



## A Web-Based Real-Time Monitoring System for GNSS Data Quality and Integrity

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## Introduction



### • Motivation

- to monitor a CORS network's overall performance
- to support server-based RTK implementation modes
- feasibility study for web services in **real-time** (as well as post-processing)

### • Related CRC-SI activities

- RTQC
- GQC: <http://gpsnet.nre.vic.gov.au/quality/index.htm>



# SydNET



Distribution of 'SydNET' stations (SydNET, 2008)

- 11 active CORS
- 3 Trimble, 4 Ashtech, 4 Leica receivers



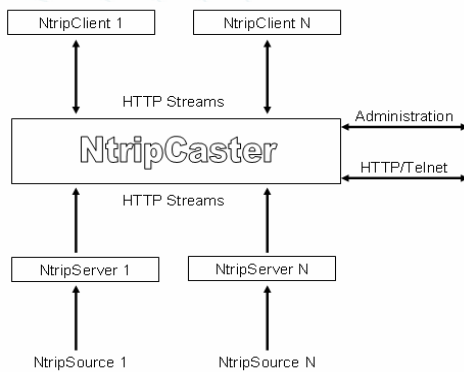
- RINEX file download via web site
- Real-time data via NTRIP protocol (HTTP, TCP/IP )



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# NTRIP



NTRIP System (Weber et al, 2005)

• **Developed by Federal Agency for Cartography & Geodesy (BKG), Germany, for EUREF**

• **Based on HTTP**

• **NTRIP components**

- NTRIP Server
- NTRIP Caster
- NTRIP Client



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# Objectives



- **Develop a system able to**
  - be accessed via web browser over a network
  - store real-time data streams from GNSS receivers
  - provide a real-time monitoring service of multiple stations simultaneously
  - publish quality parameters on the web with real-time updates, at a 1Hz rate
  - also able to access GNSS data in database ('post-processing')
  - visualise reference station performance in a graphical form
  - extensible for different data types & linear combinations (DD, WL, NL, etc)
  - utility to assess data/operations quality of CORS infrastructure



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# Design Considerations



- **Graphical representation of data**
  - Data representation format and visualisation
- **Web-based environment**
  - Ease of access
  - OS independent application
- **Database oriented application**
  - Supports rich set of database oriented tasks
- **Server-side application**
- **Client-side application**



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# Communications



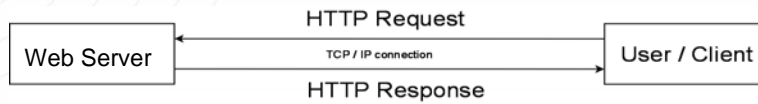
- **Between a NTRIP caster and a web server**

- The web server functions as a *client*
- Sends request to an NTRIP caster and receives data streams continuously



- **Between a web server and a user/client**

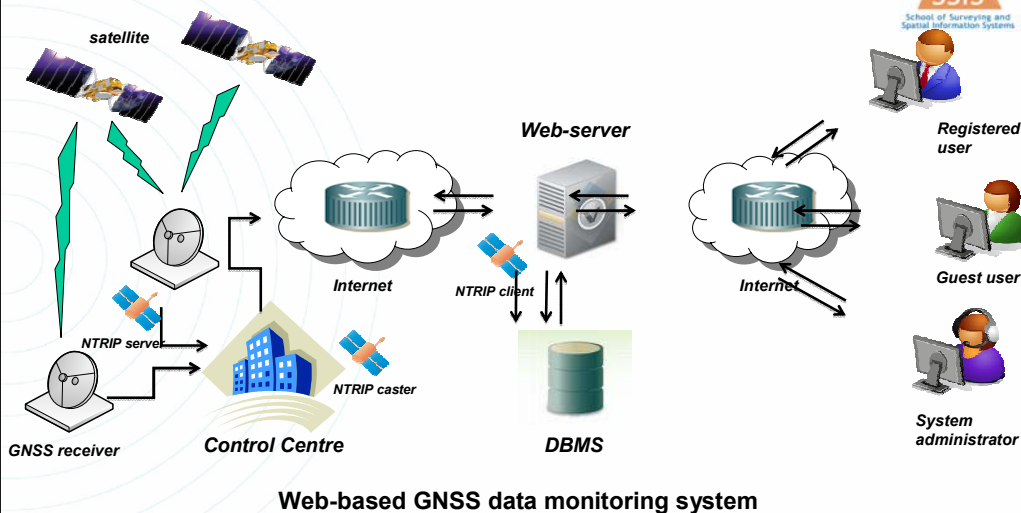
- The web server functions as a *server*
- Receives request from a user/client and sends data, e.g. at 1Hz rate



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# System Architecture



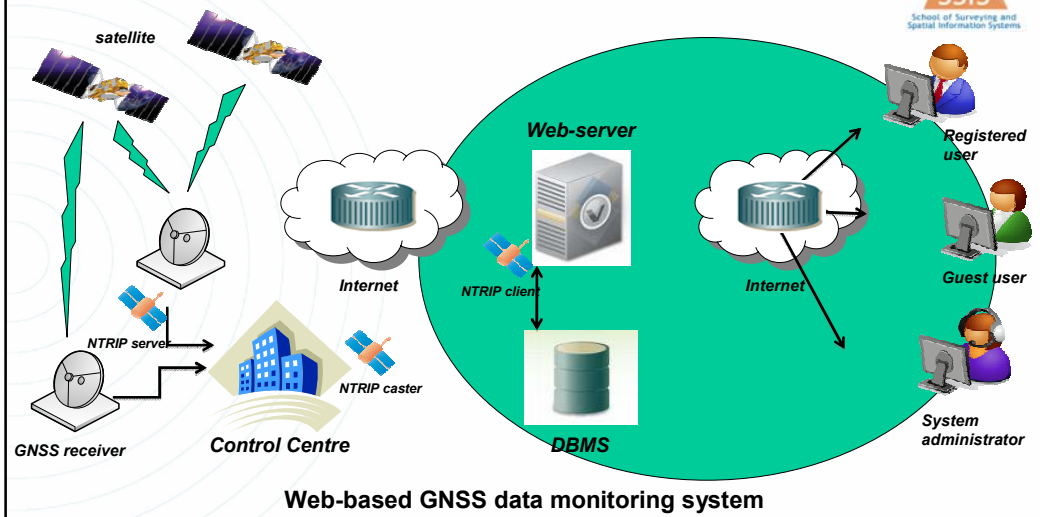
Web-based GNSS data monitoring system



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# System Architecture



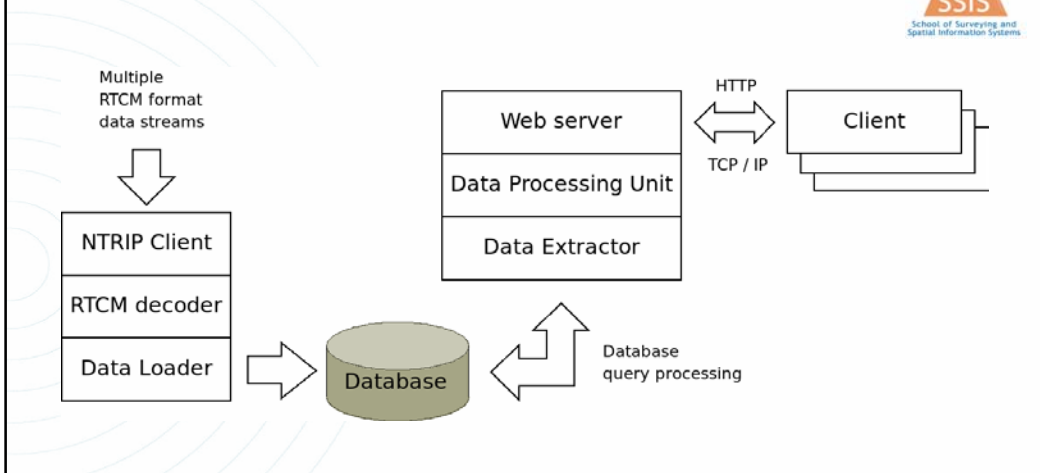
Web-based GNSS data monitoring system



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# Data Processing



Data flow of the Web-based GNSS data monitoring system



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# Components



- Communication enabler: TCP/IP, HTTP, NTRIP, RTCM
- Web server application: Web server, J2EE
- Database application: DBMS, SQL query, DB server
- Client-side application: Web browser, Java applet



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# Demo: User Configuration



- User-defined configuration
- Step-wise interface
- Access level control
- Available parameters:
  - P1, P2, L1, L2
  - P3, L3
  - I1, N3 (pseudo range derived)
- History data
  - current
  - 1 hour ago
  - 5 hours ago



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# Demo 1



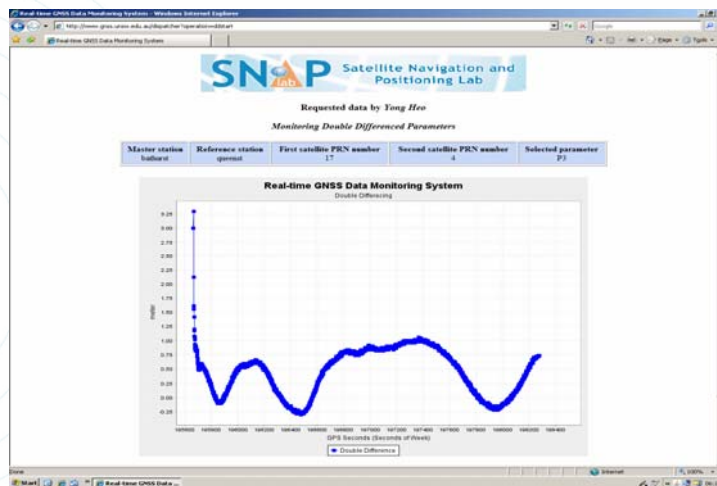
Single parameter monitoring mode



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# Demo 2



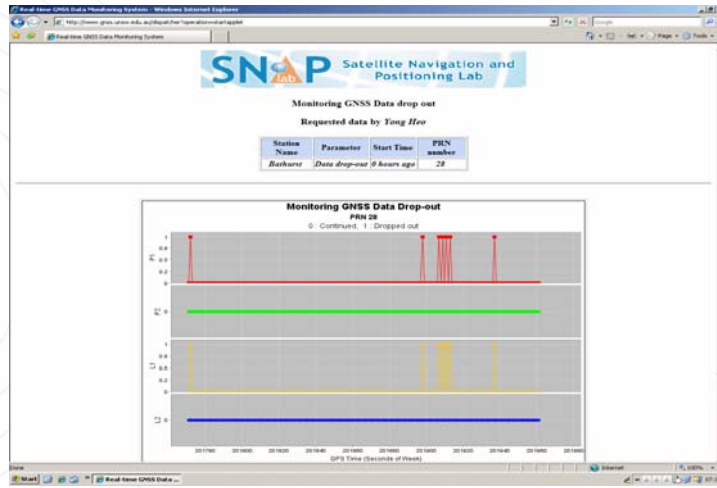
Double differenced parameter monitoring mode



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# Demo 3



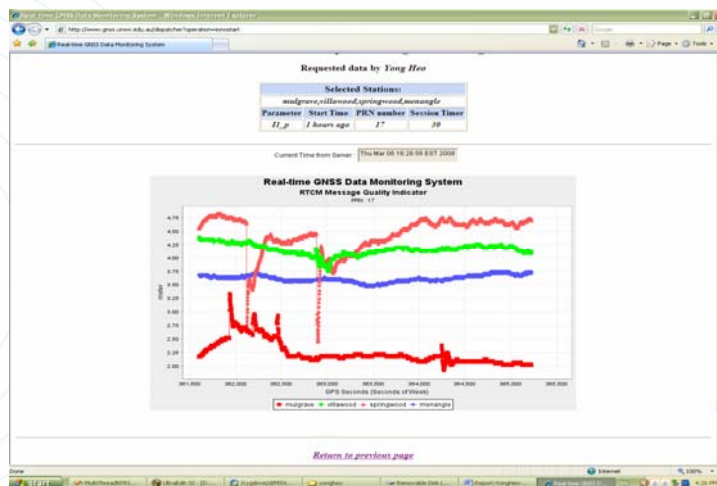
Data drop-out monitoring mode



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# Demo 4



Ionospheric delay monitoring mode



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## Concluding Remarks



- To demonstrate the feasibility of real-time monitoring, the proposed system has been implemented as a *prototype* - <http://www.gnss.unsw.edu.au/>
- Both TCP (NTRIP) and UDP (NTRIPv2) as communication protocols have been investigated as to their suitability for data delivery
- The prototype system monitors all active 'SydNET' stations from NSW Department of Lands, and some Australian Regional GPS Network (ARGN) stations from Geoscience Australia (GA) (*as part of the IGS-RT-PP*)
- Core components will be upgraded and incorporated into a NRTK system that can process multiple GNSS data streams at the server-side



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## Questions



**Thank you for your attention.**



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