Dissemination of Real-Time and Post-Mission value added GNSS data – A Global Operator’s Perspective

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Outline

• Introduction
• History and Trends
• Australia – use case
  • Coverage
• Fiji – current situation
• Real time and post processing GNSS data dissemination
HxGN SmartNet – Correction Service

• Cloud based service to provide **centimeter-level** accuracy to GNSS rovers via mobile internet **in seconds** with **24/7/365 availability**

• Largest network with over 4,500 Reference Stations worldwide available in 22 countries is providing **Open Standard GNSS correction** for RTK positioning

• Over 13 years experience in the correction service market with a globally experienced team
Evolution to HxGN SmartNet

From single base solution to a world-wide network correction services build on technology from Leica Geosystems
HxGN SmartNet Applications & Businesses

Land Surveying  Agriculture  Machine Control & Construction  GIS  Utilities  UAV

Automotive  Agriculture  Logistics  Telecoms  Asset Data Collection  IoT Applications
HxGN SmartNet: Commercial Service Offering

Commercial service offering differs from country to country (market driven)

B2C offering
- Real time correction data streams as
  - Flat rate subscription
  - Consumption-based subscription
- Download of post processing products (RINEX files, Online Post-Processing, etc.)
- Mobile app and web page access

B2B offering
- Enterprise subscription models (Consumption or based on the number of users)
- Integration of API for automation of subscription administration
- Integration of API for post processing automation (using X-pos technology)
**Industry Trend 1**

Dual Frequency GNSS introduced to the mass market

- Evolution of low cost chipset from single to dual frequency (at same low price)
- First Xiaomi Android phone with Broadcom dual-frequency chip
- Access to GNSS raw data via Android operating systems
- Possibility to utilize correction data for RTK positioning
- Main limiting factor for precise positioning: GNSS antenna in mobile phones
- Second limiting factor: number of channels for GNSS signal tracking
Industry Trend 2

SSR vs RTK

- SSR (State Space Representation): correction data format that transmits the error of the relevant GNSS sources
  - Clocks Orbits, Ionosphere, Troposphere, etc.
  - No standard established
  - Broadcast capability for larger area at low bandwidth

- RTK (OSR – Observation Space Representation): correction data format that transmits the errors as a lump sum
  - Widely implemented on dual-frequency GNSS hardware and standardized via RTCM
  - Usually used with individualized data streams for rover (iMax, VRS, SB)

Estimation of SSR parameters

SSR ➔ OSR
GGA

SSR ➔ OSR
SSR output
SSR

SSR ➔ OSR
SSR output
SSR Rover

RTK Rover

Today

Future
Industry Trend 3

GNSS on the road

- Long history of autosteering with GNSS guidance systems (&IMU)
- Accuracy requirements on the road are lower but reliability becomes the key requirement (failure rate: <0.00000001%)
- Technology: SSR with Integrity on a pan-continental level and sensor fusion
- Automotive requires to serve a very high number of users (broadcast)
- Connected Car ➔ Assisted Driving ➔ Autonomous driving
Industry Trend 4

Stretch the station separation of the network

• Higher station density is required during high solar activity to estimate the ionosphere correctly
• RTK positioning requires dense network of ~75km (limitations on the rover side)
• Positioning with SSR technology can further stretch the station spacing (reduction in convergence time at the rover)
• Network design for good or bad times?
  • Saving potential: ~3/4 of base stations
  • Station separation 75km…120km…240km
  • Consideration on redundancy for individual station failures

Source: www.spaceweatherlive.com
Conclusion on Industry trends

Things will change … but slowly

RTK will remain the most important technology in the classic GNSS market for the next 5 years (at least)
- Large user base (that will modernize slowly)
- Fastest and most accurate GNSS positions

SSR will come!
- Standardization will be the main driver
- Introduction first for mass market application (cars, mobile phones, and other new ‘rovers’)
- Low bandwidth and cheap broadcast capability will be the striking arguments for SSR
- More flexible on station separation

Cheap broadcast capabilities will be the main argument for service providers
- Cloud dissemination vs Native carrier dissemination via 3GPP
Correction Service on a worldwide scale build on over 4,500 reference stations

North America
1300+ STNs

Europe
2500+ STNs

Russia
350+ STNs

Australia
600+ STNs
HxGN SmartNet - Australia

- Largest provider of CORS service (670+) in Australia since 2009.
HxGN SmartNet - Australia

- Coverage – Victoria (125 sites)
  - Agreement with DELWP VIC = 116
  - GA = 1
  - HSN = 8
  - Integration of cross-border sites (SA & NSW)
HxGN SmartNet - Australia

- Coverage – New South Wales (228 sites)
  - DFSI-SS = 180
  - GA = 11
  - HSN = 37
  - Continuous coverage from SA and VIC through to QLD
HxGN SmartNet - Australia

- Coverage – South Australia (54 sites)
  - GA = 12
  - HSN = 42
  - Coverage is expanding
  - Offer cross border service – SA & VIC
HxGN SmartNet - Australia

• Coverage – Tasmania (23)
  • GA = 10
  • HSN = 13
  • Predominately Ag usage in North
  • Plans to expand coverage between the main towns
HxGN SmartNet - Australia

- Coverage – Western Australia and Northern Territory (96 sites)
  - GA (Land NT + LandGate) = 61
  - HSN = 35
  - Coverage is growing
  - Focus on expansion around metro Perth
Fiji CORS Network

• Current Network – Base Stations
  • Geosciences Australia / South Pacific Community Sites
    • LTK
    • SUV
  • High Target Sites
    • LAB
    • TAV
    • NAB
  • Leica Geosystems
    • ROT
    • KOR
    • KDV
    • LAK
    • ONO
Fiji CORS Network

- **Future**
  - Base stations currently being installed
    - More Base Station
    - Upgrade of stations
  - Networking Software Installation and Operation
    - What software
  - Business Model
    - Public Private Partnership
    - Publicly operated.
  - Expected adoption by the industry / private and public sector
    - Operation and maintenance
GNSS Data Dissemination

• Seems simple
  • Get data from base stations
  • Provide to end users
GNSS Data Dissemination

- Extensive Network
  - 670+ sites

- Range of Users
  - Different applications
    - Agric
    - Survey
    - Machine Control
    - UAVs
    - Utilities finding
    - PPK users
  - Different geographical regions
    - State
    - National

- Real Time Data
  - Most users

- Post Processing Data
  - PPK users

- Processing Methodology
  - Network
    - MAC
    - VRS
    - FKP
    - SSR

- GNSS
  - GPS only
  - GPS+GLONASS
  - Everything

- Datums
  - GDA94
  - GDA2020
Real-Time Data Dissemination

- Application Based Division
  - Survey and everything else except some GIS
  - Agric
  - Some GIS
Real-Time Data Dissemination

• Geographic Based Division
  • Single State License => Following Post Code
    • Most users
      • NSW
      • VIC
      • QLD
      • SA
      • WA
      • TAS
      • NT
  • National License
    • Some users
      • Will need to change port number when move states
• Currently working on an ubiquitous National and possibly Global solutions
  • Change settings automatically when crossing borders
Real-Time Data Dissemination

- **Formats**
  - Mount Point Names
    - MSM
    - RTCM 3.x
    - RTCM 2.3
    - CMR+

- **Correction Methodology**
  - Mount Point Names
    - MAC
    - VRS
    - iMAX
    - Others

- **Datums**
  - Identifier
Fiji CORS – Real Time Data Dissemination

- DNS Name = fj.hxgnsmartnet.com
- Ports
  - Survey = 9101
  - GIS = 9102
  - Agric = 9103
  - MC = 9104
Post-processing Data Dissemination

- RINEX files
  - Multi-GNSS RINEX 3.XX from the new portal
  - RINEX 2.XX from the old portal
- Basic QC information
  - Data completeness
  - Multipath
Post-processing Data Dissemination

• Virtual RINEX Request
  • Complete user input on one single page
  • Minimum user interaction
  • Fully automated generation of optimal virtual, non-physical data
  • Use of Virtual RINEX in Post-Processing has similar advantage like Virtual Reference Station corrections in Real-Time
Post-processing Data Dissemination

- Online PPK Processing Engine
- X-POS Positioning Server
  - Leica Geosystems Infinity Kernel
  - Static or Kinematic
- Customised Processing Parameters
  - Single Base Processing
  - Loose Network Processing – Many base stations
  - Tight Network Processing – Combined network solution
- Detailed Reports
  - With full error ellipses and uncertainty values
HxGN SmartNet Multiple Reference Frames Support

- Maintenance of **multiple reference frames** in one installation
- Send out raw data and RTK corrections in a selected reference frame
  - allowing the rover user position directly in their chosen reference frame without the need for transformation.
HxGN SmartNet Web and App Tools

- HxGN SmartNet web access
  - More transparency into your subscriptions (logins, rovers, status)
HxGN SmartNet Web and App Tools

- HxGN SmartNet app
  - Ideal for checking Site Status & Rover Credentials in the field
  - Network Status & NTRIP port connectivity
  - NTRIP login (username, password)
  - Mount tables
  - Subscription status
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Thank you for your attention!
Vinaka veka levu!

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