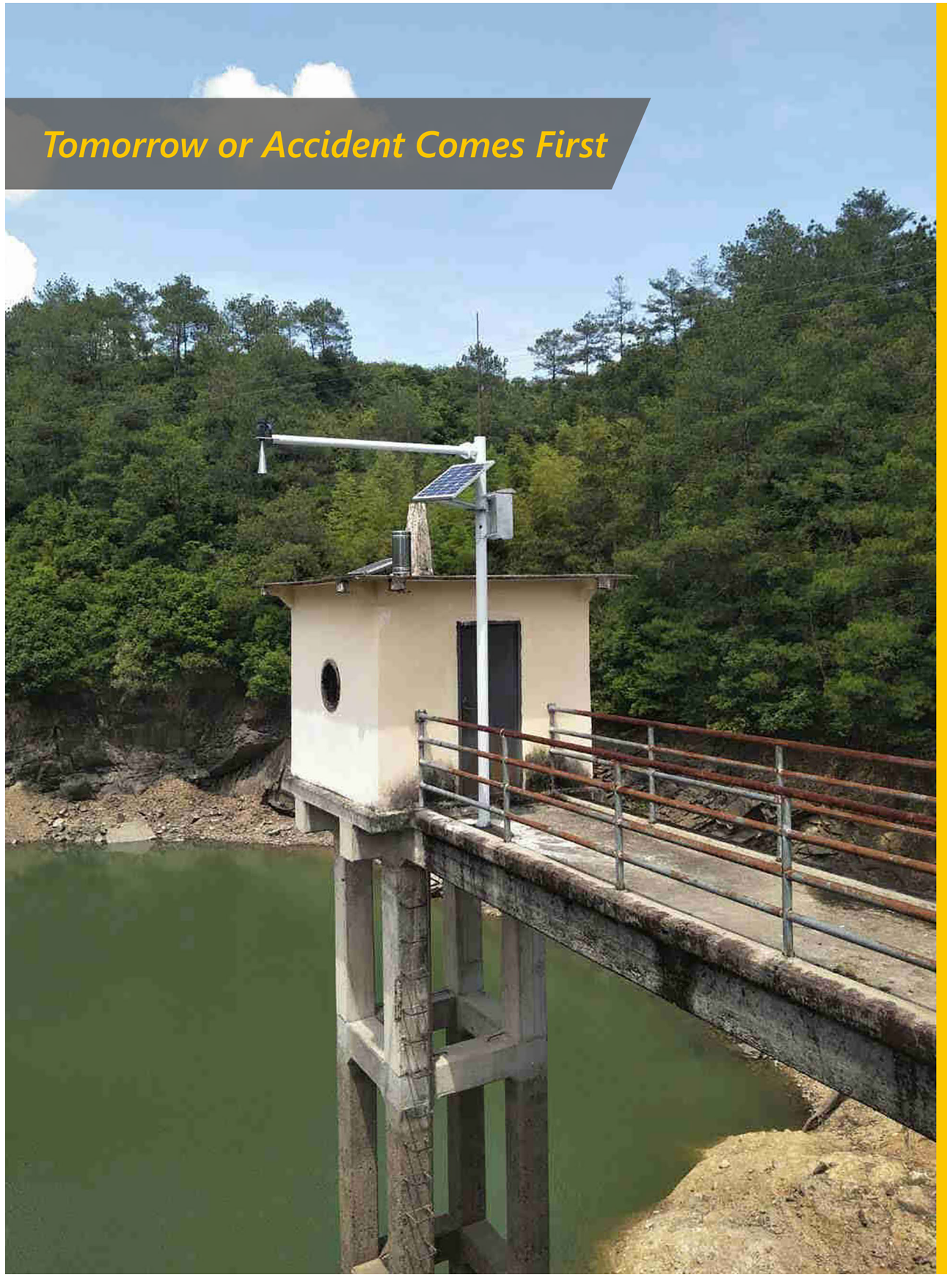


2

MONITORING

Introduction

Monitoring is a very wide concept in risk & asset management, and the value of geo-monitoring now is getting increased attention like strategically buying insurance. Within the current practice, we are engaged in a complete range of automated monitoring solutions by utilizing GNSS, Robotic Total Station, and a variety of smart sensors. Usually, a 24x7 monitoring project could consist of a single one or two collaborative methodologies mentioned below depending on the site conditions and job demands. Meanwhile, relevant software platforms shall accompany in service to visualize the system, process data and display realtime, report in meaningful ways, and deliver warning messages just in case.

GNSS Monitoring

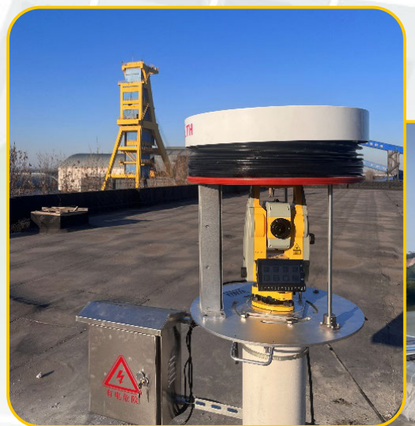
Generally speaking, this type of monitoring network includes permanently installed GNSS devices and transferable base station receivers collecting GPS observations and transmitting differential corrections as well, which is used to perform the regional monitoring of changes in the speed of tectonic movements of civilian structures or earth's crust and study the rate of deformation of architectural reality and earth's surface of small areas. Dedicated GNSS stations and quality control applications are quite commonly seen in terms of monitoring projects for bridges, dams, open-pit mines, slopes, buildings, etc. when centimeter to millimeter level accuracy is expected and satellite-based measurement is possible outdoors.

Smart Sensors Monitoring

In the geo-information industry, a variety of smart sensors are applied to record structural or meteorological data that might lead to certain geological or hydrological changes eventually. Such transducers would be systematically installed in mid-air, ground surface, or underground to perform contactless or physical measurements, and issue alert warnings when any slight change beyond the critical threshold occurs. Compared to conventional survey equipment, sensors could be more cost-friendly yet fairly productive likewise to fit some of the economical solutions. This approach shall come with an IoT software platform accordingly to manage all kinds of data for comprehensive statistics and comparative analysis.

Robotic Total Station Monitoring

Investigating surface displacements in complex environments is often subject to challenges due to apparent inaccessibility or harsh climatic conditions. To understand this key movement, Automated Monitoring Total Station (AMTS) has been in operation to continuously provide repeatable measurements with high accuracies, typically millimeter level, which features capturing data from a remote location, either within or outside the monitored area. As the total station principle is dependent on intervisibility instead of satellite signals tracking, such robotic devices might be operating also indoors and underground, for example, inside tunnels, and working together with some reflector prisms mounted onto the crucial target points.



MR2/MR3 Integrated Mobile Station Receiver

- Rugged device against 7x24 continuous operation outdoors
- GNSS board, GNSS antenna, telecom module, and tilt sensor all in one unit
- Supports GPS, Glonass, Beidou, Galileo, QZSS, SBAS, IRNSS and even Beidou-PPP, Galileo-HAS
- Cost-efficient for quick installation and flexible maintenance
- AI-based wake-up data capture and sleep stand-by for less power consumption
- Data transfer via specific DTU control device instead of external sensor
- Remote control available via software platform or APP (custom build)
- Ready to work with solar power system (MR3 only)

MR2

MR3

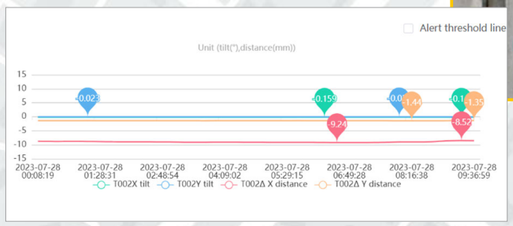
S10mini Mini CORS Receiver

- Rugged device against 7x24 continuous operation indoors
- GNSS board, telecom module (3G/4G and Ethernet), and tilt sensor all in one unit, ready to fit mini choke-ring antenna
- Supports GPS, Glonass, Beidou, Galileo, QZSS, SBAS, IRNSS and even Beidou-PPP, Galileo-HAS
- Stable power supply and telecom facilities needed for installation
- State-of-the-art Farlink 3W radio datalink built in, UHF working range 15 km max.
- Data transfer via specific DTU control device instead of external sensor
- Remote control available via software platform or APP (custom build)

S10 mini

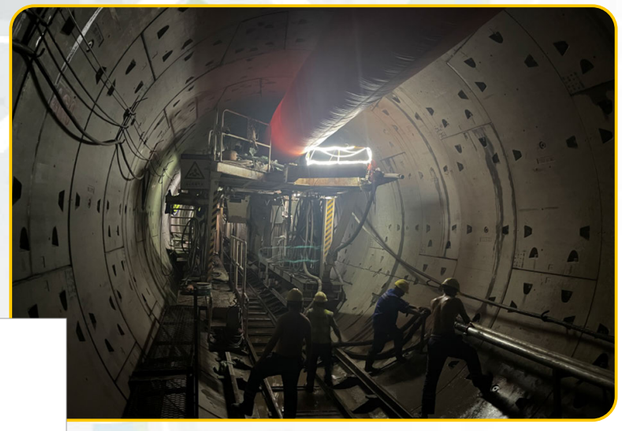
MS1 All-in-one Tilt Sensor

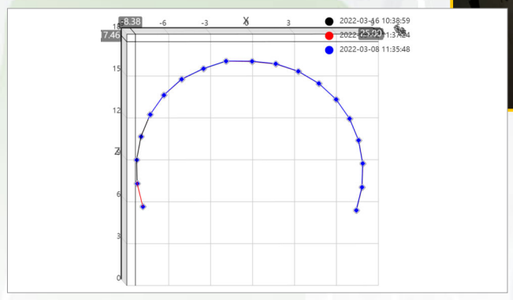
- 3G/4G telecom module built in, wireless design, cable-free
- 3-year continuous operation powered by high-performance internal battery
- Accuracy performance 0.04° with temperature extrusion (0.005°, without)
- Remote control available via software platform or APP (custom build)
- Vibration triggered in case of emergency
- Market-proven in plenty of geological and construction safety monitoring projects



ADM1 Array Displacement Meter

- Used for construction settlement, underground deformation, tunnel management, and railway settlement
- IP68 rating, ready to install in the water body
- Accuracy performance 0.005° without temperature extrusion
- Rotating angle auto adjustment, and sectional data forecasting available
- 0.5m/1m/2m per section in length, optional



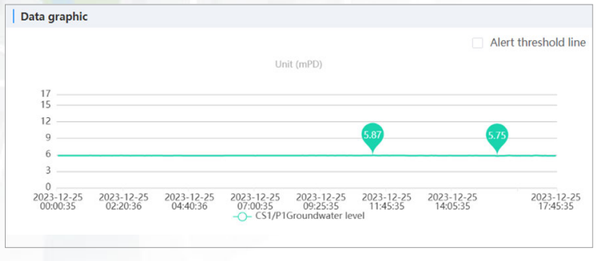


RLG001 Radar Water Level

- Used for underground water level monitoring, flowrate prediction, tidal level observation, and hydrological forecasting
- Aluminum alloy housing, and 316L stainless steel trumpet
- Contactless measurement, working frequency up to 26GHz
- 0.4-30m typical measuring range, accuracy performance best up to 3mm
- RS-485 Modbus protocol, typical; SDI-12 protocol, optional
- IP65 rating, designed for 7x24 continuous operation
- LCD screen for data display, optional

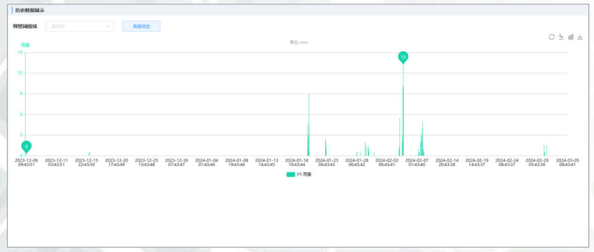
SV40-VW Piezometer

- Measures piezometric levels and pore water pressures in soil and rock formations
- Used for dam monitoring, tidal level observation, and foundation monitoring
- 0-35m measuring range, ≤0.02% F.S. resolution, ≤0.1% F.S. accuracy



RA01 Tipping Bucket Rain Gauge

- Measures volume, intensity, and duration of rainfall
- Used in meteorology, hydrology, agriculture, forestry, land use, geology, highway, railway, etc.
- Measuring accuracy ≤±2%, intensity range 0.01-8 mm/min
- Tipping bucket designed with 3D streamline style
- Self-cleaning against dust and water

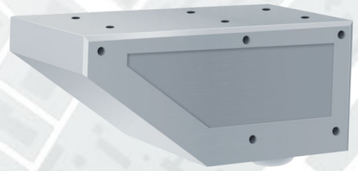


VDM01 Visual Displacement Meter

- Features cutting-edge DIC (Digital Image Correlation) and AI technologies
- Used for bridges, tunnels, slopes, buildings, foundations, dams, high formworks, etc.
- Detects structural displacement of the target in dynamic or static deformation
- Super subpixel-level edge algorithm, resolution up to 1/200 pixel
- One device ready to work for multiple points in a large area simultaneously

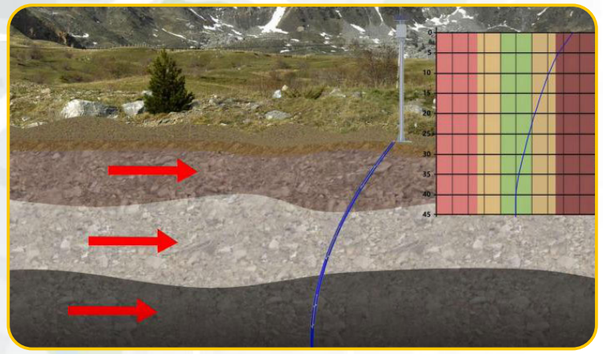
RF01 Radar Flowmeter

- An integrated flowmeter sensor that continuously measures flow speed, water level, and flow volume
- Equipped with planar microstrip array antenna and inbuilt vertical angel adjustment on board
- Features contactless measurements of the water bodies by microwave radar
- High accuracy performance powered by fluctuating water surface modeling and signal process algorithm
- IP68 rating, ready to work outdoors against all weather conditions



CX01 Smart Inclinometer

- A 3-axis tilting sensor that fits 3D spatial detection
- Typically used in monitoring projects of dams, slopes, foundations, landslides, etc.
- Measures tilt angles and vibrations (eg. frequency, amplitude)
- Highly responsive, triggering signal output delay within 10 ms
- Field-proven in plenty of projects home and abroad



HSL01 Soil Moisture Sensor

- Used in geological disaster monitoring, flood prevention and drought combat, soil moisture study, smart agricultural irrigation, etc.
- Measures soil moisture as well as ground surface displacement
- Contactless measurement, worry-free against erosion in soil
- IP68 rating, ready to work in complex outdoor environments

YC002 Remote Terminal Unit

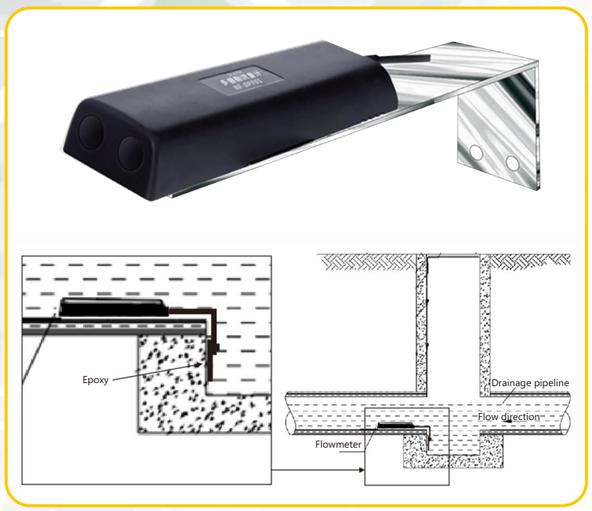
- Used for remote measurement and control in applications of water works, geological disaster prevention, roadway slope monitoring, mine slope monitoring, etc.
- Integrated with GPRS/CDMA/WCDMA/LTE/NB-IoT wireless remote and LoRa wireless short-range transfer
- IP67 rating, ready for data capture, storage, warning, and transfer in various monitoring applications
- Plenty of interfaces available, for tipping bucket, RS-232, RS-485, analog input, switch input, relay driver, etc.

MCU01 Multi-functional Data Logger

- Typically used in safety monitoring projects of geotechnical engineering purpose like dams, bridges, tunnels, slopes, dilapidated buildings, mines, nuclear power stations, civil buildings, etc.
- Plenty of interfaces available, default for RS-485, 4G telecom, Ethernet, and optional for Wi-Fi, Bluetooth, LoRa, NB-IoT
- Inbuilt high-capacity battery yet with mAh-level low power consumption design, ready to work continuously under severe conditions like rainy weather, external power supply breakdown, etc.
- A universal module that works with analog sensors of different brands, different signal output (eg. differential resistance, vibrating wire, voltage type, current mode), digital intelligent sensor, switching value counter, etc.
- Quite a few independent channels (1/4/8/16/20/32/40) available for connection

DPF01 Doppler Flowmeter

- Used to measure flow speed and volume of the water body by the differences transmitted and reflected ultrasonic frequency
- Particularly designed to keep sludge away from key measuring component for less maintenance
- High accuracy performance empowered by irregular sectional water dynamic model and intelligent flux integral algorithm
- IP68 rating, a very rugged and reliable device against harsh environments



FLG01 Float Water Level Gauge

- Used to observe the water level change of all types of water body such as rivers, lakes, reservoirs, dams, ditches, underground water, etc.
- Float diameter 10 or 15 cm optional, custom build available upon request
- High accuracy performance empowered by magneto-optical coding principle
- Reliable results independent of the impacts from temperature excursion and time drift
- Applicable for water level observatory station with vertical logging

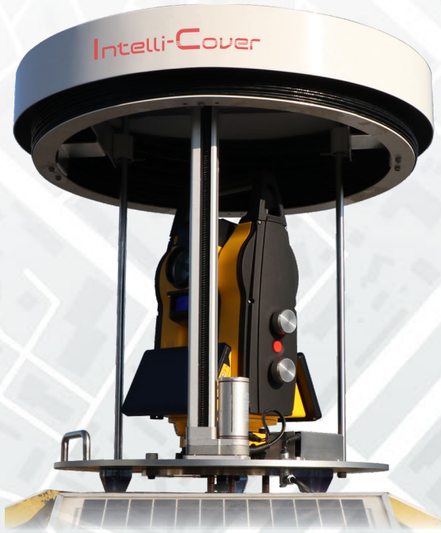
MD260 Data Transfer Unit

- An industrial-level Router for 4G telecom
- Used in electricity, oil, coal mine, finance, telecommunication, public security, industrial control, meteorology, waterworks, traffic, municipal, etc.
- A process tamer design, auto power-off and restart after internet disconnection
- RJ45, 10M/100M Ethernet cable interface
- Web control operation available
- Auto reconnect after internet disconnection, auto restart and timed restart available

Intelli-Cover II AMTS Outdoor Mate

- Setup within minutes, unattended operation with fully automated covering/uncovering by time-program commands
- Rugged and durable, designed to withhold nearly all-weather conditions
- More economical and time-saving compared with concrete shelter establishment
- Compatible with the robotic total station of all major brands on the market
- Able to work with rain gauge, tilt sensor, etc. to trigger retraction in case of bad conditions

Note: Robotic total stations for automated monitoring are presented in Chapter #10, Construction.

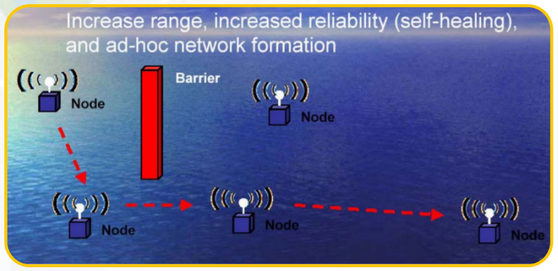


iControl-T AMTS Datalink Mate

- A highly integrated device for power supply, data communication, automated control, and smart data process
- Used for robotic total station monitoring data transfer from site to data control center
- Designed with inbuilt 4G telecom module or fiber optic interfacing, optional
- Compatible with the robotic total station of all major brands on the market
- A field-proven solution due to high cost-performance in plenty of monitoring projects

CMesh AMTS Datalink Mate

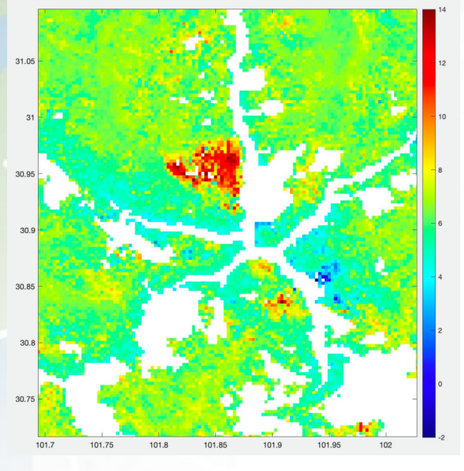
- Transforming 4G telecom to ZigBee wireless communication
- 1 km communication range per pair, multi nodes to work together in a certain project
- First one with 4G telecom module to put in 4G coverage area, and others with ZigBee to put where 4G network is not available, like underground environment



SMOS

Versatile Automatic Monitoring Software

- Supports GNSS devices, robotic total stations, tilt sensors, geological devices, hydrological devices, strain gauges, meteorological sensors, InSAR data, third-party sensor integrations, etc.
- Processes all GNSS, frequencies, and signals and delivers corrections
- Deals with algorithms from GNSS, AI, InSAR, web server, etc.
- Delivers realtime data and live graphics, and presents historical data, data analysis, customized report output, auto alert/warning via SMS and email
- Fits a variety of applications such as water works, flood control, land subsidence, geological change, power grid safety, construction monitoring, etc.



SMOS IoT Eco-system