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A new era of Geospatial solutions: Catalyst: Centimeters on your smart phone!

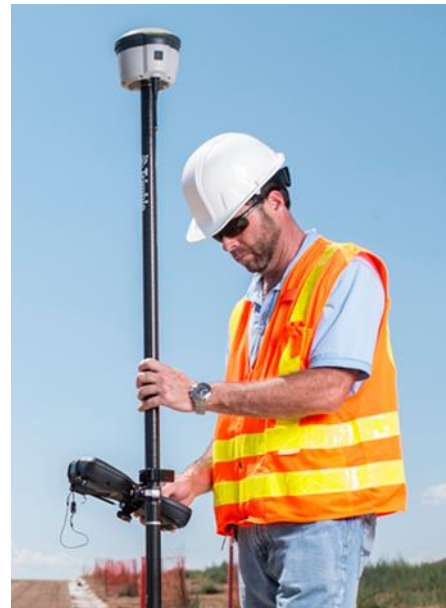


Timeline

CENTIMETRES EVERYWHERE FOR EVERYONE



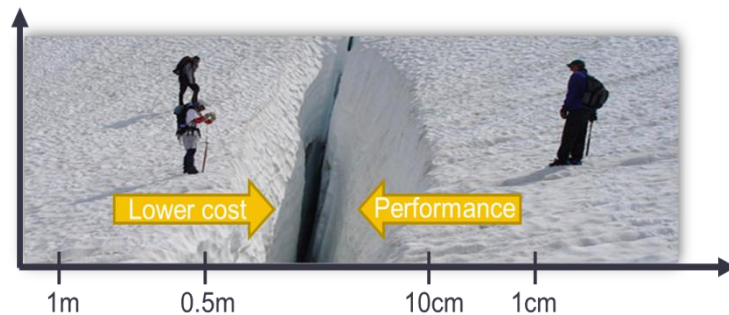
Base and rover operation
1994



Simplified -No base required
2017

Finding a solution for users who periodically need accurate positioning

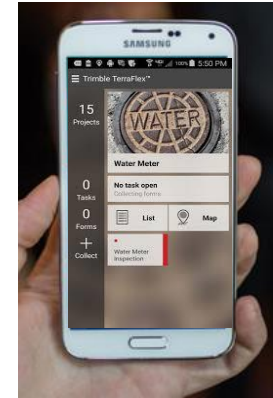
- Positioning supports the primary job function
- Examples:
 - Engineers doing inspections
 - Field technicians
 - Geotechs
 - Landscape contractors
 - Builders
 - Drain layers
 - Crop advisors
 - Survey company owners



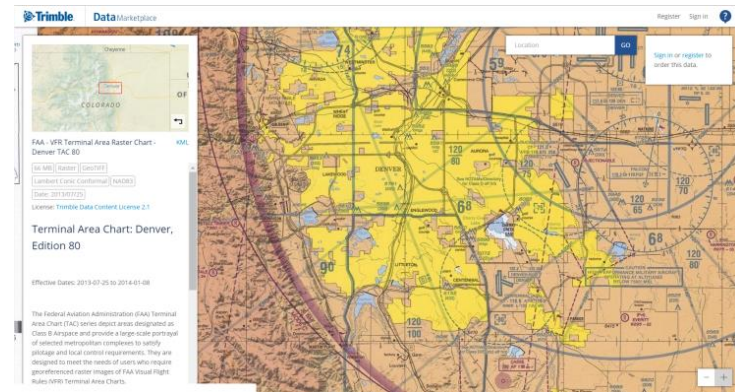
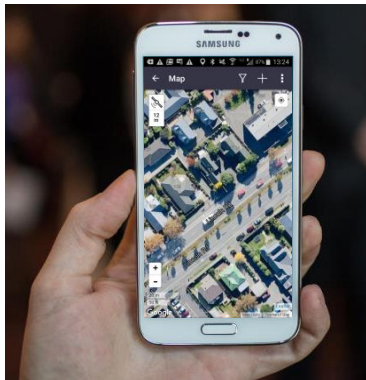
Closing the price/performance gap
to meet their needs

The smartphone platform It has evolved into a “universal tool”

- The emergence of the smartphone as a commonly used mobile tool providing new levels of
 - Simple, easy to use, convenient and affordable
- Growing use of mobile spatial information from consumers to professionals
- Supported with rugged accessories to enable use in industrial applications coming from customers' desire to use it as a universal tool



Increased availability of a broad range of digital data services combined with smart phones simplifies the use of spatial data for Professionals.



Connectivity enabled by the growth in cellular coverage, use of the Cloud and SaaS based solutions

- Provides access to the right information
 - Anywhere
 - Anytime
- Enabling new levels of field crew management
- Enabling cross-organization collaboration



Let's address the needs of a broader range of users by leveraging the smartphone to improve

- **Simplicity**
- **Ease of use**
- **Convenience**
- **Affordability**

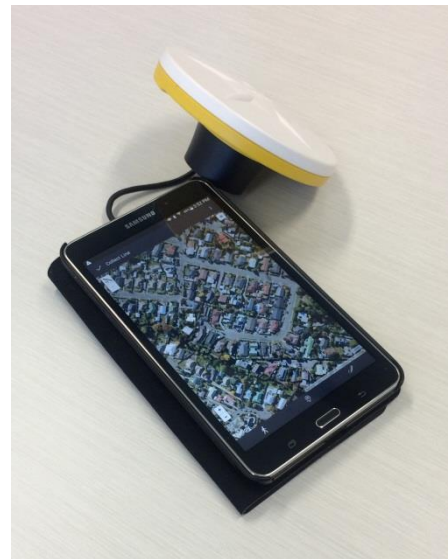
Catalyst as a system: Four key components



- A Catalyst enabled application
 - Catalyst SoftGNSS receiver service
- The Trimble DA1 digital antenna
- Your subscription to a positioning service level
- Your Smart phone

So what is Catalyst?

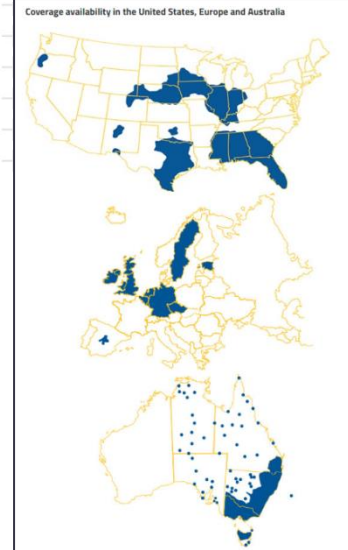
- A software defined GNSS receiver
 - Multi-frequency (L1 and L2)
 - Multi-constellation (GPS and Galileo)
- Designed for embedding into Apps for mobile platforms (smartphones and tablets)
 - Android only (worldwide)
- Supported by a small, lightweight, high performance dual frequency antenna
 - Trading best performance for more affordable pricing



Trimble DA1 with Samsung 7" tablet
running TerraFlex

Quick Connection

- At start up automatically select the best available correction service based on location and subscription level



VRS (NRTK)



RTX satellite delivered

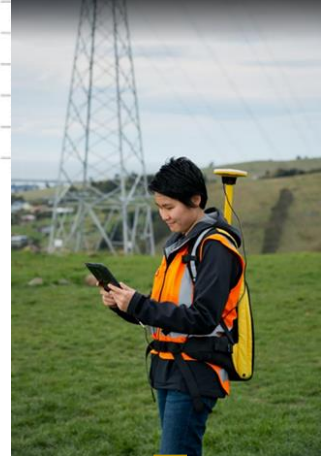
Operating vs Capital cost

- **Enabled by a new business model**
 - Download the app
 - Purchase the low cost antenna, pole and bracket
 - Subscribe to the required level of service
- **Pay based on usage**
- **Provision to scale up/down with minimal capital expenditure**
- **Pay from operating expense as a part of a specific project**
- **The only required accessory is a low cost digital antenna**



Why have an external antenna?

- Required to get the performance
 - Current smartphones are single frequency
 - Current smartphone antennas are designed for cost not accuracy
- Enables upgrading from meter level to sub-metre and centimeters
 - Simply subscribe to a higher level of accuracy as required



How does it compare?

- Successfully closes “the gap” in positioning performance by significantly enhancing the mobile devices’ positioning accuracy
 - Delivers <1m and centimetre accuracies across a range of environments
- Less accurate in harsh environments than current GIS offerings
 - Constellation
 - Better multi-path rejection enabled by the wide band measurements in our Maxwell based hardware receivers
- Takes longer to get the centimetre accuracies
 - Convergence time is a function of the constellation
 - fewer satellites in total and fewer dual frequency satellites

Environment	Smartphone GPS only	Catalyst RTX Sub-metre service GPS only	Catalyst VRS centimetre service GPS only	GNSS HW NRTK GPS+GLN
Open	3m	0.5m	0.02m	0.01m
Mixed	2.2m*	0.8m	0.02m	0.02m
Harsh	3.7m	2m	2m	1m

What are the limitations?

CATALYST VS PROFESSIONAL RECEIVERS...

- **Catalyst softGNSS dual frequency**
 - GPS L1, L2C
 - Galileo E1
 - L band for RTX corrections
- **Good performance**
 - Longer initialization
 - Centimetre operation over shorter baselines
 - Performs best in open environments
- **Professional triple frequency receivers**
 - GPS L1, L2C, L2E, L5
 - GLONASS L1, L2, L3
 - Galileo E1, E5a, E5B
 - Beidou B1, B2
 - L band for RTX corrections
- **Great performance**
 - Very rapid initialization
 - Centimetre operation over very long baselines
 - Most accurate across all environments

What are the limitations?

- **At a system level you are limited by the phone/tablet**
 - **Operating temperature range**
 - Limited by the cell phone
 - Battery life may be poor at low temperatures
 - The upper temperature range is effected by the processor load
 - Our experience suggests 0-30 degrees Celsius as the practical range
 - Will operate at both lower and higher temperatures depending on the user device
 - **Battery life**
 - Limited by the internal battery
 - Typical phone (e.g. Samsung S5) is about 2 hours constant use
 - Varies with device, configuration (Wi-Fi or cellular) and applications being run
 - Option to address, the external battery
 - Provides approximately 2 hours per battery (one supplied standard)
 - **Rain/snow**
 - Varies with user device but most require an environmental case for reliable screen operation

Provides an option to meet a different set of user requirements

POSITIONING PROFESSIONAL USER

- Industrial grade quality
- Works in all weather
 - Extremes of hot, cold, and wet
- Battery lasts all day
- Expect to last for years - durability essential
- Most productive
- Capital purchase



POSITIONING SUPPORTED USER

- Prosumer grade quality
- Works in “normal” weather
 - Limited only by the phone
- Battery lasts long enough to support the primary job
 - External battery options
- Expect to update as smartphone technologies update
- Primarily operating expense



Summary

- New receiver-in-sw solution that allows you to BYOD
- Enables positioning on demand services
- Delivers unprecedented ease of use for sub-metre positioning globally
 - Ubiquitous coverage enabled by satellite and cellular delivery
- Enables the new users in your organization to “self service”
- Is the “Catalyst” for a host of new applications for high accuracy GNSS
 - Enabled through our SDK for the App developer community

