

Presented By:
<Your name goes here>

Trimble Monitoring

Automated Movement Detection with Confidence

Agenda

- 01** Who is Trimble (5 min)
- 02** Trimble Monitoring (15 min)
- 03** Industries and Customers (15 min)
- 04** Live Demonstration (15 min)
- 05** Solutions Overview (30 min)
- 06** Next Steps (15 min)



01

Trimble Overview



Trimble Overview



Group



NASDAQ:
TRMB (S&P500)



\$3.2B
In Revenue



39%+
Building &
Infrastructure



Innovation



2,000
Patents



360 Construction Workflow
& Technology Patents



\$450M+ (~15%)
R&D Re-invested



Resources



11,500+ Employees
in 35 Countries



1000+ Construction
Professionals



Global Customers
in **150** countries



Trimble Sectors



Natural
Resources



Geospatial



Construction



Transportation



Autonomy



Corporate
Accounts



Additional industries we serve



Rail



Environmental & Waste



Water Utilities



Electric Utilities



Mining



Forestry



Field Service

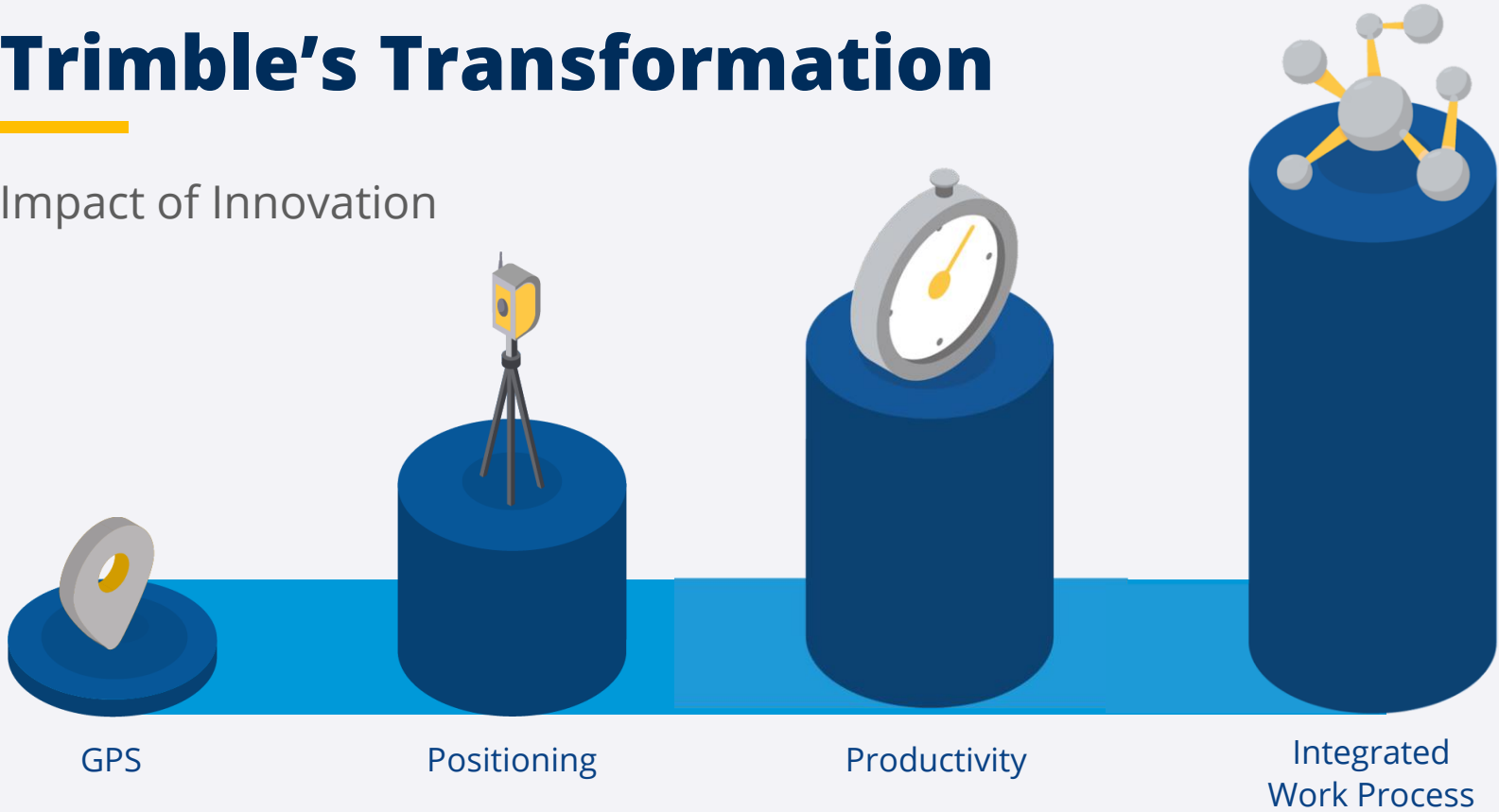


Oil, Gas, & Chemical



Trimble's Transformation

Impact of Innovation



Great Customers

Design & Engineering	Construction	Owners & Developers	Academic
       	                    	               	      



Trimble Surveying & Mapping connects the physical earth with the digital world enabling professionals in a wide variety of industries to transform the way they work

Surveying & Mapping solutions enable surveyors and mapping professionals to precisely capture information about critical infrastructure and create a digital representation



The Trimble Geospatial Story

- **Premium** brand in the survey and mapping industry
- Leader in **GNSS**, **Optical** and **Imaging** technology
- Diverse portfolio of data collection **hardware and software** solutions
- **Vertical market solutions** to address different market segments and their unique needs
- Leverage **global distribution network** for localized expertise, service, support and delivery

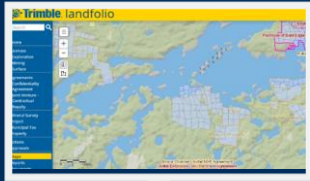
Geospatial



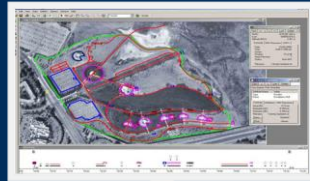
- **>70%** of POB¹ top 100 geospatial companies use Trimble
- **>10,000** surveyor and mapping firms in N.America are Trimble customers
- Joint venture with Nikon



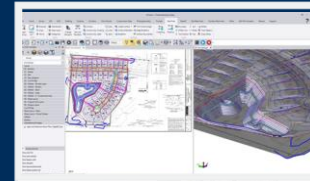
The Trimble Geospatial Story



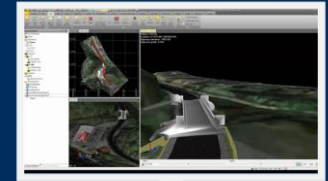
**Cadastral & Land
Administration**



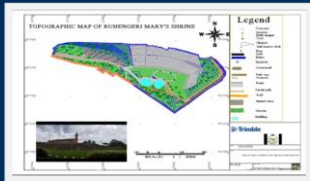
**GIS and
Mapping**



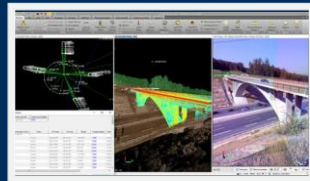
**Surveying &
Construction**



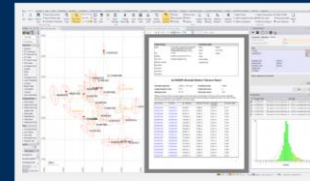
**3D Modeling
& Imaging**



Topographic



**Data
Analysis**



Reporting



Customers We Serve

**Survey, Engineering
and Construction**



**Mobile and
Aerial Mapping**



GIS



Forensics



Utilities



Military



Rail



Land Administration



Solutions We Provide

Precision GNSS



Total Stations



3D Scanning
and Imaging



Mobile Mapping



Rail



Software



Mobile Computing



Cloud



**Trimble monitoring
solutions are
an integral
part of
our portfolio**



02

Trimble Monitoring



Trimble Monitoring

Enabling **automated movement detection with confidence** for surveying and construction professionals supporting informed decisions about infrastructure.





- >20 years of history in Automated Monitoring, starting with Geodimeter
- 1000+ installations on projects across the globe
- Projects ranging from a few sensors to several thousands sensors
- Active sites and instrument operation continuously for 15+ years
- 100+ distribution partners providing local support and servicing



Trimble Monitoring Advantage

Surveying automation you can rely on.



Focus on customers success

24/7 support, installation and local services provided by the best distribution network in the Geospatial industry and the Trimble Monitoring team.



Durable and reliable solutions

Minimize project downtime and lower the cost of ownership with equipment and solutions designed to operate in the most challenging environments.



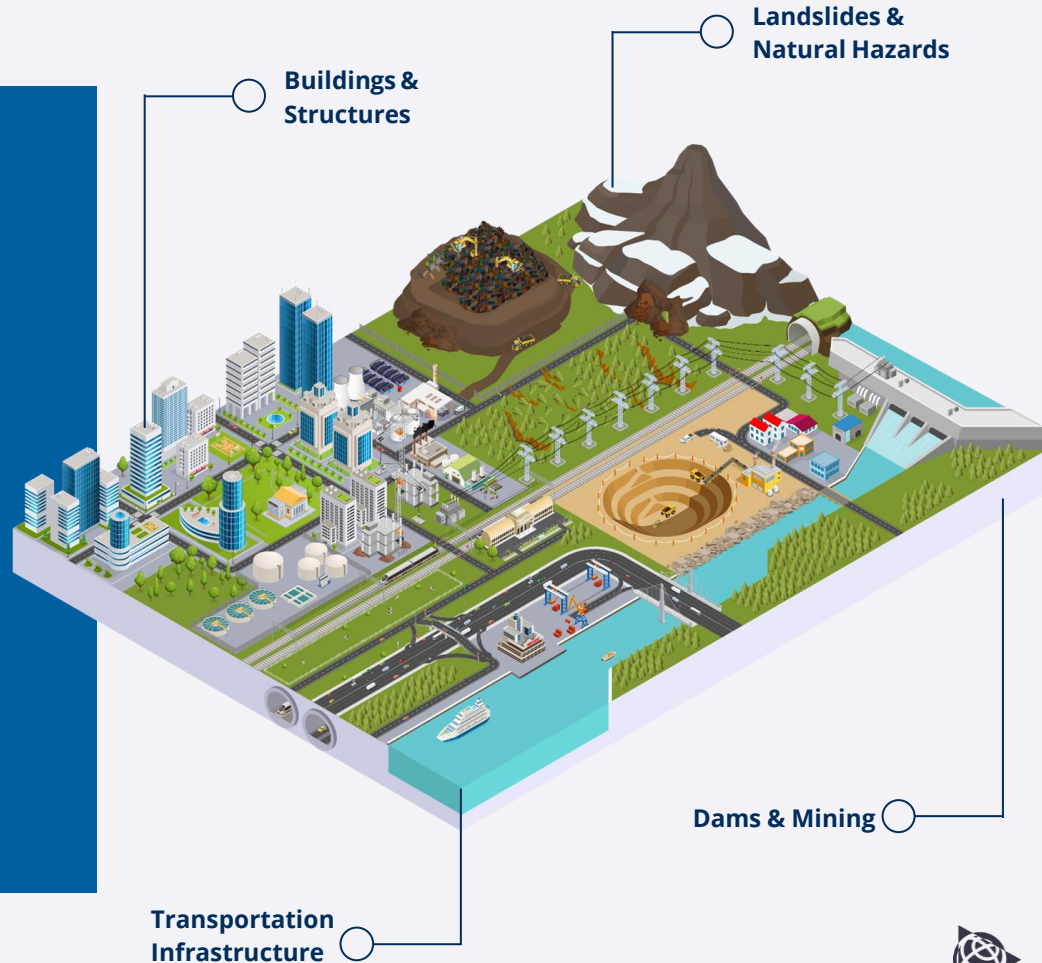
Automate and expand your geospatial services

Grow your business by automating data collection and analysis, reducing errors and costs associated with multiple site visits through the Trimble ecosystem.



03

Industries and Customers



Transportation Infrastructure



Crossrail, UK, Rail



Italy, Tunnel



Lake Tahoe, US, Road

Rail track monitoring



Road monitoring



Tunnel and convergence



Bridge infrastructure



Biel, Switzerland, Rail



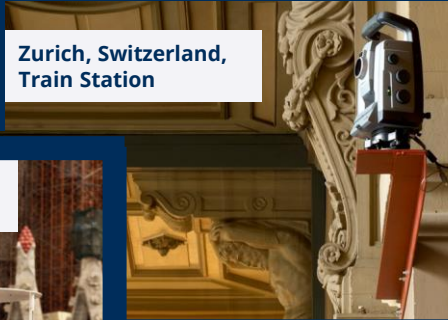
Florence, Italy, Rail

Buildings and Structures

Seattle, US, Deep Excavation



Zurich, Switzerland, Train Station



Barcelona, Spain, Construction



US, Earthworks Construction



Netherlands, Parking Garage



Construction management



Excavation and Earthworks



SKANSKA

Historical structures and rehabilitation



Dams and Mining



Indiana, Industrial Plant



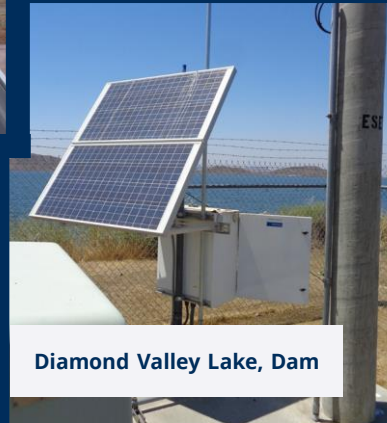
South Africa, Dam



DRC, Frontier Mine



South Africa, Grootegeluk Mine



Diamond Valley Lake, Dam

Dam wall monitoring



CITY OF CAPE TOWN
ISIXEKO SASEKAPA
STAD KAAPSTAD



台灣電力公司
Taiwan Power Company



Open-pit mining and tailings dam stability analysis

BARRICK



RioTinto



Industrial plant operations



Landslides & Natural Hazards

Denali NP, Subsidence



Emilia Romagna, Italy,
Slope Monitoring



Cervinia, Italy, Landslide



Landslide monitoring

Geodetski
fakultet
Sveučilište u
Zagrebu



Landfill management

FLORA
SURVEYING ASSOCIATES

WM
WASTE MANAGEMENT

Natural hazard prediction



04

Monitoring Solutions



Semi-automated vs. Fully-automated Monitoring



- Multiple visits to site are preferred
- Sensor is not fixed (e.g. tripod)
- Slow and low risk movement
- Small data sets/local storage



- Automated/remote collection and alarming
- Sensors permanently on site (e.g. pillar)
- Time sensitive movement detection
- Large datasets/local or virtual database

Increasing Project Requirements



Automated Monitoring

system overview

**TRIMBLE S SERIES, SETTOP M1,
NETR9 TI-M, GEOTECHNICAL, ACCESSORIES**

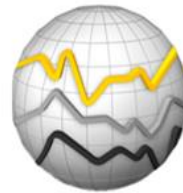


**Sensors based on the
project requirements**



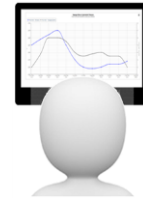
**Power and
communication**

TRIMBLE 4D CONTROL



**Trimble 4D
Control**

**Configuration, Storage
and Data Management**



**Trimble 4D
Web**

**Visualization, Reporting
and Alarming**



Semi-automated Monitoring

system overview

TRIMBLE ACCESS MONITORING



Data Collection and Scheduling
Total station, GNSS,
Level **Trimble Access Monitoring** field software

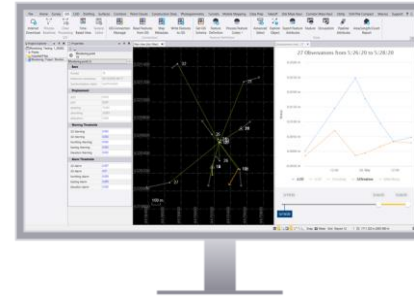


Data Transfer

Trimble Sync Manager
or manual data transfer



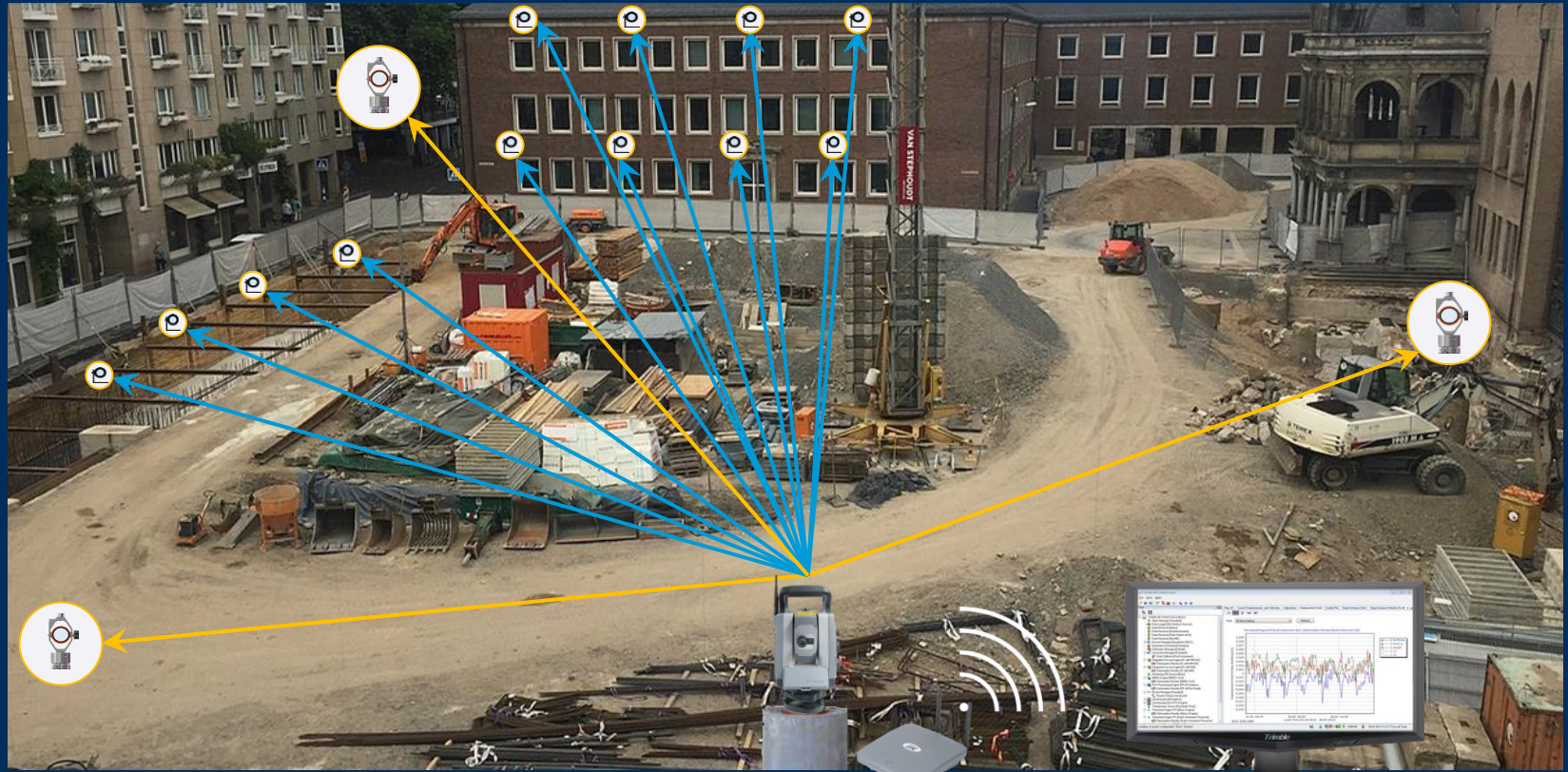
TRIMBLE BUSINESS CENTER MONITORING



Data Management, Processing,
and Reporting
Trimble Business Center Monitoring



Total Station

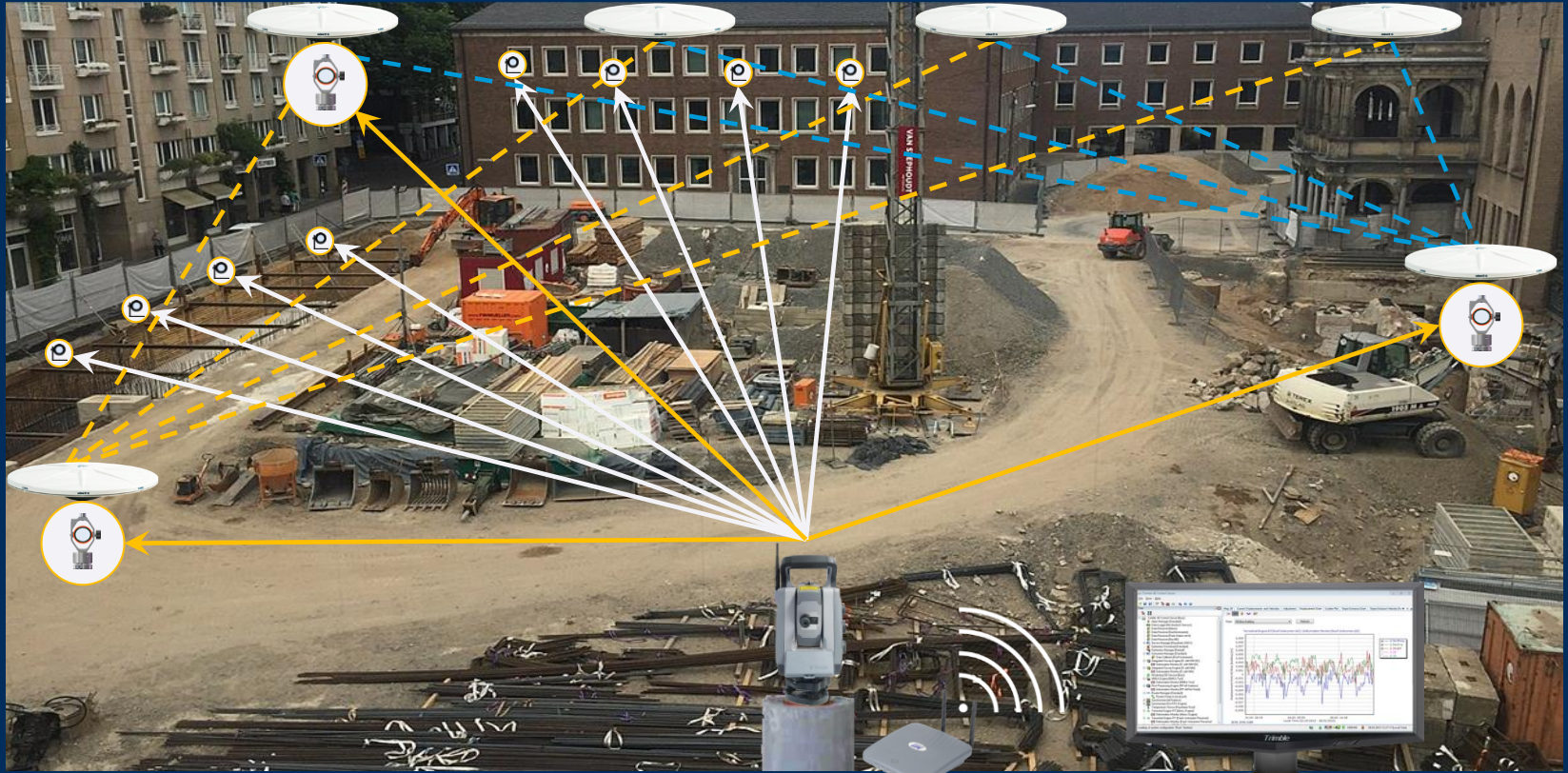


Trimble 4D Control





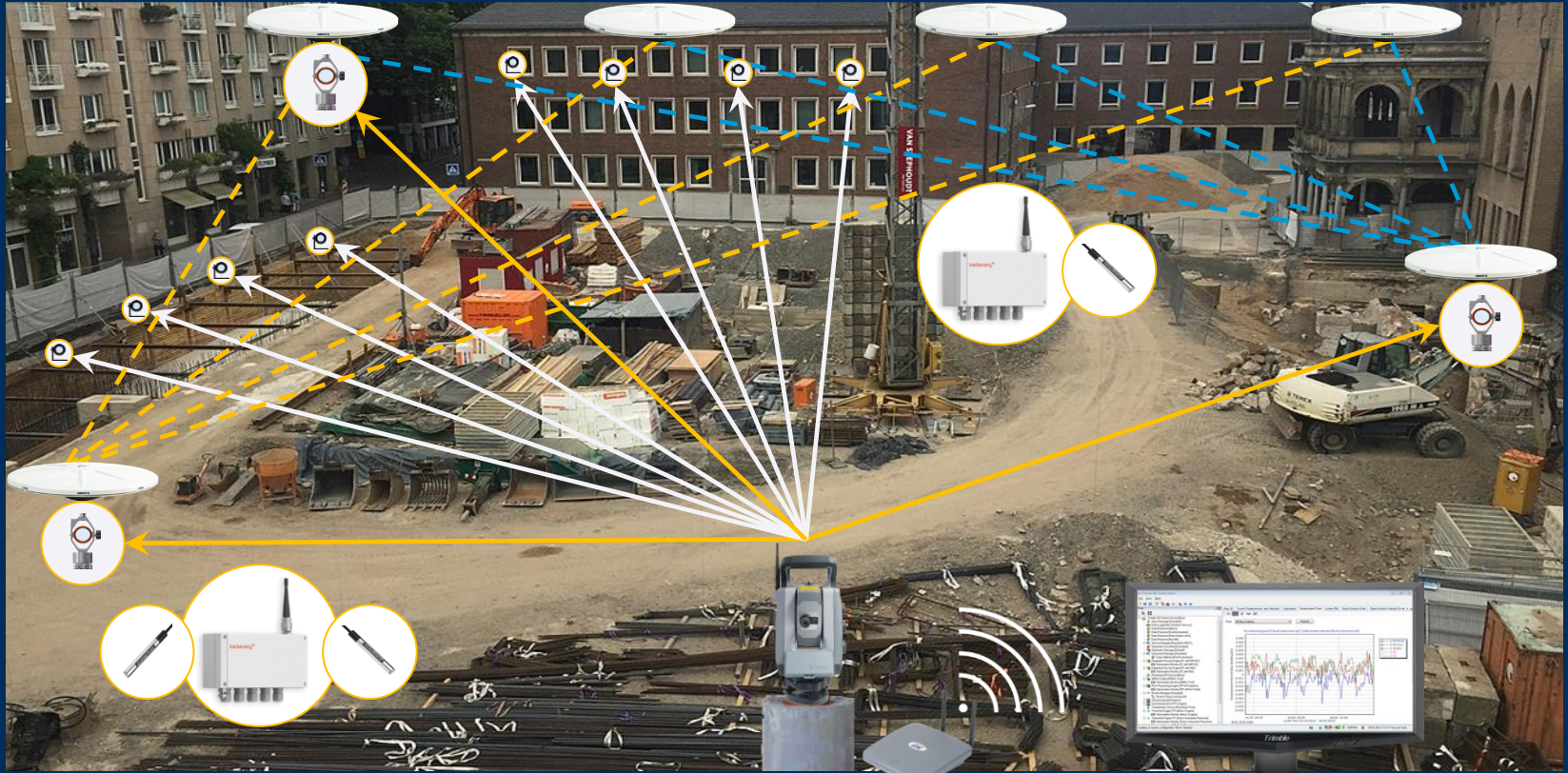
Integrated Survey



Trimble 4D Control

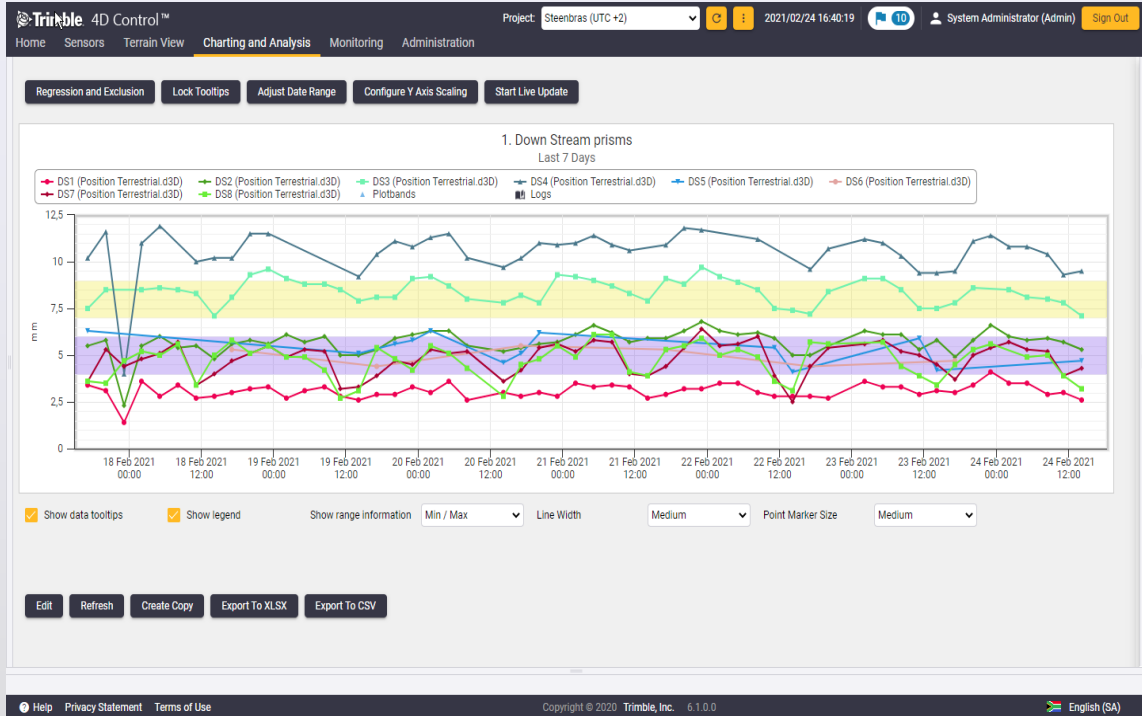


Additional Sensors



Trimble 4D Control





Deliverables

It's all about...

- Charts
- Analysis
- Reports
- Alarms

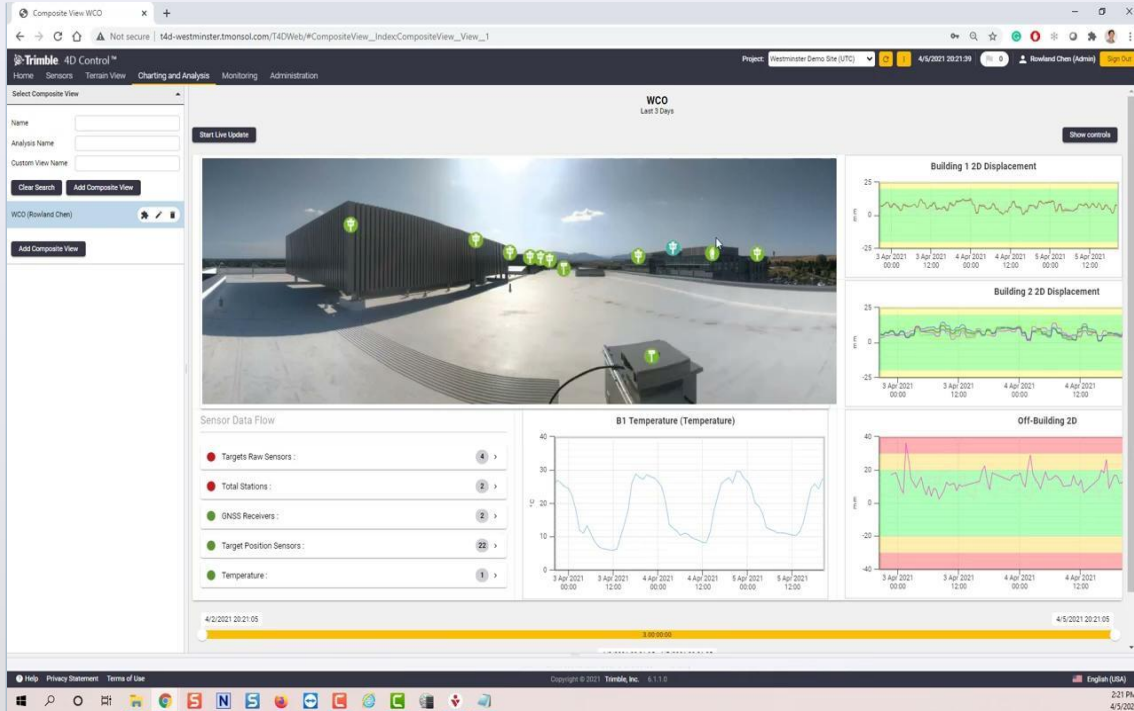


04

Live Demo



T4D Demo

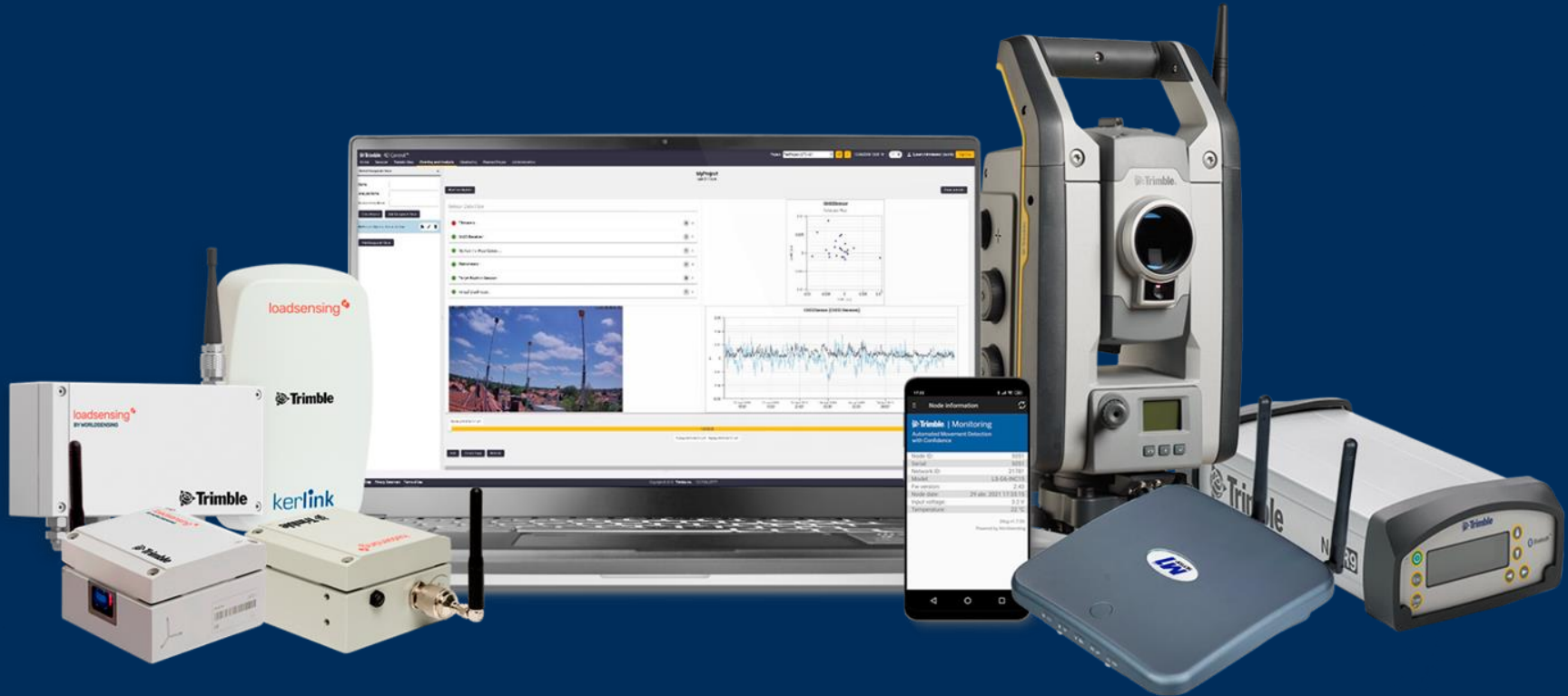


05

Solutions Overview



Trimble Monitoring Family



Solutions

01

**Robotic Total Stations and
On-site Communications**

02

**Trimble Access Field Software
and Data Collectors**

03

Monitoring GNSS Receiver

04

Accessories

05

Geotechnical

06

Trimble 4D Control

07

Trimble Business Center



Total Stations - Trimble S-Series

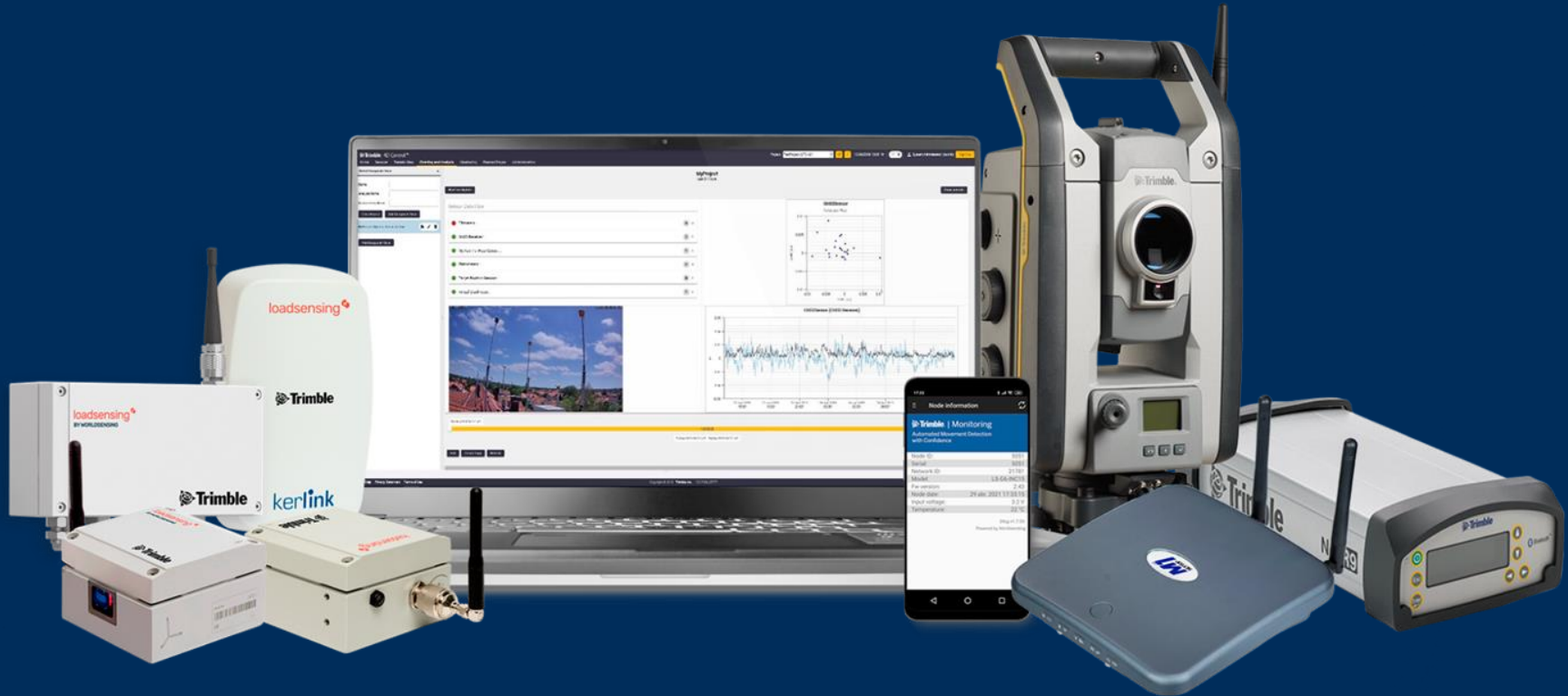


05

Solutions Overview



Trimble Monitoring Family



Solutions

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On-site Communications**

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Trimble 4D Control

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Trimble Business Center



Total Stations - Trimble S-Series



Trimble S-Series Provide Durable and Reliable Instruments for Tunnel Surveys



S9 and S9 HP

For **most demanding monitoring applications** with long range option and 0.5" angular 0.8mm EDM accuracy.



S7

Premium all inclusive model perfect to use in monitoring and general surveying.



S5 Ti-M

For **efficient and dependable** operation, maintaining the highest possible accuracy.



Reliability and Durability in Most Challenging Environments

- **Longest continuous operations** with the best sealed system on the market powered by Trimble frictionless MagDrive technology and IP65 rating.
- **Protect your investment** and use interchangeably in general surveying and monitoring with upgradable servo and fully robotic options.
- **Add targets and perform checks remotely** by seeing what the instrument sees with Trimble VISION.
- **Stay locked on the right targets**, collecting the information you need in tight corridors - Using Trimble Autolock and Trimble FineLock.



Total Station Decision Matrix

Multiple flavors of instruments to fit your needs

Application	Instrument	Features
Most challenging construction and engineering environments	S9 HP 0.5" Autolock, VISION, FineLock	Autolock, Finelock, VISION cameras, highest accuracy EDM
Long range monitoring (>700m open pit mines, dams, etc.)	S9 HP 0.5" Robotic, Long Range FineLock	Long Range Finelock, highest accuracy EDM (no VISION)
Flexibility between monitoring and surveying	S7 DR Plus 1", AutoLock (upgradeable to Robotic), VISION, Scanning, FineLock	Autolock, Finelock, VISION camera, Scanning, Robotic mode



Communication and Control - Settop M1

INTEGRATED
SURVEYING
IN ONE
SIMPLE
DEVICE



Settop M1 - Turning a Total Station into a 24/7 System has never been easier

- **Controls the instrument** - acts as a total station controller providing power and watchdog capability to ensure your instrument never stops working.
- **Flexible connectivity options** - communication via cellular (4G) with SIM card support, satellite data or via Ethernet to local LAN network with support for radio connections and mesh configuration.
- **No loss of data. Ever!** - with onboard storage your system keeps working and all the data is saved in case of communication link down.
- **Powerful WebUI** - connect to your instrument on a desktop or mobile from anywhere in the world and see what instrument using Trimble Vision.



Data Collectors and Trimble Access



Data Collector with Trimble Access

Field data collection and site preparation



TSC7

Most power and
functionality (Windows)



TSC5

Best all around rugged
data collector (Android)



TDC600

Small profile, light
weight, doubles as
phone (Android)



TCU5

Onboard
(Android)



Trimble Access Monitoring

Field software for efficient data collection and monitoring site setup

Automated data collection

Efficiently collect monitoring measurements with in-field reporting and alarms

Site setup and preparation

Define your monitoring network and targets to prepare for automated system with Settop M1 and T4D Integration

Reporting and analysis

Share reports from the field and integrate with Trimble Business Center for a comprehensive semi-automated package



Automate your Total Station with Settop M1

Creating autonomous systems in 15 easy steps



NetR9 Ti-M GNSS Receiver



Extremely accurate and reliable with the Trimble NetR9 Ti-M

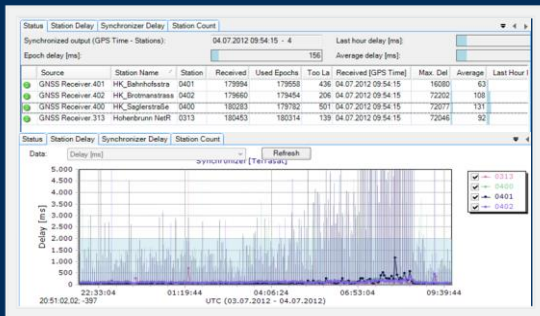
- **Extremely reliable** - support for applications requiring high frequency updates (20Hz) providing mm-level accuracy for most demanding applications with Maxwell 6 board inside
- **Highly accurate** - paired with T4D Control software, get the most out of the any project scenario by a number of processing options and adjustments available
- **Protect your investment** - utilize both for Monitoring and CORS/VRS network operations and configure processing styles
- **Flexibility in T4D** with additional GNSS Receiver options: Trimble R9s, Alloy



GNSS Processing with T4D

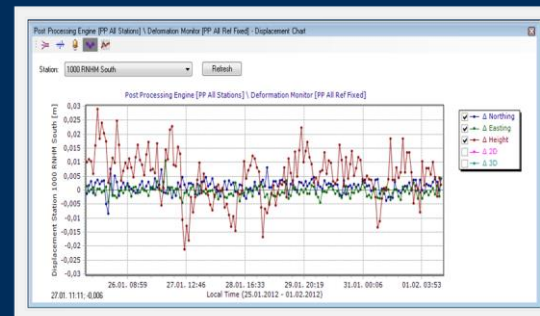
Powerful and flexible

Real-time



Baseline or VRS mode.
High frequency (sub-second).

Post-processed



Processing of stored raw
with precise ephemeris.



Accessories



One stop shop for all your monitoring needs

Prisms and targets

- Small 25 mm prisms (box 25)
- Special tunneling and asphalt prisms
- Large prisms for greater distances

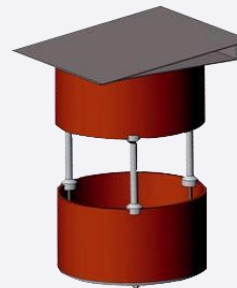


Power and cables

- Solar panels
- Backup battery options

Mounts and enclosures

- Instrument shelters
- Box enclosures



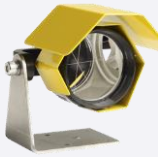
Prisms and Targets

Prisms for various monitoring applications



Small Monitoring Prism

Box of 25, good for all situations



Large Monitoring Prism

Best for long range targets and reference points



Integrated Survey Prism

For integrated survey setup using TS and GNSS



SECO Circular Prism



Asphalt / Road Prism

Deployed on trafficked surfaces



Wall-mount Monitoring Prism

Screw mount in surfaces like tunnels, walls



Mounts and Enclosures

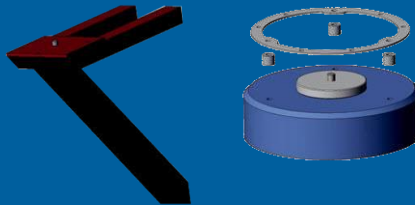
Total Station Enclosure

Jail with security locks
Housing with sloped top



Sensor and Target Mounts

Wall mounts
Pillar plates



Cabinets

Standard cabinet
Extended cabinet for GNSS



Geotechnical Sensors



Geotechnical monitoring introduction

How?



Loadsensing Main Benefits

Long-range

up to 15 km / 9 miles

Low-power

10 years of
unattended operation

Quick and easy set-up

No additional
programming
required

Robust Design

IP67 certified and
tested from -40C to
+80C

Compatibility

With all major sensor
manufacturers

Network Management

Connectivity
Management Tool



Geotechnical wireless dataloggers

Data loggers

Vibration wires



VW 1 channel
With ext. antenna



VW 1 channel
Without ext.
antenna



VW 5 channels

Analog



ANA 1
channel PICO



ANA 4
channels

Digital




1 RS485 & 2
SDI-12 channels



Geotechnical wireless dataloggers

Dataloggers

Datalogger	Type sensor
Vibration wire 1-5 channels	Piezometer 
	Load cells
	Strain gauges
	Pressure cells
Analog 1-4 channels	Load cells
	Displacement sensors
	Pressure Transmitters
	Temperature probe
	Rain gauges
Digital RS485 & SDI channel	IPI (In Place Inclinator)
	Load cells
	Piezometers
	Extensometers
	Piezometer



Piezometer (water level)



Temperature probe



Pressure cell
(stress on plane
surface)



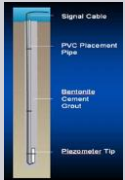
Strain gauge
load cell



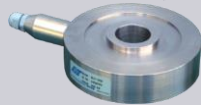
Displacement
sensor
(crack meter)



Data Logger Sensor Compatibility



Piezometers



Load cells



Water level Sensor



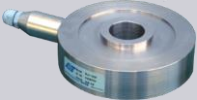
Pressure Cells



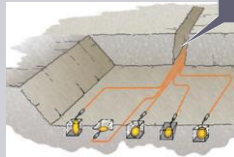
Strain gauges



Extensometers Rods



Load cells



Settlement Cells



Crack meters



Tilt Meters



Sensor Compatibility across many geotechnical manufacturers



Geotechnical wireless sensors

Sensor connected - Tiltmeters



LS-G6-INC15
Wireless tiltmeter
With an external
antenna



LS-G6-INC15-I
Wireless tiltmeter
With an internal
antenna

Application

Railway track monitoring

Building response to tunneling and excavation-induced ground movements.

Foundations and deep excavations

Landslides and slope stability.

Bridge and structural health monitoring.

Embankments



Geotechnical wireless sensors

Sensor connected - Tiltmeters



LS-G6-INC15
Wireless tiltmeter
With an external
antenna



LS-G6-INC15-I
Wireless tiltmeter
With an internal
antenna

Features

Wireless sensor

High accuracy and repeatability

Long battery life (> 5 years @ 1h sampling rate)

Reduced size (103x100x61 mm, internal antenna version)

Two versions available - external and internal antenna

Durable and versatile



Geotechnical wireless sensors

Sensor connected - Tiltmeters



LS-G6-INC15
Wireless tiltmeter
With an external
antenna



LS-G6-INC15-I
Wireless tiltmeter
With an internal
antenna

Advantages

- Highly accurate and reliable biaxial tilt sensor
- Long-range communications (up to 15 km / 9 miles)
- Long battery life (> 5 years @ 1h sampling rate)
- Robust, small and weather-proof box
- Easy configuration
- Proven track record

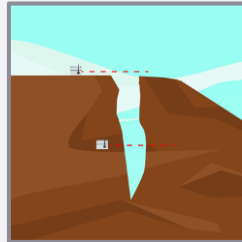
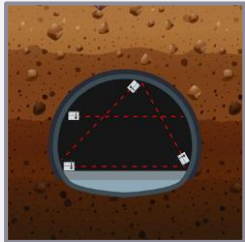


Geotechnical wireless sensors

Sensor connected - Laser distance



LS-G6-LASER
Laser Distance Meter



Application

Tunnel and mining convergence monitoring

Deformations in underground excavations

Remote monitoring of slope movements

Fracture and faults surveillance

Bearing and expansion joint movements

Monitoring displacement in structures and buildings

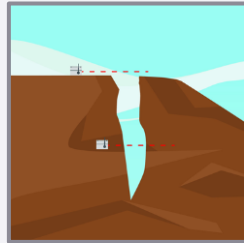
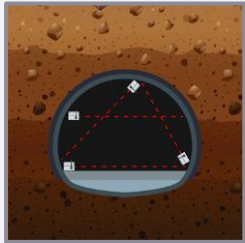


Geotechnical wireless sensors

Sensor connected - Laser distance



LS-G6-LASER
Laser Distance Meter



Feature

Wireless sensor

High accuracy and repeatability

Long battery life (> 5 years @ 1h sampling rate)

Reduced size (103x100x61 mm, internal antenna version)

Two versions available - external and internal antenna

Durable and versatile

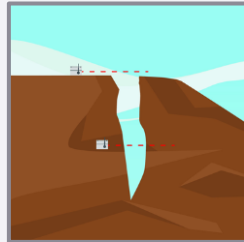
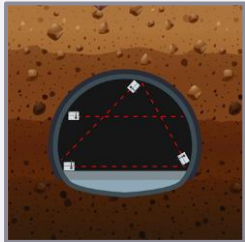


Geotechnical wireless sensors

Sensor connected - Laser distance



LS-G6-LASER
Laser Distance Meter



Advantages

- Highly accurate and reliable biaxial tilt sensor
- Long-range communications (up to 15 km / 9 miles)
- Low-power, long battery life (over 5 years)
- Robust, small and weather-proof box
- Easy configuration
- Proven track record



Geotechnical onsite communications

4G rugged, outdoor gateway



Advantages

Communicate with up to 250 wireless sensors on site

Long-range communications (up to 15 km / 9 miles)

Meets LoRaWAN regional frequency requirements

Rugged, outdoor enclosure

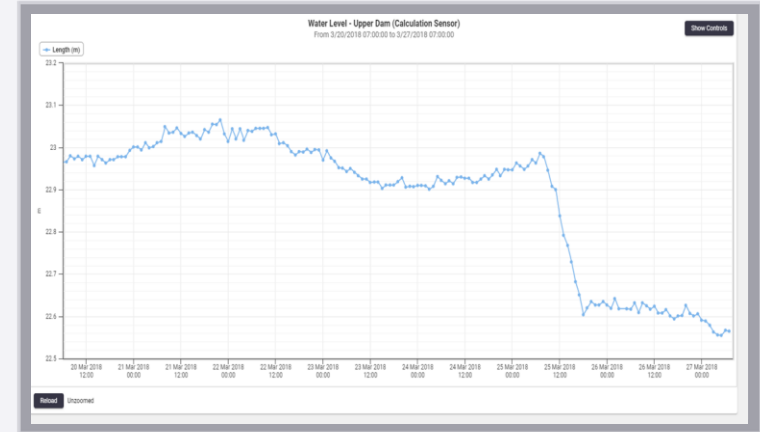
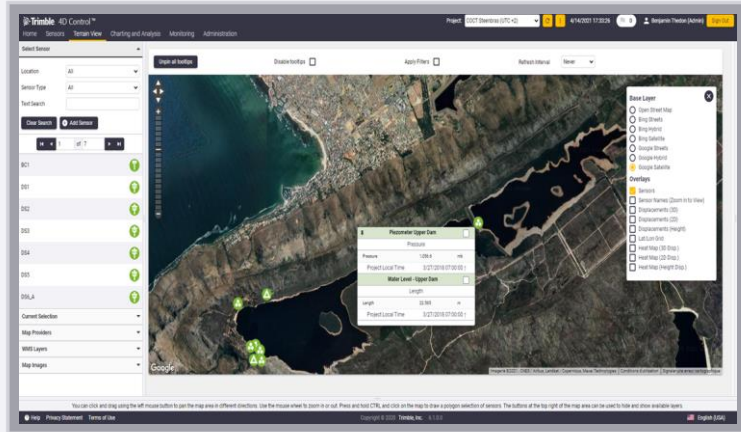
Easy configuration through web UI

Integrated GPS, LoRa, and 4G

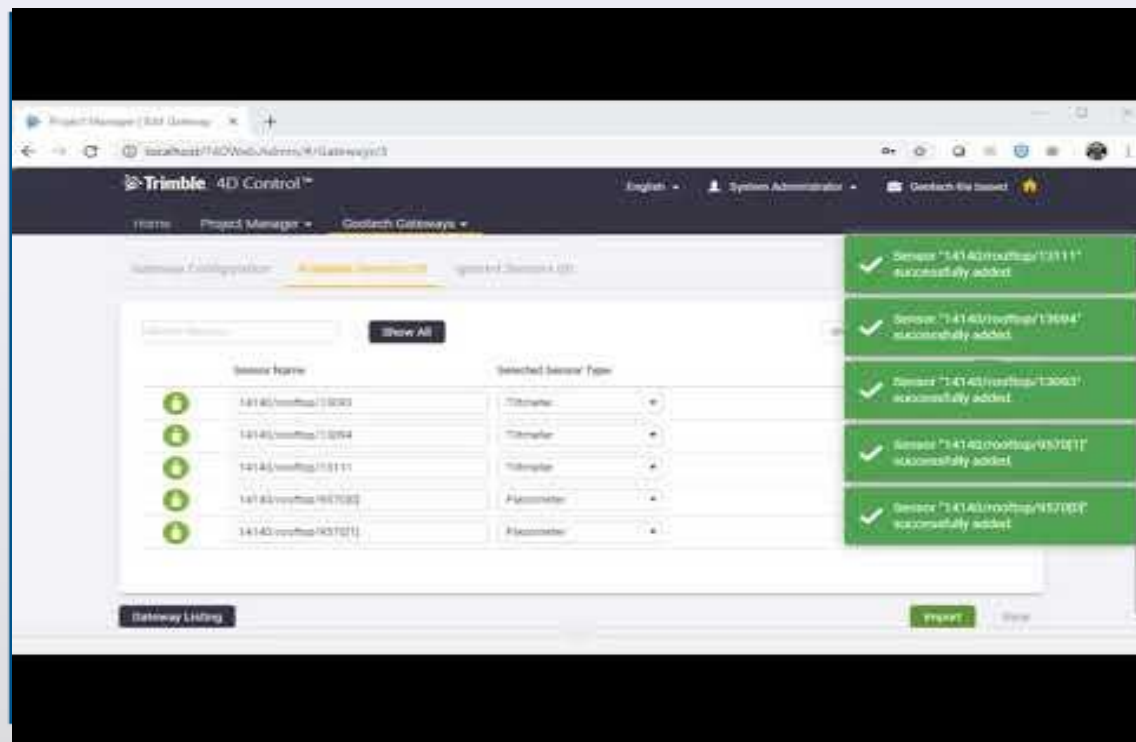


Geotechnical data visualization and analysis

T4D automated analysis, alarming, and reporting



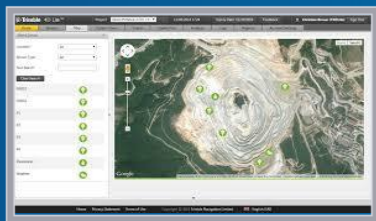
Geotechnical sensor configuration on T4D



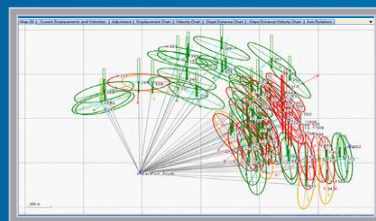
Trimble 4D Control - Software that brings it all together



T4D Control software enables **automated movement detection with confidence** for surveying and construction professionals supporting informed decisions about infrastructure.



**Sensor Management
and Data Integration**



**Geodetic Processing
and Adjustment**



**Comprehensive
Analysis and
Visualization**



**Conditional Alarming
and Reporting**

Automated integration of geospatial data together in a single platform

Geodetic and Geotechnical sensors supported by T4D



Total Stations

Total stations determine three dimensional coordinates of target points by combining horizontal angle (Hz), vertical angle (V) and distance (d) measurements.



Geotechnical Sensors

Geotechnical instrumentation refers to all the different sorts of instruments that are used to monitor the earth and environment (e.g. soil moisture, temperature), structures on it and beneath it (e.g. cracks).



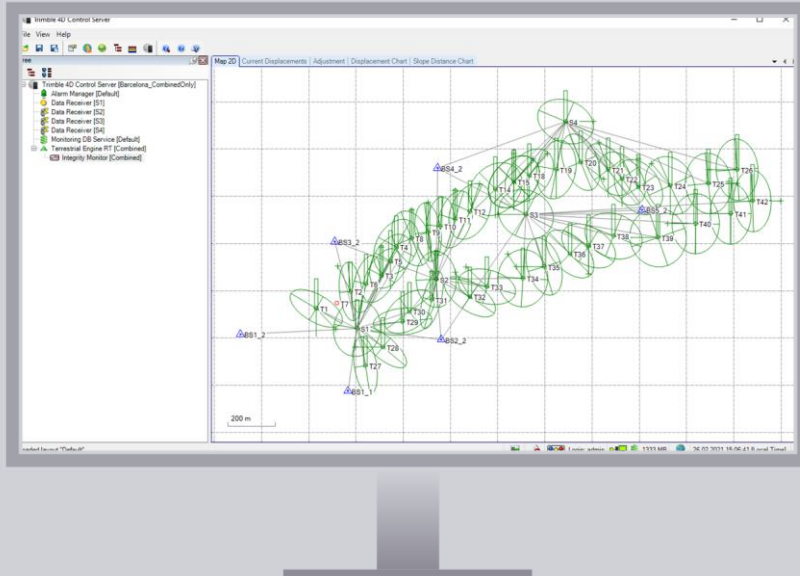
GNSS Receivers

GNSS receivers deliver high frequency and accurate three dimensional coordinates of target points.

Unique selling point



Geodetics and Processing



Coordinate Systems and Scale Factors

Large database of published coordinate systems
Site calibrations and local projects

Comprehensive Least Square Adjustment

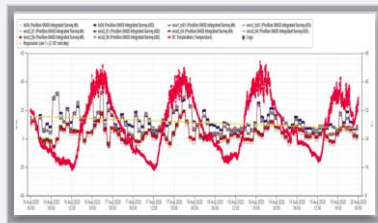
Blunder and systematic error detection
Minimize and distribute random errors
Combined adjustment of all geodetic sensors

Automated measurement corrections

Automatically correct measurements using
on site temperature and pressure sensors
Minimize negative atmospheric influences



Comprehensive Analysis and Visualization Flexibility and power to supporting decision making



Visualization

Different visualisation options
(e.g. normal chart, bar chart)
Multiple map base layers
(Google Maps, Microsoft Bing, WMS,...)
Heat Maps with displacement overlays

Analysis

Observation and velocity analysis
Apply unique mathematical calculations
for application specific analysis
Create velocity and inverse velocity for trend determination

Real-time updates

All analysis, reports, charts, and visuals
are updated in real-time



Conditional real-time alarms

Scheduled reports

- Report on sensor status, alarms, analysis
- Define report schedule and recipients

Public custom views

Create custom web URLs for stakeholders demonstrating analysis and charts



Flexibility to deploy T4D on physical or virtual server

T4D Deployment



Physical

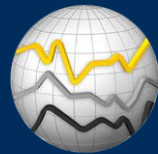
- On site server/computer
- Managed by internal IT team
- Larger upfront cost to set up



Virtual

- Pay as you go
- Reduced IT burden and auto updates
- Scale server as project requirements change
- Security services and data protection
- Microsoft Azure support





Picking the right T4D Edition for you

Flexibility for monitoring projects of all lengths and sizes

T4D Advanced

Everything!

Full processing of geodetic and geotechnical sensors with all visualization, reporting, and alarming in T4D Web

T4D Intermediate

Geodetics and processing for total station and GNSS to integrate with your existing visualization and reporting system

T4D Field

Total station data collection and measurement corrections exported to your visualization and analysis platform

T4D Geotech

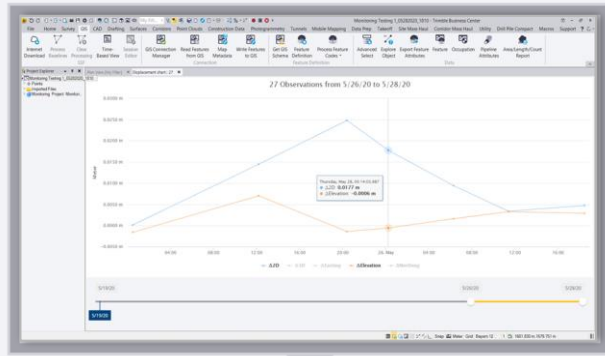
T4D Web analysis, visualization, reporting, and alarms for Geotechnical-only

Add additional total station, GNSS, and geotechnical sensor nodes for project requirements



Trimble Business Center - Platform for surveyors

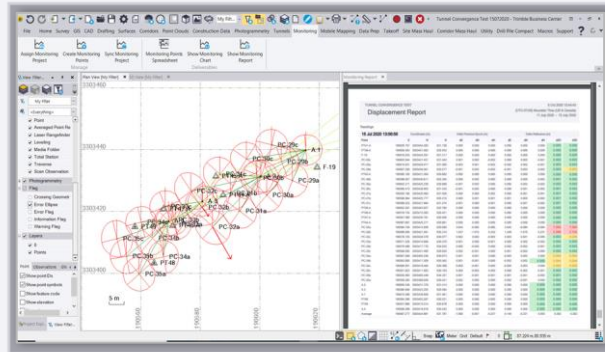




Semi-automated Monitoring Deliverables

Visualize and quantify movement Patterns

3D displacement vectors generated from GNSS, total station, or level data



Flag points with significant movement

Define alarm and warning thresholds

Comprehensive deliverables

Generate charts and reports for monitoring data from any geodetic sensor



06

Next Steps

Implementing an automated monitoring system

The Trimble Monitoring Process

- Look at project requirements and understand best system for the job
- On site installation and training service
- Ongoing support
- Expanding system and to new projects



Trimble Monitoring Process



**Working together
to understand
project scope**



**Designing the right
monitoring system
for the job**



**Trimble distributors
and installation
teams providing
training and support**



**Rely on our global
support network to
provide help when
needed**



**Take your success
and sale to
new projects**



Partnering with Trimble is guaranteed success

monitoring.trimble.com

Check out a live monitoring project on the website

