

# Monitoring a Tunnel Construction Site

Tunnelling for a new transport route isn't as simple as boring away at the earth. It requires the constant monitoring of geotechnical and structural parameters to maintain a safe and efficient work site. Ackcio Beam fully automates this process and makes critical data from sensors remotely accessible to decision makers. Here's how that works.

## 01 ANALOGUE NODES

On nearby buildings, Ackcio **BEAM-AN-S1** (1 channel) and **BEAM-AN-S4** (4 channels) Nodes ensure real-time monitoring of crack meters and displacement sensors to ensure the safety of the surrounding infrastructure.

## 02 ACKCIO GATEWAY

The Ackcio **BEAM-GW** receives sensor data from the Nodes within the network. Ackcio's Snape software that runs on the Ackcio Gateway is used to configure and manage the project. It also provides the option to push the data via FTP/API to a selected server and/or software of your choice.

## 03 WIRELESS TILTMETER NODES

Ackcio **BEAM-TM** Nodes bundle Ackcio's long-range wireless mesh technology with Sisgeo's trusted bi-axial self-compensated MEMS inclinometer, measuring the horizontal and vertical movement of the surrounding buildings.

## 04 WIRELESS TILTMETER NODES

Ackcio wireless tiltmeter Nodes **BEAM-TM** can be used to monitor the slope stability around the tunnel site.

## 05 ACKCIO NODES

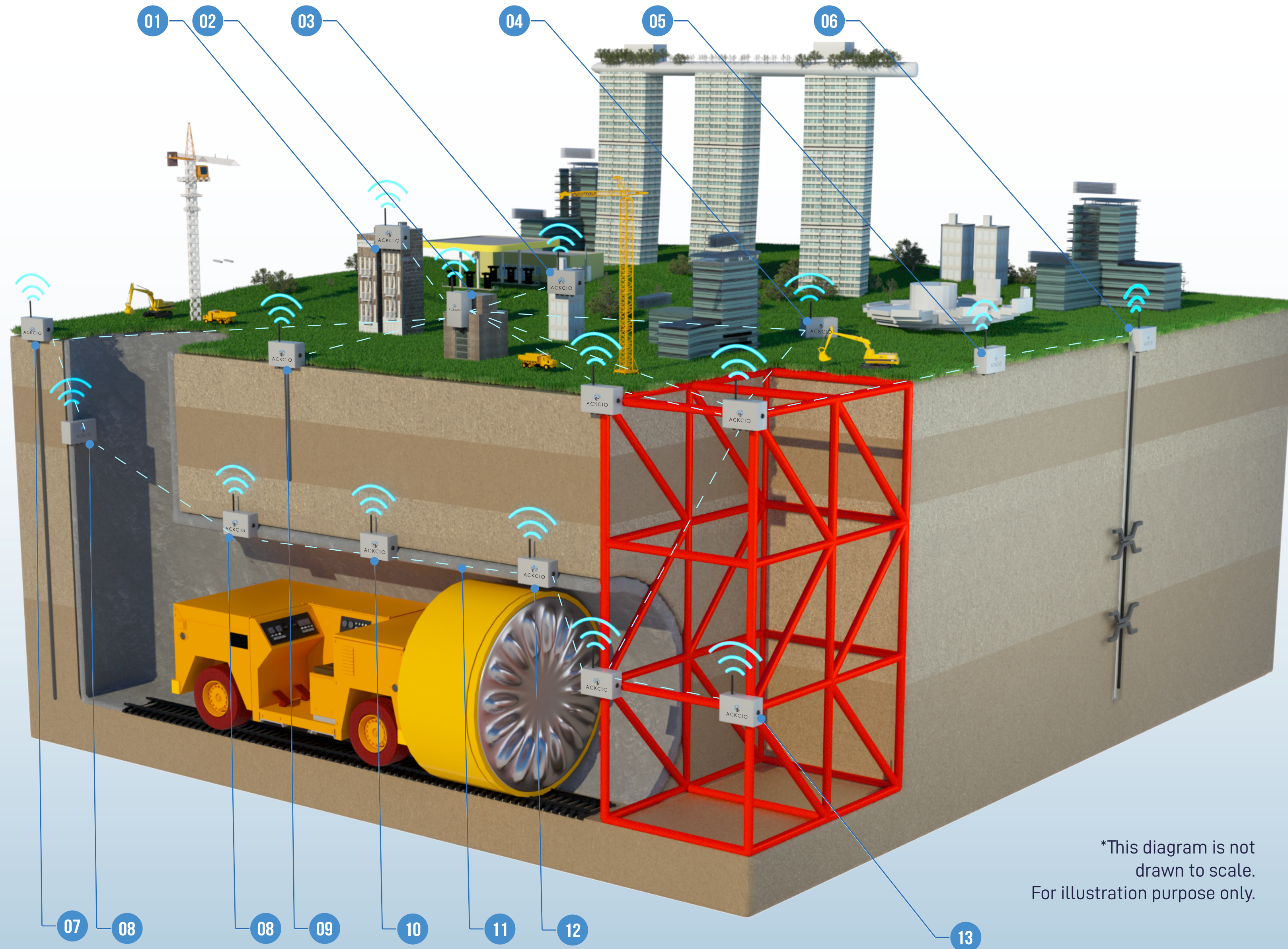
Each battery-operated Node acquires data from multiple sensors and transmits the sensor data wirelessly through the Ackcio Mesh network to the Ackcio Gateway.

## 06 ANALOGUE NODES

Ackcio **BEAM-AN-S4** (4 channels) Nodes automate the monitoring of a multi-point borehole extensometer (MPBX) that measures vertical deformation at various depths.

## 07 DIGITAL NODES

Settlement displacement around the tunnel shaft is monitored by leading brands of digital in-place-inclinometers (IPI's)/MPBX/SAA's/ extensometers in real-time using Ackcio **BEAM-DG** Nodes.



\*This diagram is not drawn to scale. For illustration purpose only.

## 08 VIBRATING WIRE NODES

Ackcio **BEAM-VW-S1** (1 channel) and **BEAM-VW-S8** (8 channels) Nodes monitor strain gauges and load cells fitted throughout the tunnel shaft along with convergence instruments and settlement cells through the tunnel.

## 09 VIBRATING WIRE NODES

Piezometers measuring the underground pore water pressure are monitored in real-time using Ackcio **BEAM-VW-S1** (1 channel) and **BEAM-VW-S8** (8 channels) Nodes.

## 10 DIGITAL NODES

ShapeArray instruments monitor tunnel deformation in real-time using Ackcio **BEAM-DG** Nodes.

## 11 ACKCIO MESH

Ackcio's patented long-range wireless **MESH** network connects the Ackcio Nodes to the Ackcio Gateway. The mesh network is self-healing, enhancing the transmission reliability. The ability to 'hop' significantly increases the aggregate communication range, especially in underground deployments. The system is highly flexible and scalable.

## 12 REPEATER NODES

If deployment challenges reduce the range of Ackcio Nodes, Ackcio **BEAM-RN** Nodes assist in extending the wireless range of other Ackcio Nodes within the network.

## 13 VIBRATING WIRE NODES

Layers of strutting are equipped with Ackcio **BEAM-VW-S1** (1 channel) and **BEAM-VW-S8** (8 channels) Nodes to monitor strain gauges and load cells.