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Combining CORS networks, automated observations and processing, for network RTK integrity analysis and deformation monitoring

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Paper objective:

- *Educate about GNSS positioning*
- *give value to RTK network integrity management and CORS data*
- *explore how GNSS network operators and surveyors can support monitoring projects and expand their business*

- **Slides**
  - GNSS methods
  - CORS>network RTK>integrity management
  - Monitoring field techniques with survey equipment
  - CORS>networks>deformation monitoring and automation
  - Automated integrated surveying

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GNSS methods

- Observables
  - Code
  - Carrier phase
  - RT & PP

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CORS>nRTK>int. mngmt

- Continuously Operating Reference Station
  - GPS or GNSS
  - RT and/or PP

West Wyalong CORS –
AUSCOPE and CORSnet-NSW

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CORS>nRTK>int. mngmt.

- CORS provides “active control”
  - Control that is “alive”
    - observed automatically
    - no site visit to observe
  - Streamlined monumentation management for public and private benefit

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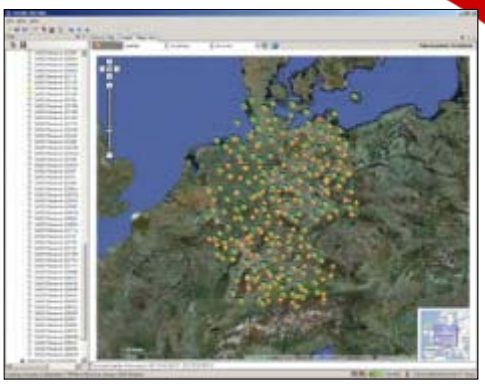
CORS>nRTK>int. mngmt.

- Network RTK
- Using CORS for wide are modeling iono, tropo and satellite orbit errors
- Optimise rover precision



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CORS>nRTK>int. mngmt.

- Network RTK
  - Industry accepted methods (RTCM)
    - VRS Virtual Reference Station™
      - Non-physical or computed reference
    - MAC Master Auxiliary Concept
  - nRTK requires accurate and homogenous CORS coordinates

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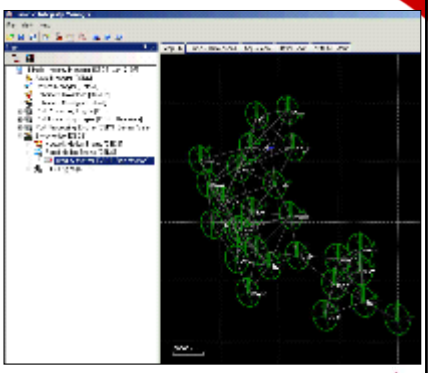
CORS>nRTK>int. mngmt.

- Integrity Management
  - Vital for any network
    - RT or PP
  - Critical for network RTK
  - Manually>Geodesist
  - Automatically>Trimble Integrity Manager software or similar



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CORS>nRTK>int. mngmt.

- Integrity Management
  - Gives assurance of QOS
  - All computation, alarming and reporting automated

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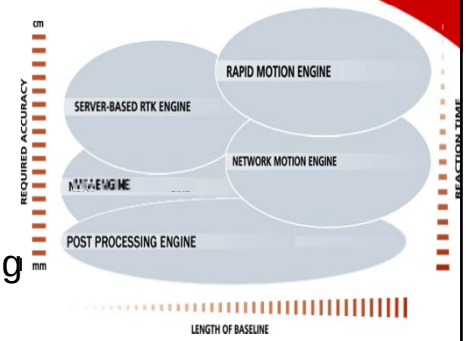
CORS>nRTK>int. mngmt.

- Integrity Management
  - Automation allows multiple processing methods to be employed
  - Detects sudden or long term movements



Trimble GNSS processing engines

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Field techniques

- Shifting topics slightly...
- Techniques for monitoring with survey equipment
  - Campaign style
  - Installation style

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CORS>nw.>def. mon. & auto.

- nRTK operators start using CORS for control for other projects
- ***Applying integrity management techniques to enable GNSS deformation monitoring***
- Installation style monitoring growing
- RT and PP CORS data has value

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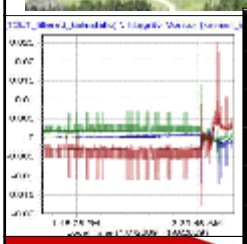
CORS>nw.>def. mon. & auto.



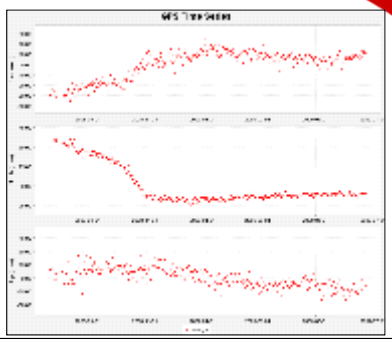


Image source: http://www.geonet.org.nz/resources/gps/timeseries/index.html accessed July 2009 for UTK1 station data

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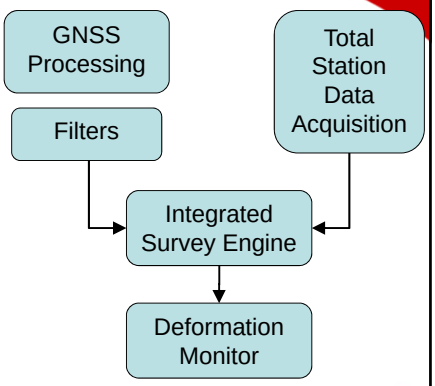
Auto. integrated surveying



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Auto. integrated surveying

- Choose the sensor for the job or combine

GNSS sensor technology		Terrestrial / Optical sensor technology	
Advantages	**Disadvantages**	**Advantages**	**Disadvantages**
No line of sight	Needs open sky	No sky view required	Line of sight required
Reference can be kilometres away	Nearby objects can cause multipath	Very high precision	Dust, fog and rain can reduce the maximum distance
Continuous all weather operation	Power and communication may be required at each point	Power and communication only required at the instrument	Refraction errors increase over distance
Antenna setup simple		Passive targets relatively cheap	Higher latency with many targets
Low latency		Easy to increase the point number/coverage	
Network RTK solution i.e. VRS			

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Concluding remarks

- CORS networks are a central point for all positioning professionals
- Integrity management is vital for CORS network services
- Monitoring market is growing due to:
  - aging infrastructure
  - global awareness
  - growth of GNSS as monitoring tool to aid engineers
  - automation of monitoring tools

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Thanks

- At Trimble booth until mid-afternoon today
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