Multi-purpose and Multi-users Real Time Network…

May 19, 2011
Pierre Desjardins

Agenda

- Modern GNSS Infrastructure
  - Adoption of RTN is fait accompli
  - Modern Geodetic backbone for Surveyors
  - New geocentric customers emergence and adoption

- Emerging Economies and RTN:
  - Different realities
  - Different needs

- 3rd Generation RTN solution
  - More scalability of accuracy → More users
  - More applications → More users²
  - Lower cost per user
Infrastructure & GNSS Infrastructure

“Without a stable foundation a building will collapse”

Infrastructure Examples:
- Cellular Towers
- Interstate Highway Network
- Power Grids
- Fiber Optic Backbone
- GPS is the 9th Utility!

Infrastructure systems are enabling technologies ...and economies!

Lessons Learned

- Emergence of RTK network in Europe (DE) in the 90s
  - IT to compute complex solutions
  - IONO modeling & low IONO conditions
  - LAN communication to CORS
  - Wireless revolution
  - Reliable CORS L1/L2 HW
- ...Quite a few lucky breaks!

GNSS Infrastructure makes centimeters ubiquitous!
Trimble VRS Networks
>200 Networks >3,000 CORS >40 Countries

2011 View

Lessons Learned

- Trimble VRS™ Network deployments
  - Gradual adoption: Central Europe → AM → Asia
  - Based on Cadastral Reform – Digital World (CN)
  - Follows Industrial Comm. Networks Deployment
  - As Cadastral implementation appears in new Emerging Economies, similar RTN requirements exist

But required IT communication infrastructure are lacking so Made in Germany will not work in most African countries on day 1
How to replicate elsewhere?

- Evidence is that a singular unified RTN backbone network is critical to successfully implement and maintain a cadastre.
- But the EU, AM and Asia models are not always possible in Emerging Economies:
  - Lack of basic infrastructure
  - Legislations
  - Skill and experience with modern technologies
  - Accuracy needs differ

The value of the land and of its use defines the accuracy of its cadastral registration.

- “Germany” cm accuracy is not always needed nor justifiable
- Accepting and implementing sub-meter accuracy reference backbone provided the scalability towards cm-accuracy is planned from the beginning is a better plan!
Trimble VRS$^3$Net

- 3$^{rd}$ Gen. RTN technology – more scalability

The first step – 3 steps → Accuracy:

1. Today Sparse CORS model with periodical upload and post-processing (AFREF model)
2. To Sparse VRS @ >150Km station spacing producing 10 cm (Horizontal)
   - IONO Dependant

Inter-Station spacing = a function of the IONO activity

Vertical Total Electron Content on a global map, as derived from GPS base station observations in a calm ionosphere (1998)
Trimble VRS\textsuperscript{3}Net

- 3\textsuperscript{rd} Gen. RTN technology – more scalability

The first step – 3 steps $\rightarrow$ Accuracy:
1. Today Sparse CORS model with periodical upload and post-processing (AFREF model)
2. To Sparse VRS @ >150Km station spacing producing 10 cm (Horizontal)
3. IONO Dependant
4. To regional (island) densification @ 50Km to achieve 2-3 cm accuracy

\textit{GNSS Infrastructure makes centimeters ubiquitous…eventually!}

Positioning Applications

- Construction
- Surveying
- GIS
- In-vehicle Navigation
- Infrastructure
- Agriculture
- Asset & Fleet Management
- Portable Devices
For the few or the many?

- Barrier to RTN deployment - cost vs. number of users
- So cost – simply # of potential users
- How? Simply the number and type of applications (APPs) on a common platform

The next significant step - TDE

GNSS Infrastructure makes centimeters ubiquitous!

Trimble Distributed Environment (TDE)

- …a common platform with the potential to built multiple APPs
**Monitoring APP**

- **Trimble 4D Control**
  - Small and mid scale monitoring applications
  - Dam, Mines, Bridges

- **Trimble Integrity Manager**
  - Large scale monitoring applications
  - Tectonic plates, GNSS networks

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**Trimble VRS³Net APP**

- Asset tracking
Atmosphere APP
Precise IPWV for nowcasting weather model

Conclusion
- Most Western World is covered with RTN
- Emerging Economies – Different needs
  - Solution: Trimble VRS³Net
  - 3rd generation RTN
  - Platform to build new APPs
  - A fully scalable solution:
    - Variable accuracy at variable density
    - Increased # of applications
      - Increased # of users
    - Reduced cost per users/department