

Connecting the Unconnected

Altai Technologies Bridges Critical Communications in Hong Kong's Central Kowloon Route

Engineering seamless wireless connectivity across one of Hong Kong's most complex tunnel constructions — ensuring precision, safety, and real-time collaboration from the first excavation to final operation.



**Smart Antenna
Technology**



Wi-Fi 6 Performance



Adaptive Backhaul



**Centralized
Management**



Future-Ready



**End-to-End
Connectivity**

Introduction

The **Central Kowloon Route (CKR)** is a key strategic infrastructure project in Hong Kong designed to ease severe traffic congestion across Kowloon. During its development, the project team faced one of the most complex challenges common to modern large-scale infrastructure works — maintaining reliable, real-time connectivity within confined, signal-impenetrable underground environments.



Project Scale

The CKR is a **4.7-km dual three-lane trunk road** linking Yau Ma Tei in West Kowloon to Kowloon Bay.



Underground Alignment

The majority of the alignment runs through **deep underground tunnels**.



Connectivity Challenge

Maintaining **reliable, real-time connectivity** in confined, signal-impenetrable underground environments.

Connectivity in Modern Tunnel Construction

Reliable wireless connectivity is no longer optional in large construction projects — it is mission-critical. In complex tunnel projects such as the CKR, communication networks:

Enable precision alignment and stability monitoring

Laser-based monitoring systems detect millimeter-level shifts in tunnel structure, requiring constant connection to data centers.

Support worker safety

Real-time alerts from sensors help prevent incidents and improve emergency response coordination.

Improve operational efficiency

Instant access to live data allows engineers to make informed decisions on-site, reducing delays and rework.

Replace impractical wired networks

In active construction environments where layouts change frequently, fiber installation is often impossible or unsafe.

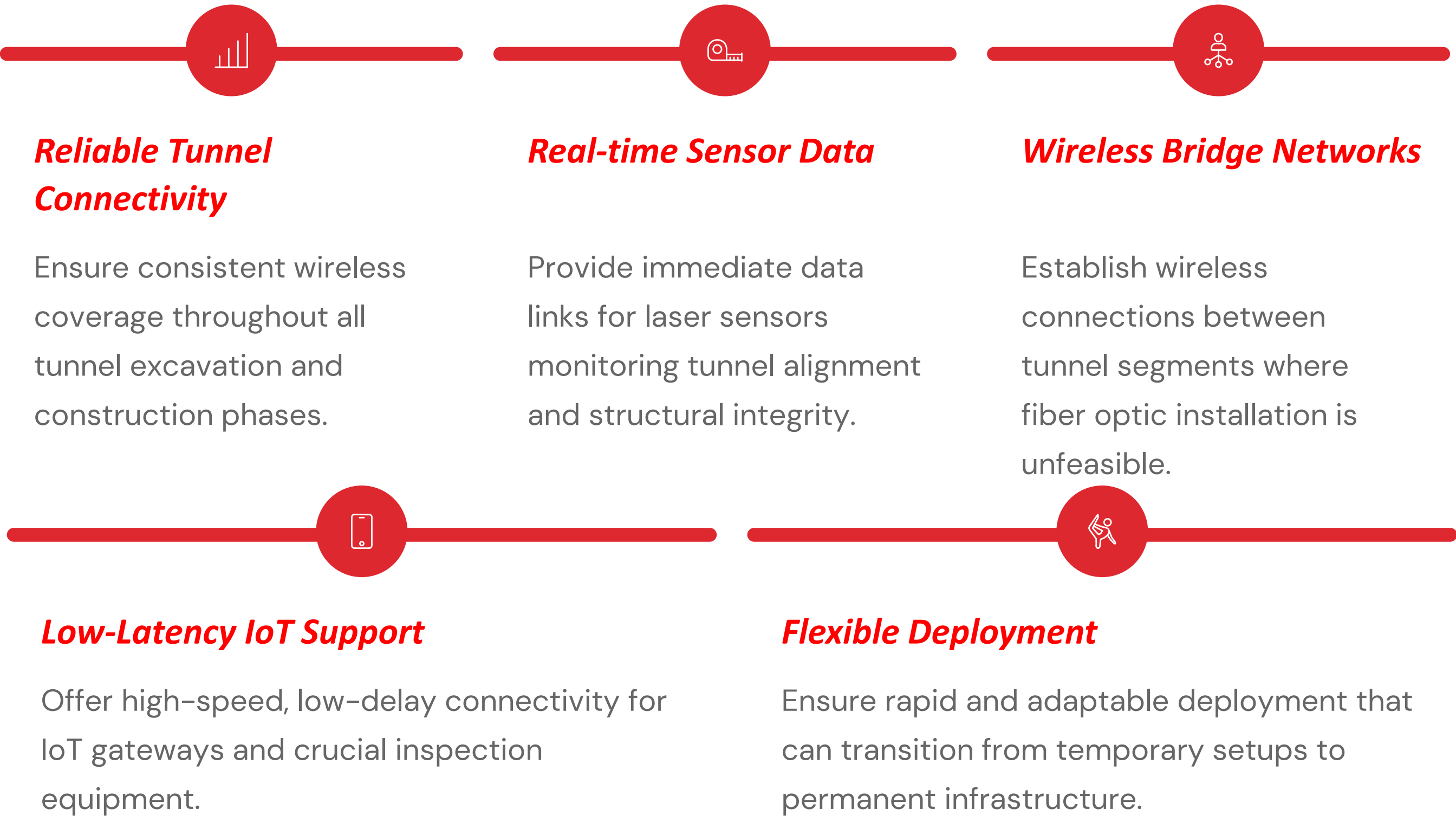
Bridge communication gaps

In areas without cellular signals or internet coverage, wireless backhaul ensures that all devices remain connected to central systems.

Altai's Super Wi-Fi platform integrates all these requirements into one robust solution, providing **high-capacity, low-latency coverage** under challenging conditions.

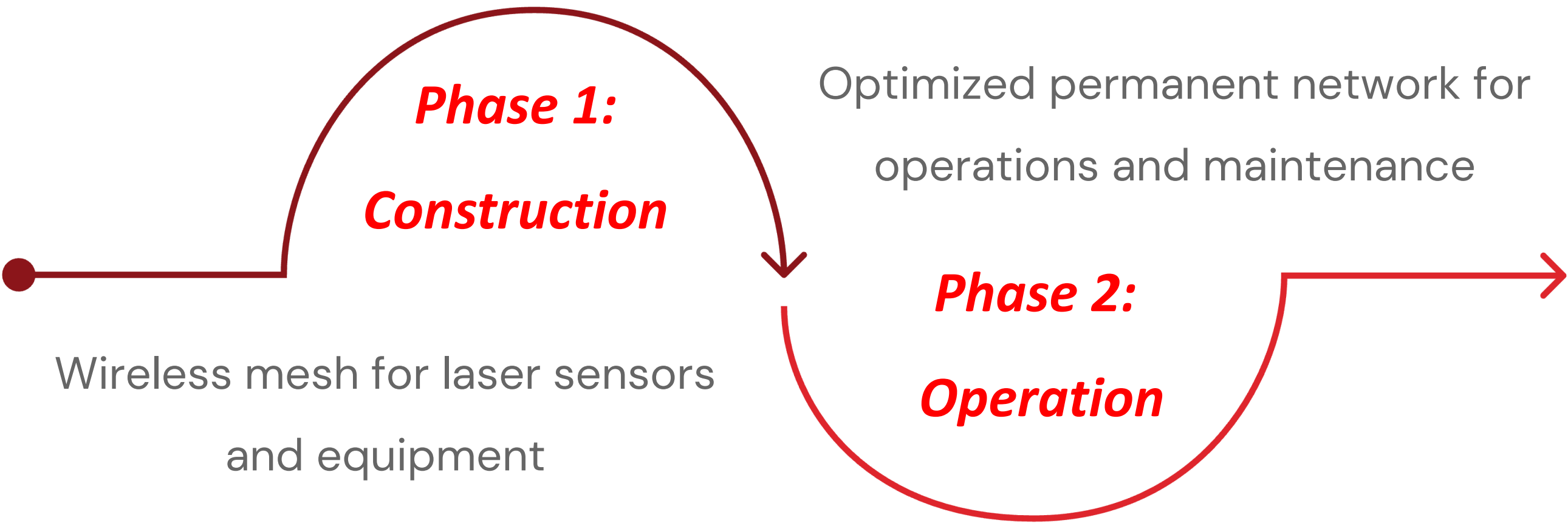


Project Objectives



Multi-Phase Wireless Solution

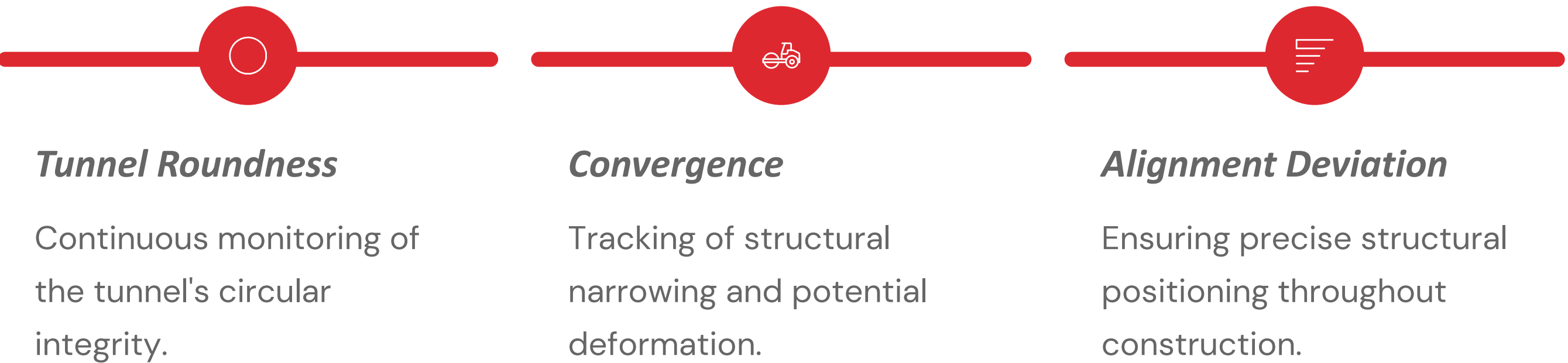
Altai developed a multi-phase wireless solution beginning in the construction stage and evolving seamlessly into the final tunnel operating network.





Construction Phase

Early in the project, **Altai AX600-S Wi-Fi 6 Access Points** were installed to create a robust wireless mesh backbone within the advancing tunnel.



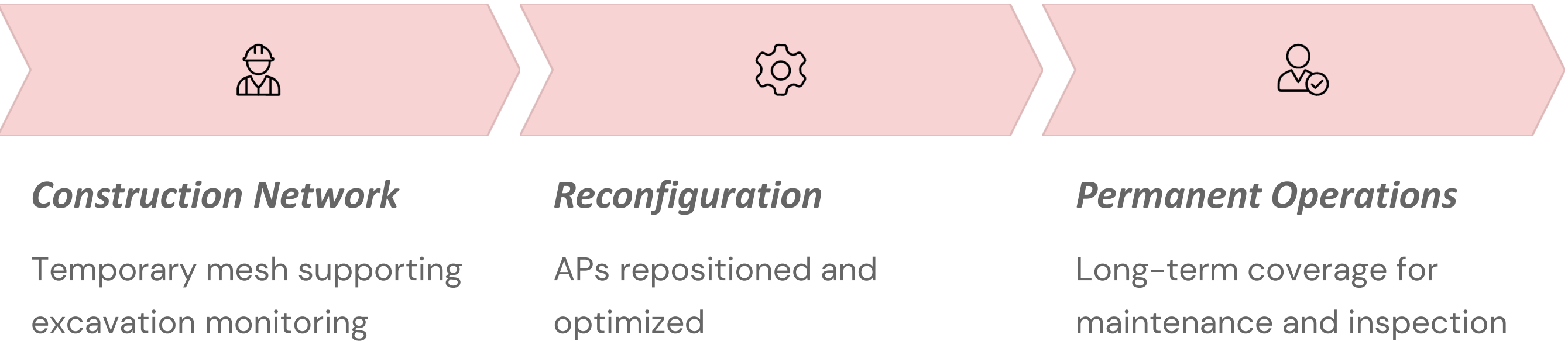
These laser alignment sensors continuously measured these critical parameters, transmitting real-time data to the control center.

Real-Time Monitoring
When threshold changes were detected, the system sent instant alerts to engineers and safety teams, enabling rapid corrective action.

Comprehensive Support
The same network also supported on-site handheld terminals, IP cameras, and IoT devices used for progress tracking, — all without the need for fiber cables.

Operational Phase

After construction completion, the network was reconfigured and optimized for long-term tunnel operation. The existing APs and industrial switches were repositioned and fine-tuned to cover two main tunnel sections — approximately **220 m and 355 m** — providing seamless Wi-Fi coverage for operations, maintenance, and inspection crews.



Challenges



No fixed infrastructure

No pre-installed Ethernet or fiber during excavation works.



High environmental stress

Extreme humidity, dust, vibration, and temperature fluctuations.



Dynamic site layout

APs needed to be repositioned as tunnel excavation progressed.



Critical monitoring requirements

Continuous real-time connectivity for laser alignment alert systems.



No cellular coverage

Underground environment blocked mobile signals completely.



Network Architecture

The network consisted of the following key components:

Component	Function	Key Attributes
AX600-S Wi-Fi 6 Access Points	Provide 2.4 GHz & 5 GHz coverage and wireless backhaul between segments	Dual-band MU-MIMO, IP67 design, up to 1 km LOS bridging
MIS120P Industrial Switches	Serve as PoE power source and Layer 2 backbone	Redundant ring, VLAN, industrial reliability
AltaiGate 210 WLAN Controller	Central management for all APs	Supports up to 200 APs and 4,000 clients
Industrial Power Supply (120 W)	Converts AC to 48–57 VDC	Reliable for harsh environments
Optical Fiber at Entrance / Optional 5G Router	Provides uplink connection	Redundant connectivity at gateway node

 **Note:** Network interval and segment distances are conceptually based on Altai's T2 Tunnel HLD design principles. Actual CKR configurations are field-optimized through site surveys.

AX600-S	
Technology	2x2 MU-MIMO Wi-Fi 6
Standards	802.11a/b/g/n/ac/ax
Max LOS access	*1km x 60° @ 2.4GHz *1km x 80° @ 5GHz
Data rate	574+1201 Mbps
Antenna	Int. 14dBi 2.4GHz Int. 15dBi 5GHz
Dimensions	491 mm x 221 mm x 73 mm
Weight	2.1 kg (Without Mounting Kit)



MIS 120P	AltaiGate 210
	



Results and Achievements



Enabled Early-Stage Connectivity

Supported laser-based tunnel alignment monitoring and alert systems during construction.



Improved Construction Efficiency

Allowed real-time communication among site teams and automation systems.



Zero Downtime

Maintained uninterrupted operation for IoT gateways, GNSS support, and handheld terminals.



Cost Reduction

Eliminated expensive and inflexible fiber cabling runs.



Scalable Transition

Same network transformed seamlessly from construction to operational phases.



High Durability

IP67 and industrial-grade hardware ensured reliability under harsh tunnel conditions.



Conclusion

The Central Kowloon Route project demonstrates how **Altai Super Wi-Fi technology** delivers reliable, long-range, and flexible connectivity in highly constrained environments.

Construction Phase Impact

By deploying the network early in the construction phase, Altai enabled not just communication convenience but structural safety assurance — supporting precise laser alignment systems and critical monitoring processes.

Operational Excellence

As the project transitioned to its operational stage, the network evolved into a permanent wireless infrastructure, continuing to provide high-speed coverage for IoT systems and maintenance operations.

This successful implementation underscores Altai's capability to transform connectivity challenges in mega-infrastructure projects into efficient, scalable, and safe digital ecosystems.

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