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**MINING + 5G PRIVATE NETWORK SOLUTIONS**





# PRIVATE NETWORK FOR MINING

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# REAL WORLD CHALLENGES - MINING

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## INDUSTRY CHALLENGES

## GOALS

## PRIVATE NETWORK VALUES

Hazardous environment in the underground, high accident rate

Ways of working

Enable remote operation  
Enforce H&S protocols

Poor communication between underground and outside

Improve underground to surface connectivity

Enable wireless communication, miners remains contactable at all times

Readiness to evacuate miners in the unfortunate events

Quick event detection

Sensors and camera + predictive analysis. Alarm immediately when detect abnormality

Productivity

Automation

Connected equipment





# ENABLING USE CASES

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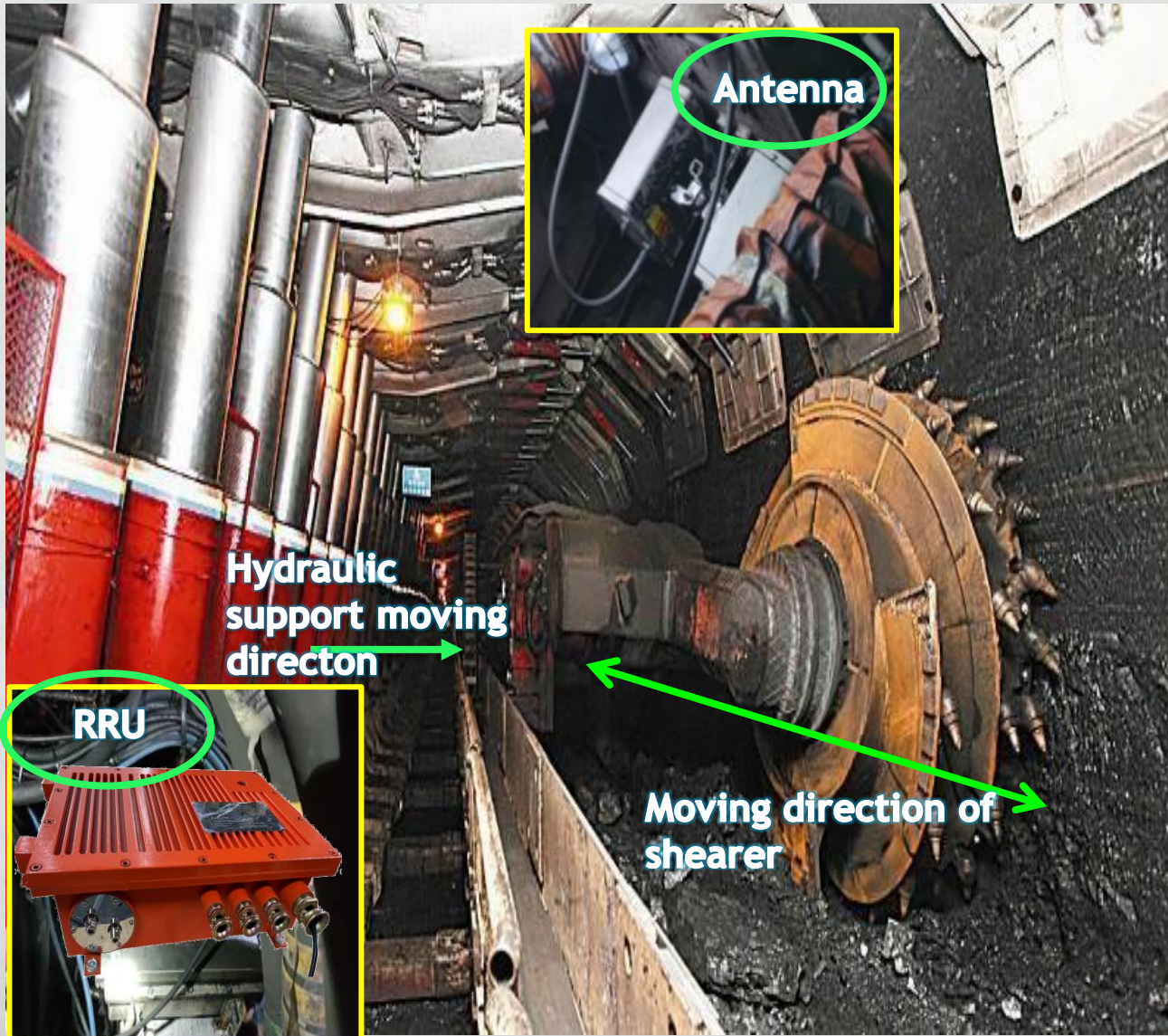






# REMOTE COAL MINING

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- Connecting **HD cameras, navigation device and sensors** to the 5G private network via 5G CPE.
- RRU at 80m separation, with two external antenna installed back-to-back on top of the hydraulic support. Providing **undisrupted 5G coverage** when the hydraulic support moving.
- All data such as **shearer position, audio, video, water pressure, machine temperature** are sent back to ROC where miners can remotely monitor and control the mining process.
- Enabling **real-time monitoring, shearer auto-alignment, and unmanned operation** at the working surface.



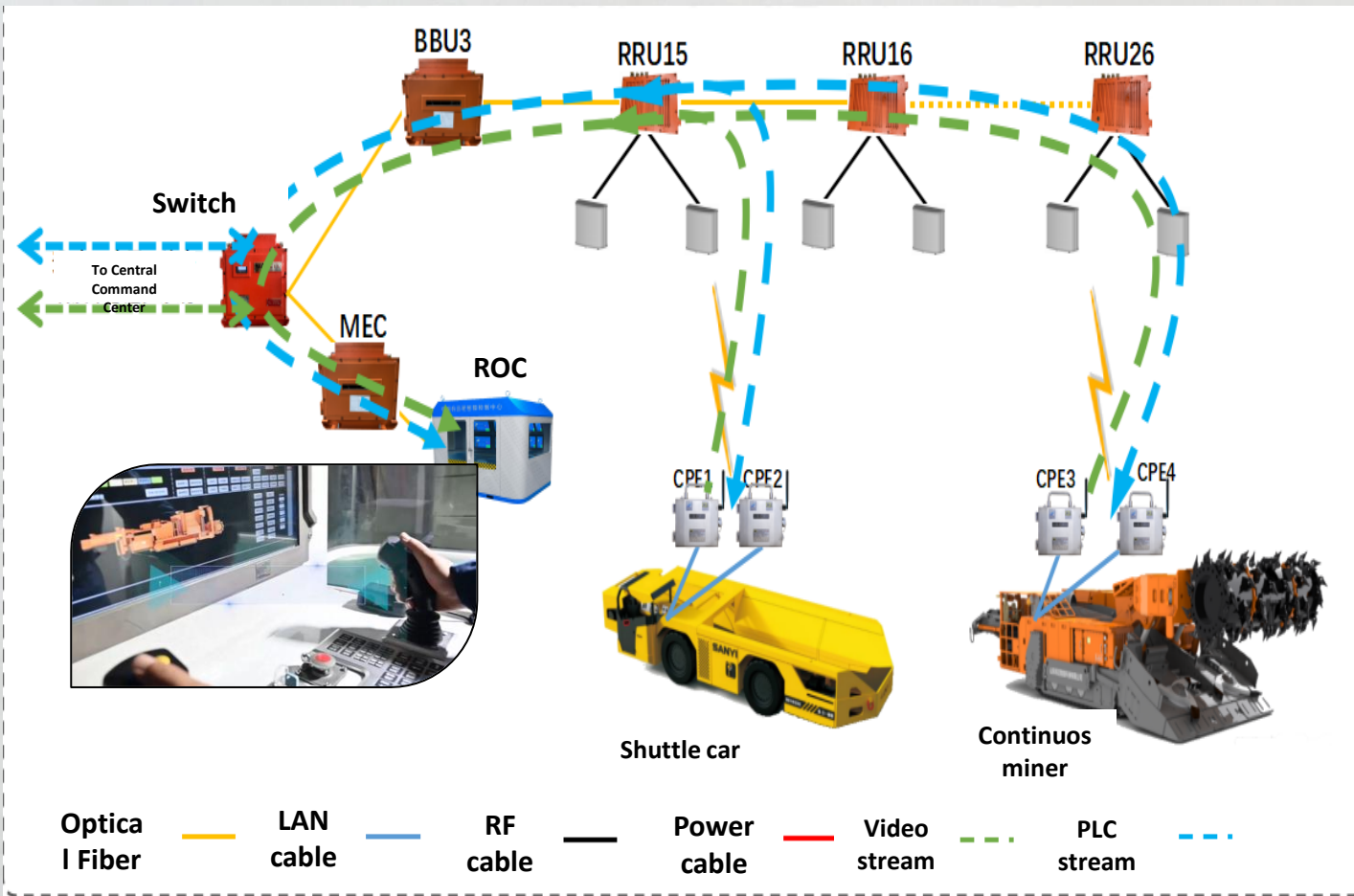
\*ROC: Remote Operating Center





# REMOTE OPERATION

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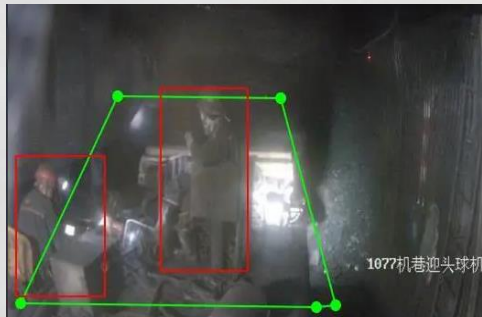
- Both shuttle car and continuous miner are attached with two CPE, one for **HD camera** and another for the Programmable logic controller (**PLC**).
- Working video and control signal are transmitted back to the Remote Operation Central (**ROC**) or Central Command Center through 5G network, realizing **real-time monitoring of drilling working status and remote control of continuous mining machine and shuttle car**.
- Via **local breakout**, the video data and control signal will be shunted and process locally in the **MEC**, enabling **high bandwidth and low latency application**.



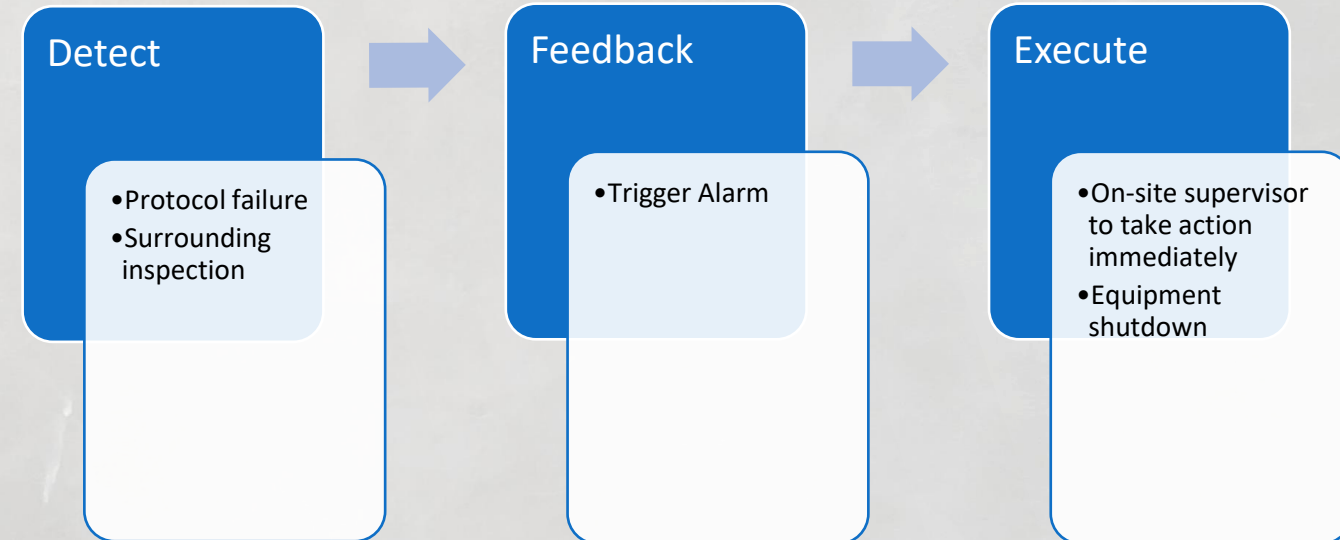


# MONITORING UNDERGROUND SAFETY

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- **DETECTION OF PROTOCOL FAILURE:** sitting on conveyor belt, no safety helmet, smoking, gathering in tunnels, sleeping etc.
- **MONITORING & INSPECTION OF KEY PLACES:** Central substation, Underground substation, Water pump substation
- **IMAGES ANALYSIS OF COAL/ORE TRANSPORTATION :** (CONVEYOR BELT) quantity, foreign object and belt offtrack





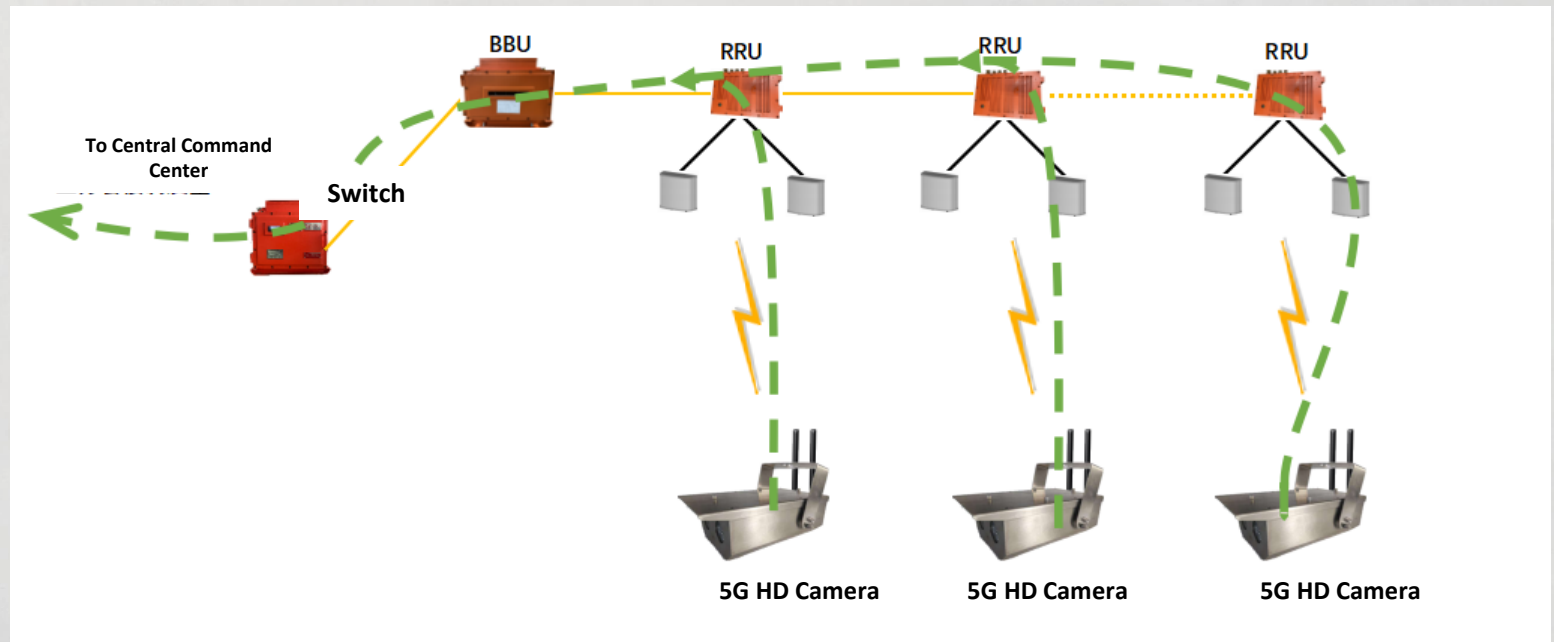


# UNATTENDED SURVEILLANCE

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**MAINLY USED AT CENTRAL SUBSTATION AND WATER PUMP ROOM:**  
The AGV and 5G HD camera are deployed in key places of underground, the surveillance images and video are uploaded to the Central Command Center through 5G network, to achieve the goal of autonomous operation.

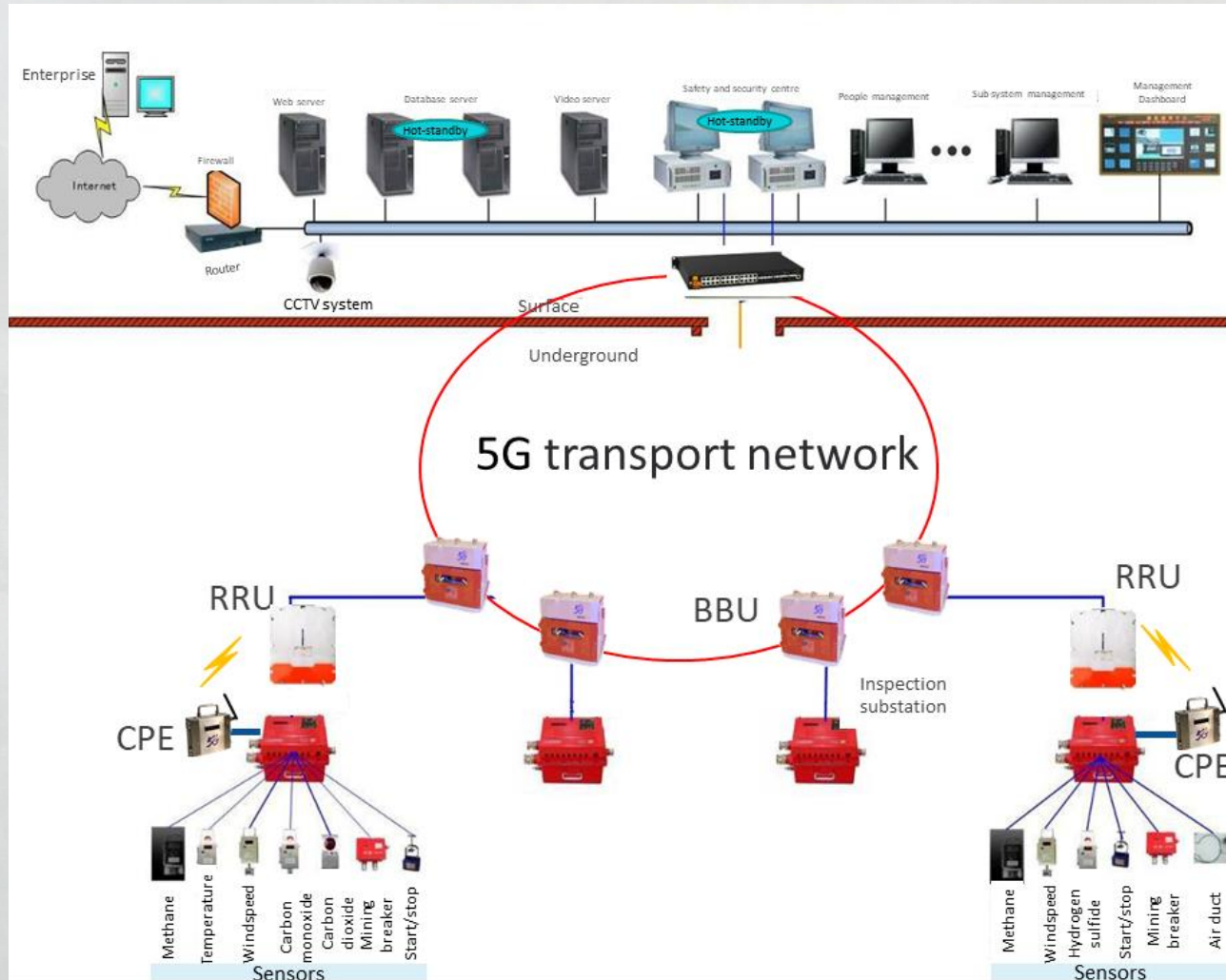






# REMOTE ENVIRONMENT ANALYSIS

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- Various sensors deployed in the underground are connected to 5G CPE.
- Sensing: Convection speed(Ventilation) and poisonous gas
- The system can monitor the concentration of carbon monoxide, oxygen, sulfur dioxide and nitrogen dioxide sensors, monitor the convection speed and air volume
- Data from the sensors will be relayed to data center via inspection substation
- Inspection substation support both CPE or direct connect to BBU switch via optical fiber.





# THE OUTCOME

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## ■ SAFETY

- ✓ Reduced underground manpower by 50%
- ✓ Incident numbers for individual mines are confidential but the mining statistic for the same period shows a
  - ✓ 16% drop in accidents
  - ✓ 12.7% drop in the fatality rate.

## ■ PRODUCTIVITY

- ✓ Processing w/o intervention reached more than 90%







**COMBA SOLUTION**

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# COMBA PRIVATE NETWORK PRODUCT

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# SOLUTION PRODUCT OVERVIEW

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COAL MINING



METAL ORE MINING

## EQUIPMENT SITE ROOM



BBU



5GC



UMS



BBU



5GC



UMS

## EQUIPMENT ON FIELD



RRU



Switch + BBU



5GC



APP. server



Radio



Hub



MEC

## CPE



CPE



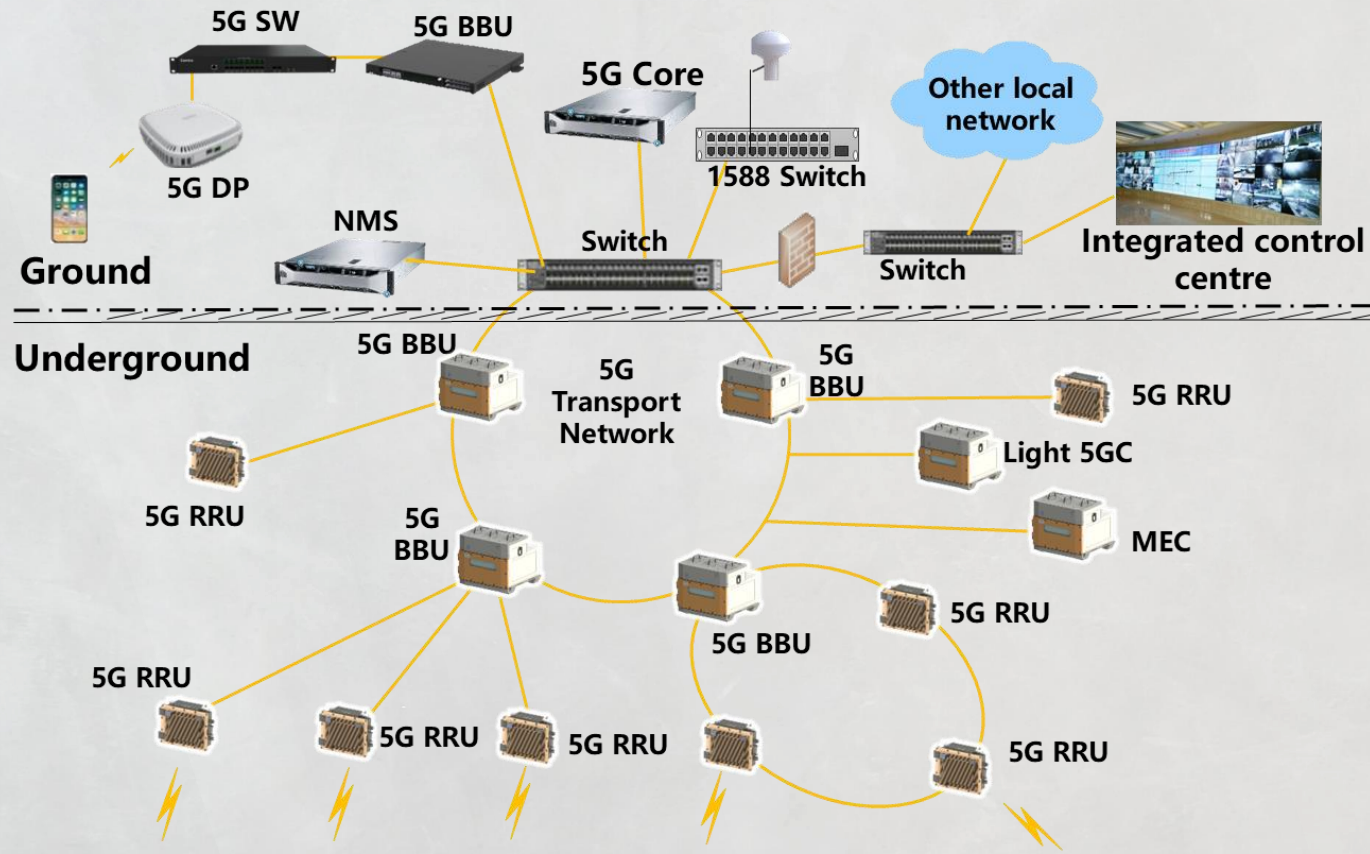
CPE





# NETWORK ARCHITECTURE

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## HIGH RELIABILITY

Underground 5G system is a self-contained 5G E2E system.

In case of backhaul transmission failure to 5GC, **real-time auto switchover to underground 5GC** helps **avoid interruption** to mining operation.

## INTRINSIC SAFETY CERTIFIED

Underground equipment met the safety and explosion-proof requirement

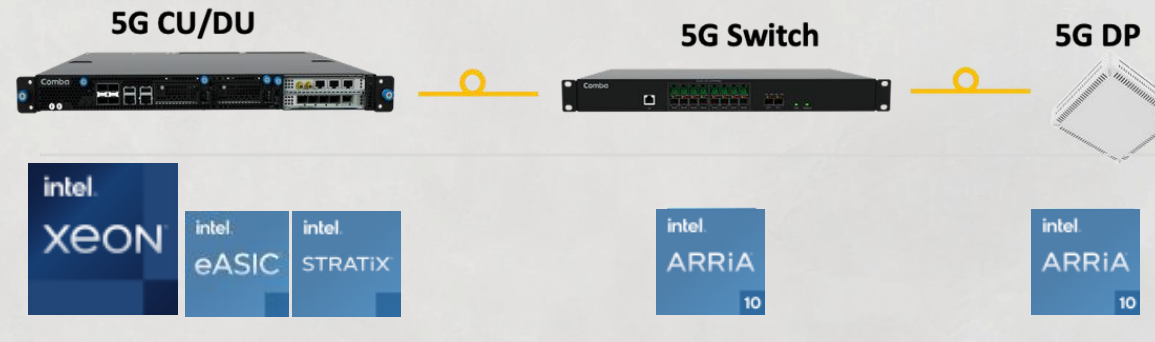
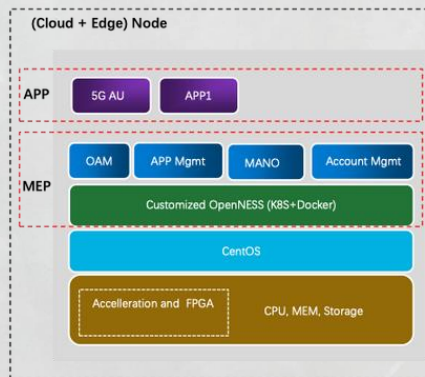






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## Intel® Smart Edge Open & Intel® FlexRAN™ Solution



- Support the combination of BBU and MEC
- Open API provides network capability to 3rd party application
- Traffic offloading
- Support the opening of wireless network capability, platform basic capability and positioning capability

### Several concepts were studied

Intel offered a time to market advantage

- Availability
- Deep cooperation on technology and business with local support
- Advanced roadmap





# 5G+Mining Private Network Solutions