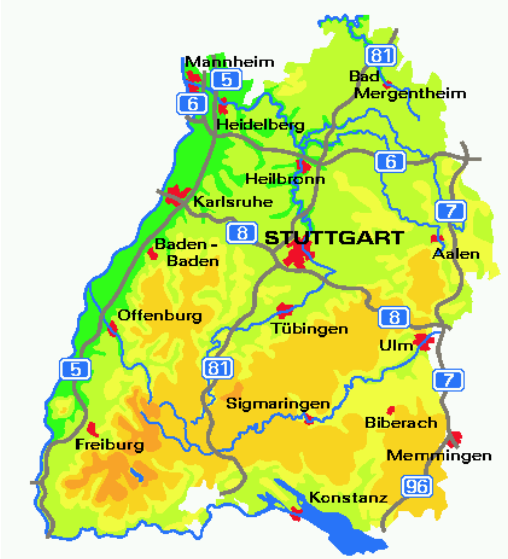
### ■ NW:

- ◆ roadshows for non-users
- ◆ workshops for beginners
- ◆ annual customers conferences



### ■ BW:

- ◆ Workshops in close cooperation with universities
- ◆ Customer polls (2004 and 2005)
- ◆ Sporadic newsletter informations
- ◆ Hotline weekdays 8 am – 4 pm

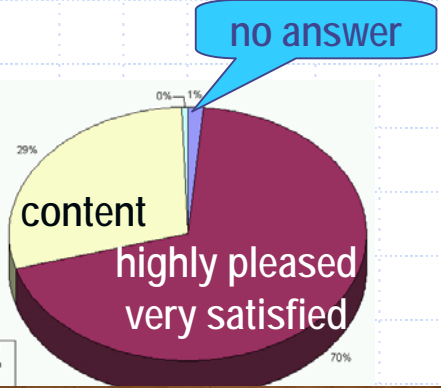


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# SAPOS® - customers conference -

- ◆ 5 regional terms with up to 100 visitors per meeting
- ◆ exchange of informations and ideas
- ◆ high user acceptance



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# information about problems from the processing center

The goal was to inform the user directly (not only over internet / WAP) about current problems and maintenance activity of the processing center



# A

# B

**Rover Display**  
Software created message about operation condition  
RTCM2.3 (16)

**Mobile Phone Display**  
Manually created E-Mail  
0,20 € per message for user

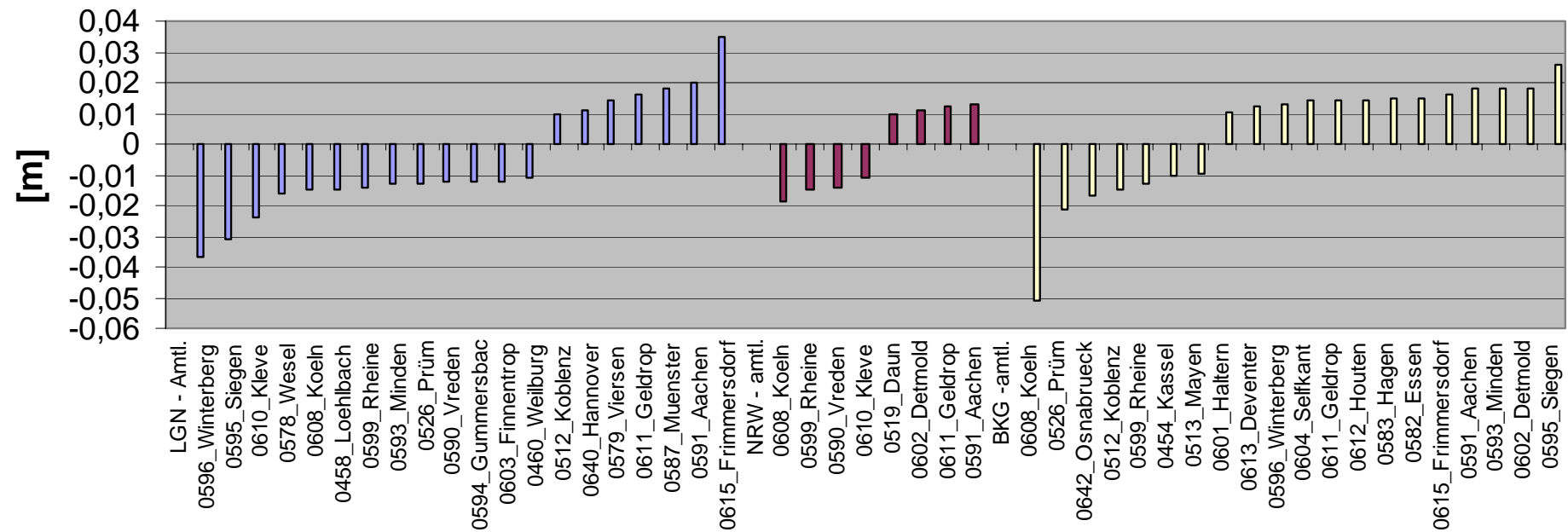
- Problem 1 :
- message standard
  - code / in brief / detailed
  - message maintenance necessary
- Problem 2 :
- manufacturers required to implement messages
  - RTCM-Format needed

- Problem 1:
- Mobile phone network latency and different message data format
- Problem 2 :
- Response 2 % of 1000 users
- Problem 3:
- 10 messages in 7 months were necessary (mostly scheduled maintenance activity)
- Problem 4:
- 1 % of the users plead „continue !“
  - 1 % of the users plead „stop it !“



# NW: coordinate monitoring problems

**GPS-Woche 1319, SAPOS-NRW,  
 drei anerkannte Auswertansätze: LGN, NRW, BKG;  
 Restklaffungen in Höhe, aufsteigend sortiert,  
 Stationen <+-1 cm ausgeschnitten;  
 die Extremwerte sollten identische Stationen betreffen!**

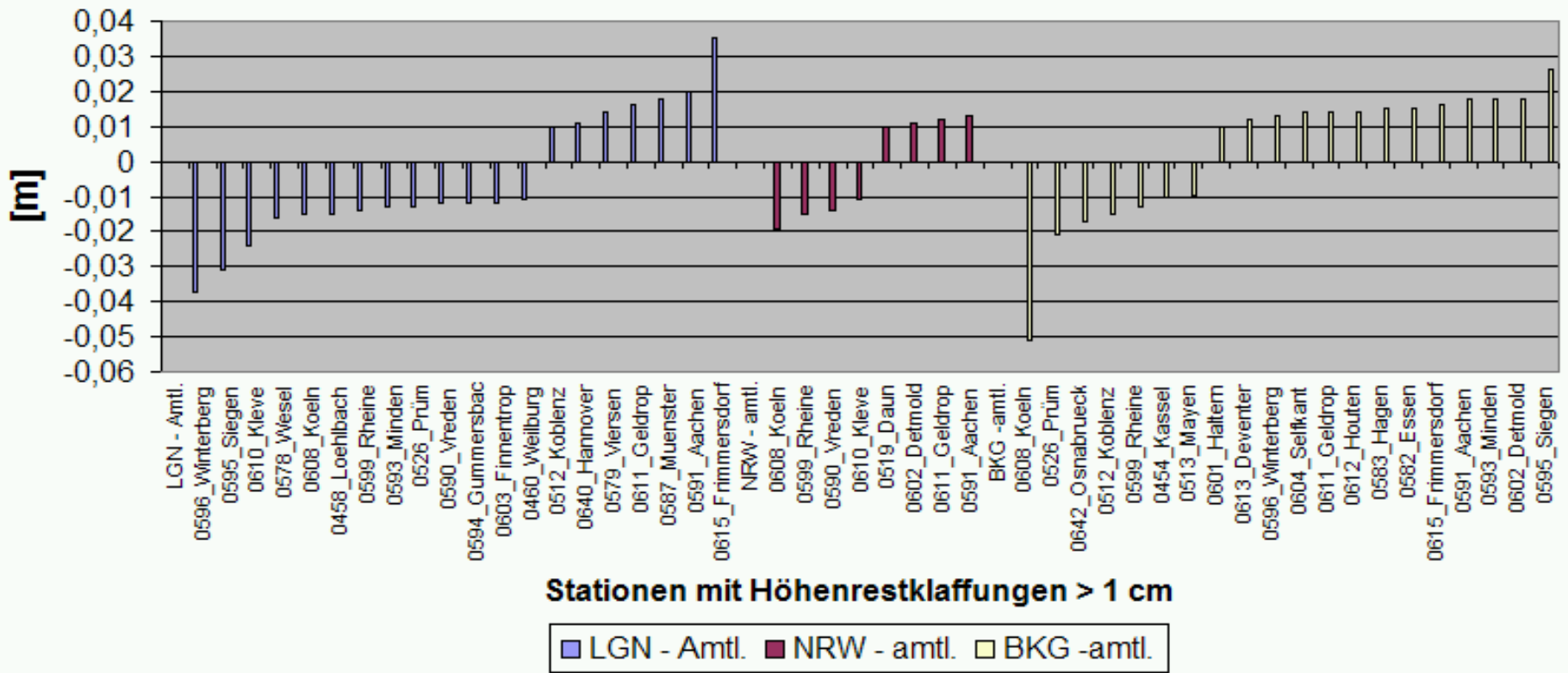


**Stationen mit Höhenrestklaffungen > 1 cm**



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# NW: coordinate monitoring problems

- ◆ state of knowledge:
  - monitoring of station coordinates aims at unexpected changes and unauthorized interferences of station hardware
  - so monitoring of station coordinates focuses upon the stations with the greatest deviations from official values
  - to justify a reaction on apparent/make believe movements we need unanimous declarations from different software tools.
  - state of the art models and softwares do not answer sufficiently :
  - different software packages analyzing identical data point at different maximum deviation stations
  - a positive reaction with the consequence of a coordinate change is impossible
  - quality management fails
  - who knows the solution ?



# Greetings to the GPSNet using fellows of the world



from the GPSNet using SAPOS operators in Germany!

