Building Modern Infrastructure for National Positioning Capability

(AKA how can we stream a lot of data efficiently?)

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Summary

Journey of modernising our infrastructure *away from the 80s*

- How we do things
- Successes
- Challenges (especially around real-time streaming)
- How do you do it? Let's chat!
Geoscience Australia (GA)

Department of Industry, Innovation and Science.

Geoscience Australia is Australia’s pre-eminent public sector geoscience organisation. We are the nation’s trusted advisor on the geology and geography of Australia. We apply science and technology to describe and understand the Earth for the benefit of Australia.
Geodesy Section

Geodesy is the science that studies the size and shape of the Earth and how they vary over time.

Geodesy provides the positional framework for all surveying, mapping and geographic information applications in Australia.
Geodetic Observation Techniques
Geodetic Observation Techniques

Survey  | GNSS  | Gravity  | Radar  | Laser  | VLBI

Global Navigation Satellite System
National Positioning: Motivations
From this ...
... to this
GNSS Station Components

- Monument
- Antenna
- Power
- Receiver
- Communication
National Positioning: infrastructure
Vision

Our aims

- Transition to real-time operations
- Transition from static to kinematic applications support
- Transition from science to industrial and environmental applications
- Exploit all GNSS
- Support Australian industry
- Support science infrastructure
- Support international collaboration
- QA of data products
- Transition from <1,000 users to 100,000+ users
Successes: standardising site metadata

GeodesyML metadata standard

- Management of 1000+ receivers
- Removed reliance on “static” text-based log files
- Machine-to-machine transfer of metadata via API web services
- All open source (http://geodesyml.org)
- Who’s using it?
  - IGS Central Bureau
  - UNAVCO
  - GA
  - Australian jurisdictional governments

Text-based metadata 🚫

XML standard 

GeodesyML (GML OGC based) ✅

3. GNSS Receiver Information

3.1 Receiver Type

- ASHTECH UZ-12
  - Satellite System: GPS
  - Serial Number: ZR520021114
  - Firmware Version: ZC00
  - Elevation Cutoff Setting: 0 deg
  - Date Installed: 2002-10-29T00:00Z
  - Date Removed: 2006-01-23T23:59Z
  - Temperature Stabiliz.: none
  - Additional Information:
Successes: infrastructure migration to cloud

In-house datacentre
- Network bandwidth bottleneck
- Regular network outages

Cloud based (AWS)
- Zero outages (except in beginning)
- Usage quadrupled
  ~150 users → ~600 users
  @ 4000+ connections
Successes (soon): migrating away from FTP to API

FTP ❌

Web API ✔

Index of /geodesy-outgoing/gnss/data/daily

$ curl "https://api.archive.geodesy.ga.gov.au/?stationid=alic\&rinexversion=2\&filetype=obs\&fileperiod=hourly\&startdate=2018-05-01T00:00:00Z\&enddate=2018-05-30T00:00:00Z"
Challenge: clunky streaming protocol

Networked Transport of RTCM via Internet Protocol (NTRIP)
Essentially an enhanced HTTP protocol from the 90's

1. Not scalable
   - Long running connections are hard to load balance, especially with a protocol that wasn't designed for it
   - Not sustainable for 100,000+ unpredictable user capacity

2. Not reliable
   - We don't have guaranteed (at least once) delivery, so we need to double (or triple) handle data for redundancy
   - This bandwidth is not sustainable for flaky 3G connections of remote stations
Challenge: manual network management

• 1000+ receivers currently managed *manually*

• Sparse metrics on sites

• If site goes down, we don’t know unless we actually look

• Would be good to get automatic alarms

• Even better, automatic recovery

*Embarrassingly, a phone call from users might be the first we hear of an outage*
Have done similar projects? Let's chat!

Geodesy tech is stuck in the 80's

• Others are facing these issues in Geodesy, but haven't really solved them

• Haven't needed to scale like this before, but positioning is becoming more important (and greater in size)

Please come chat if you have worked on similar projects!
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