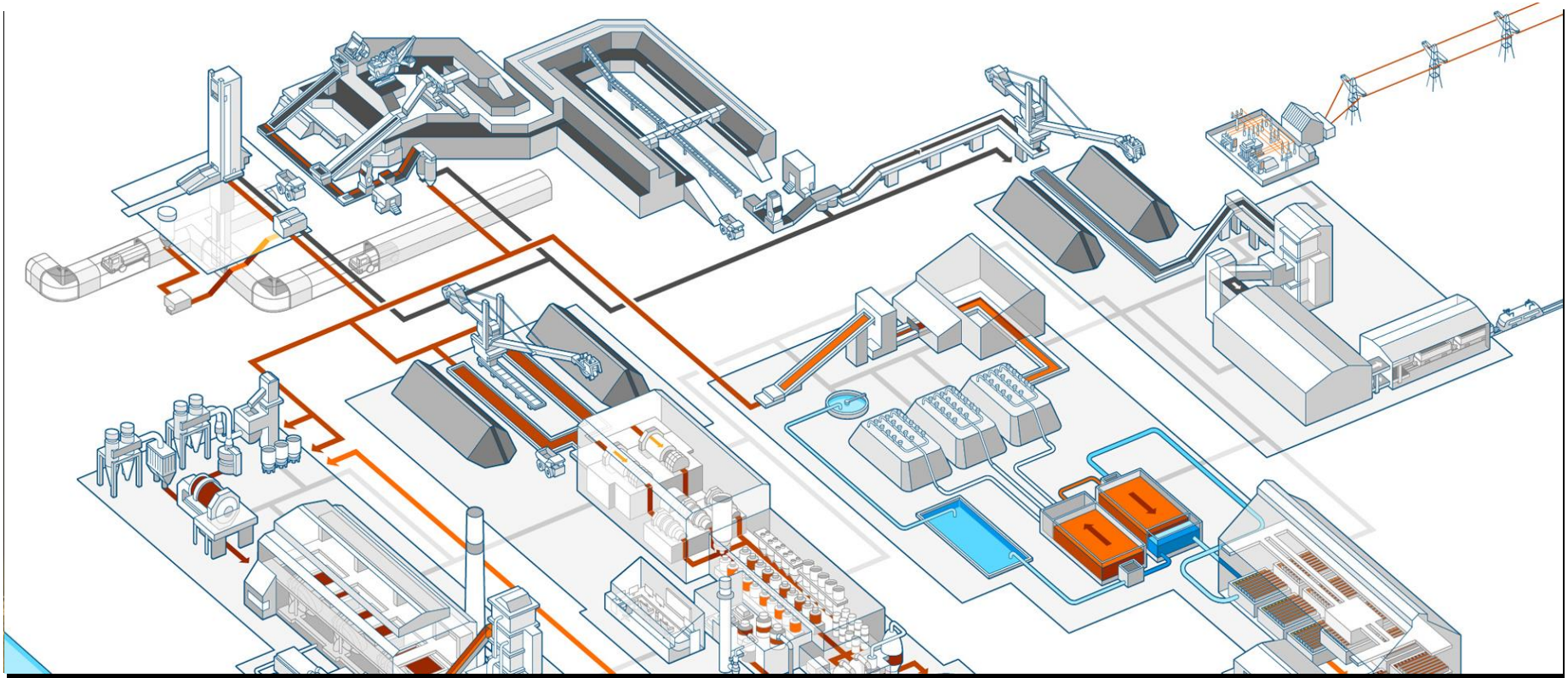


Patrik Westerlund, SEABB, PAPI UGM Automation

ABB Smart ventilation

Integrated Mine automation and electrification

Mine Operation Center

Substations

GIS Substations

Transformer

E-Houses

MCC & Drives

Communication network

Wired & wireless Supervision

IP Telephony, video

Asset & people tracking

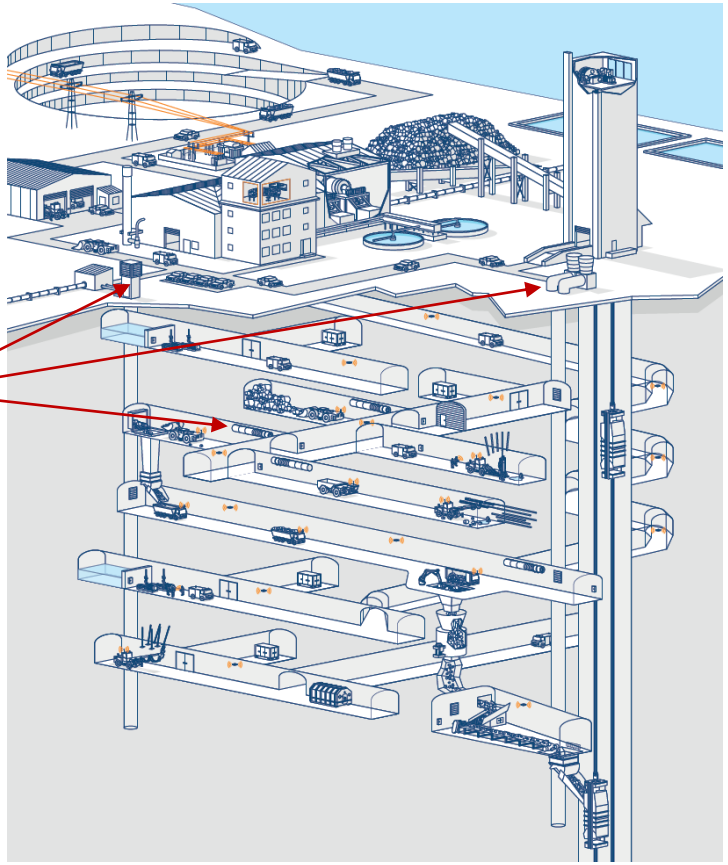
Mine ventilation

Mobile assets

Remote monitoring

Production reporting

Work order mgmt.



Stockyard management

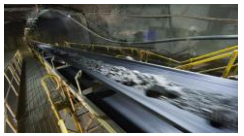
Hoisting systems

Water handling

Drainage system

Water pumps

Crushing and conveying



Loading pockets

Crushers

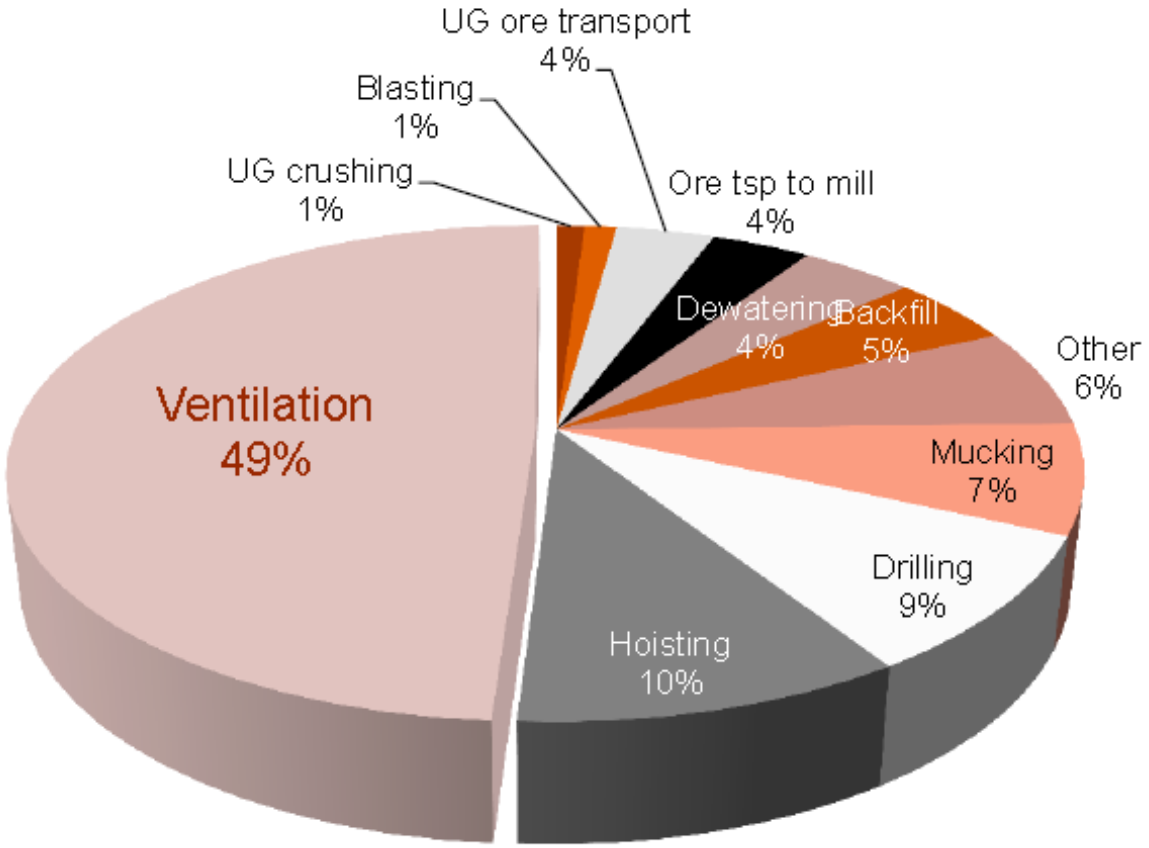
Feeders

Conveyors

Why control underground mine ventilation?

- Ensuring a healthy working environment underground
  - Dilution of hazardous substances
  - Climate control
- Quicker evacuation of blast gases
  Shorter downtime
- Minimize energy consumption
  reduce cost
- Better utilize existing infrastructure
  CAPEX and OPEX control

Potential for energy savings
NRC Study: Energy consumption by mining activities

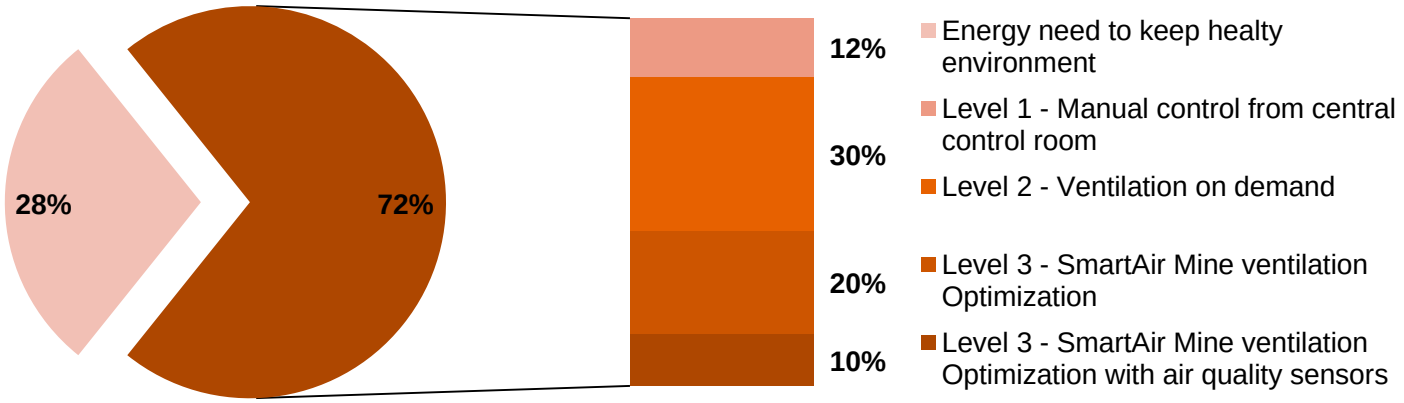


AVG total consumption of 10 mines = 90.4 kWh / tonne ore hoisted, 44,3 kW in ventilation

Ref: 2005, Natural Resources Canada, Benchmarking the Energy Consumption of Canadian Underground Bulk Mines

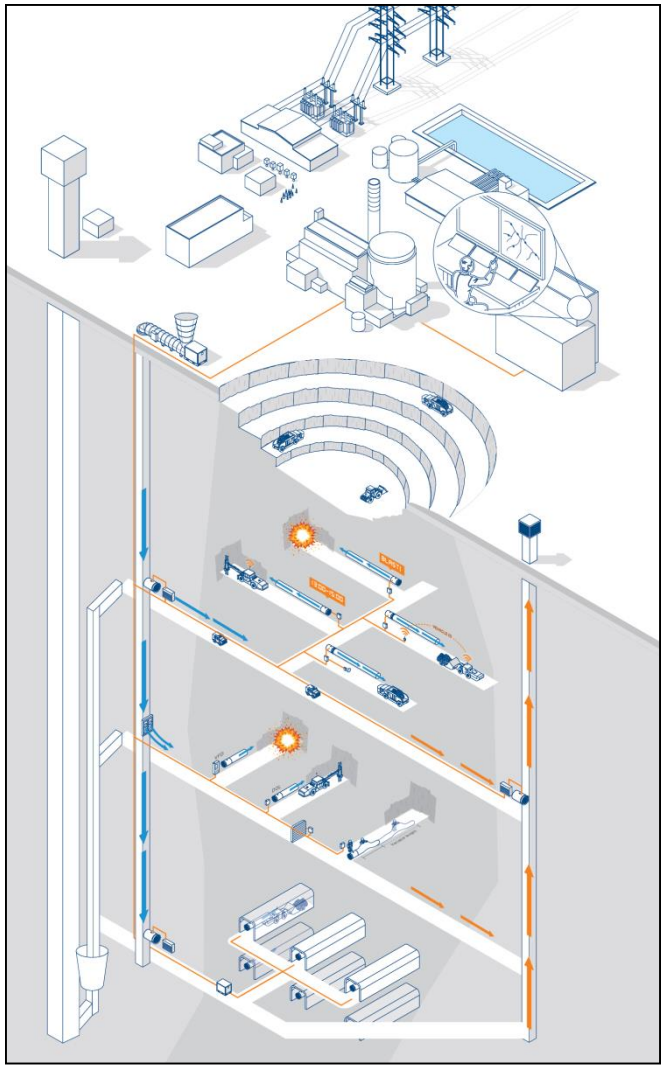
ABB Smart Ventilation
Potential Savings

Example of potential ventilation energy savings for an underground mine with a production of 2,5 MT/year



Percentage of nominal ventilation energy consumption over a 365 days

ABB Smart Ventilation
Select your level of monitoring, control and optimization



- Level 1 - Smart Basic

  Basic control and monitoring of fans, louvers and ventilation doors. All are monitored and controllable in the ABB 800xA System together with air quality and air flow sensors.

  - Reduced energy costs and increased safety by improved operator supervision and control

- Level 2 - Smart Mid

  Full scale Ventilation on Demand solution. Automatic control of all fans, louvers and controllable ventilation doors

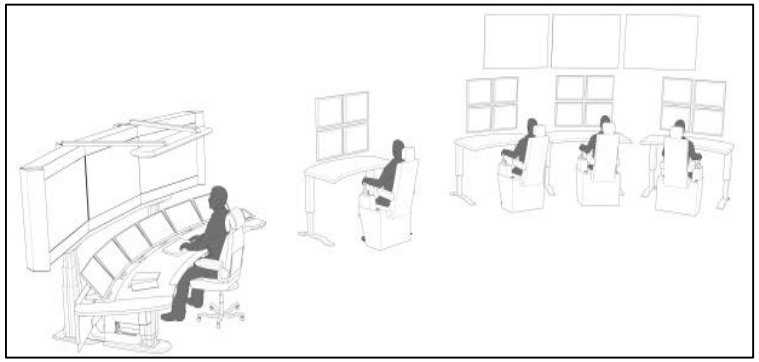
  - Improved air quality by providing fresh air where demanded
  - Energy savings up to 30-50% per year

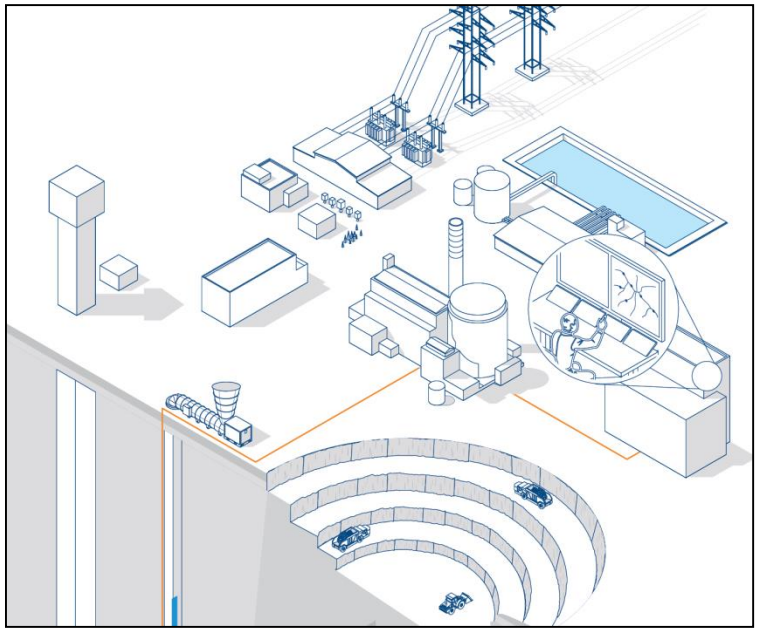
- Level 3 - Smart Perfect

  Mine ventilation optimization using ABB SmartAir™ optimizer. Uses airflow sensor feedback to perform online optimization of main ventilation fans

  - True mine wide control & optimization of air flows and air quality while minimizing energy consumption in real-time.

ABB Smart Ventilation
Built on System 800xA – complete, open and flexible





System 800xA, a world class collaboration platform

- Operators, Engineers and Mine managers can supervise and control the total ventilation system both centrally as in mobile devices
- Energy consumptions and KPI's are easily accessible for all users

Modularized solution

- Smart ventilation software library provides standardized operator environment - efficient operation
- Modularized hardware solution built on System 800xA standard components - efficient engineering and reduced maintenance cost

Open platform

- Easy to hook up fans connected or controlled in other ways to the ABB Smart ventilation system via open interfaces like OPC and Modbus TCP

ABB Smart Ventilation
System Overview

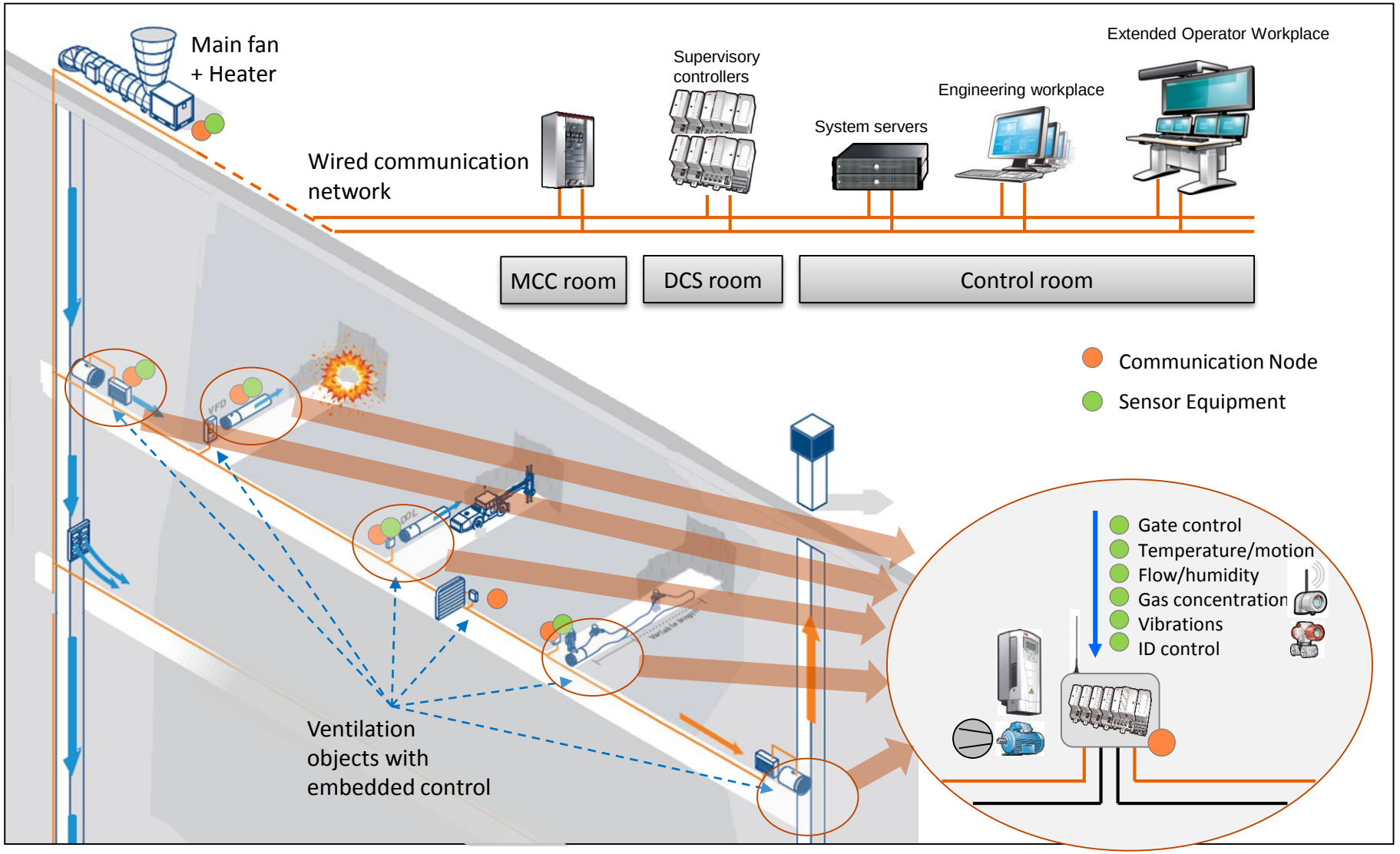


ABB Smart ventilation
System architecture

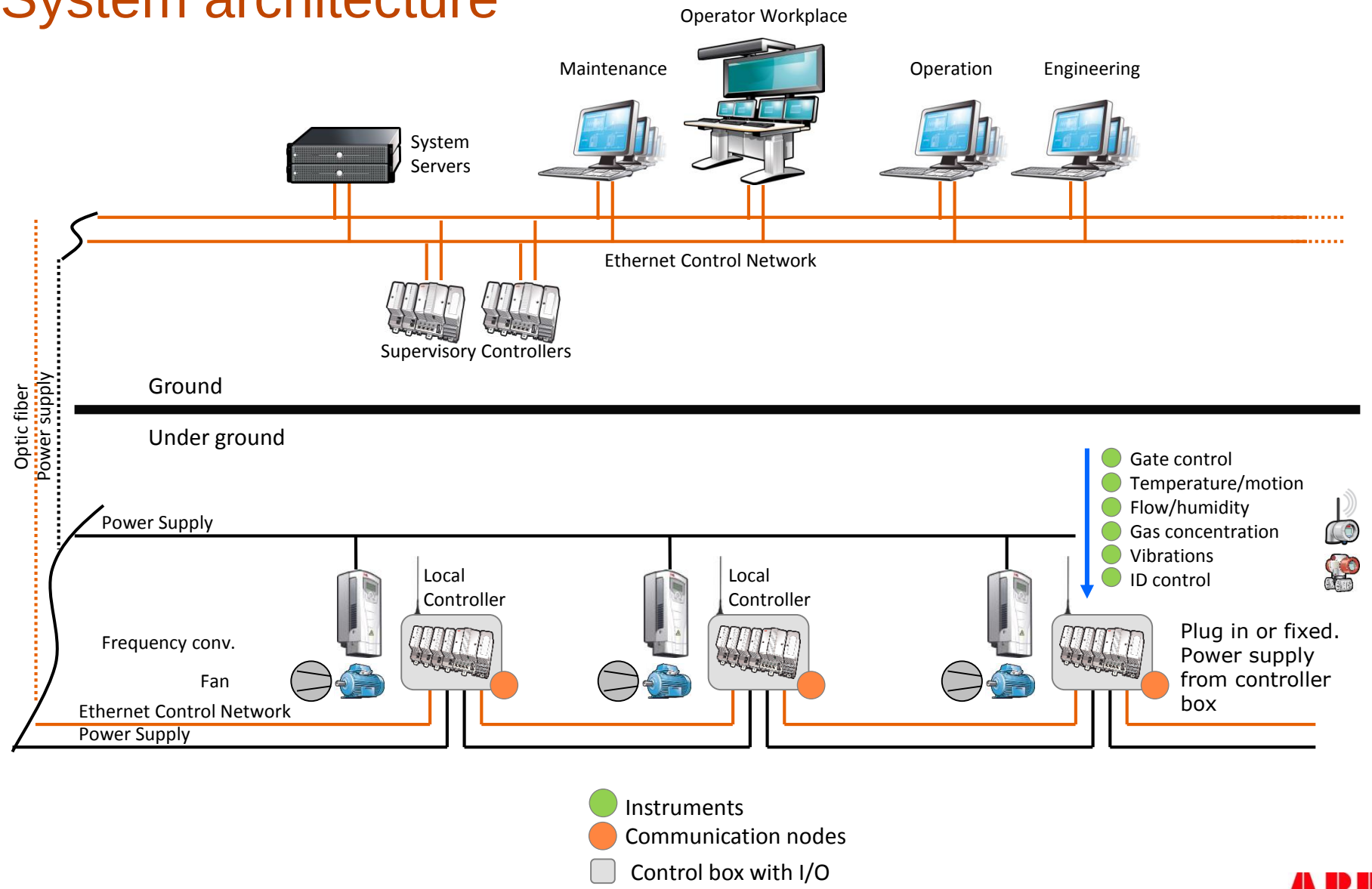
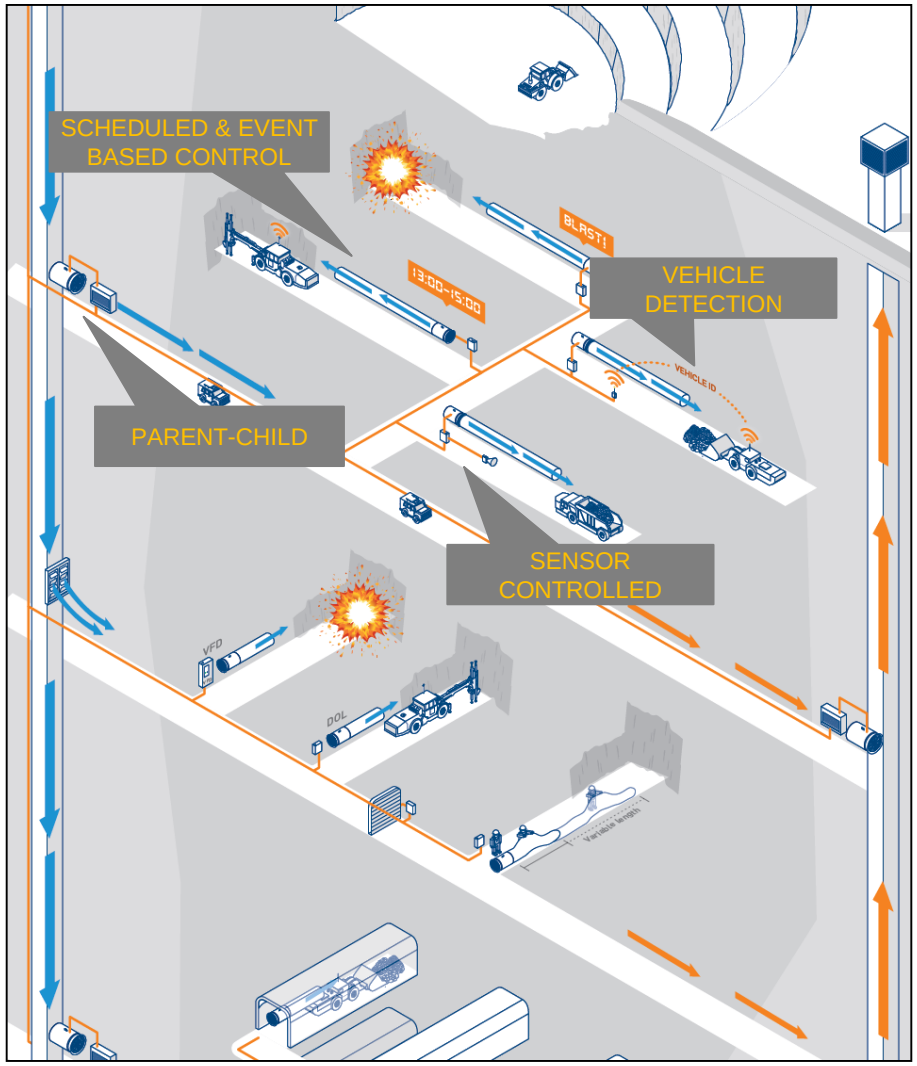


ABB Smart ventilation
Ventilation on Demand - functionalities



Scheduled & Event Based control

- Ventilation need based on time schedule reflecting production activities
- Blast activities (pre-, post & shutdown) based on time schedules or connected to blasting device.
- Support for fire situations

Sensor controlled

- Control of ventilation through physical sensors locally - Air quality, flow or pressure control

Flow control based on calculated demand

- Control by calculated need of air dilution. Calculations are based on vehicle/personnel detection and identification via Local vehicle tracking or a Global tracking system

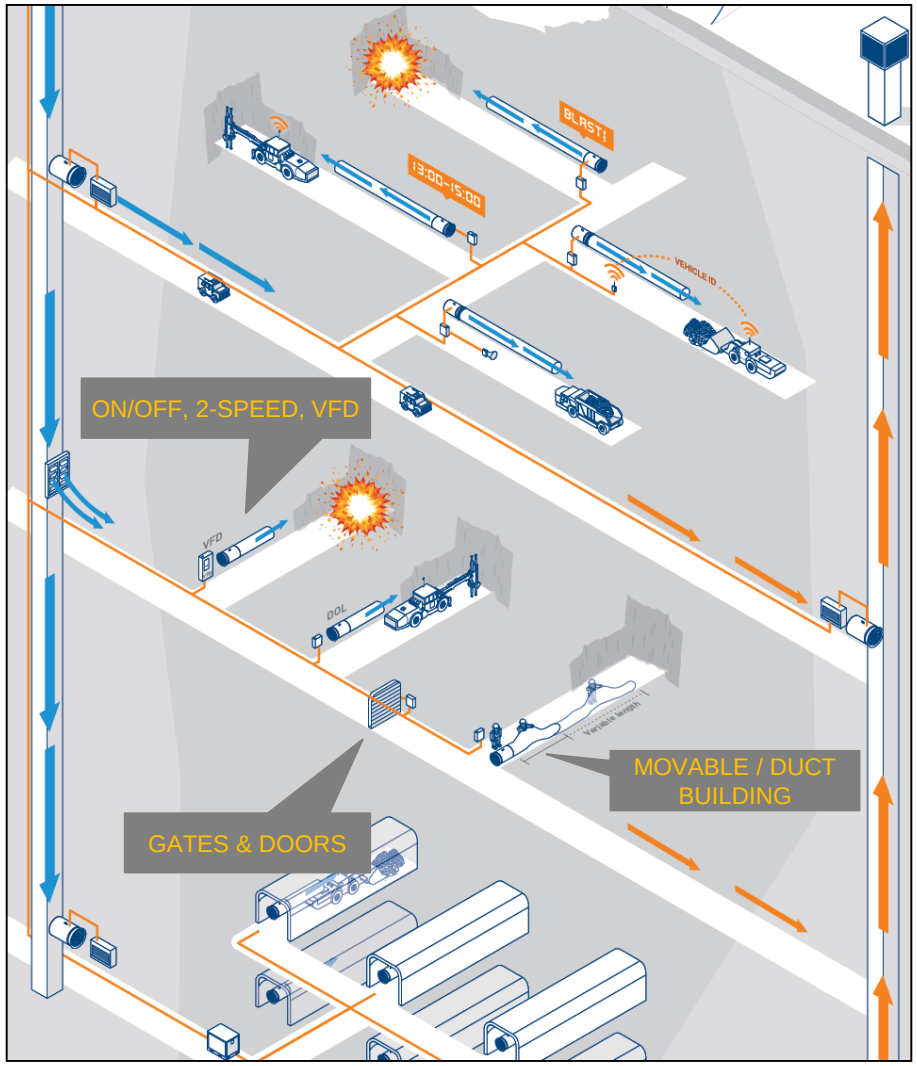
Handling of parent-child relations

- Easy setup of the correlation between fans

Local distributed intelligence

- ensures that air quality is kept under control even if the communication network suddenly goes offline - "intelligent fail-safe function"

ABB Smart ventilation
Flexibility



On/Off, 2-speed, VFD and Louvers

- All types of fan motor controls are supported by standard modules. Also louvers are supported with standard module
- Fans with or without controlled dampers supported by standard module

Gates & Doors

- Gates with different level of instrumentation and actuators are supported by standard modules

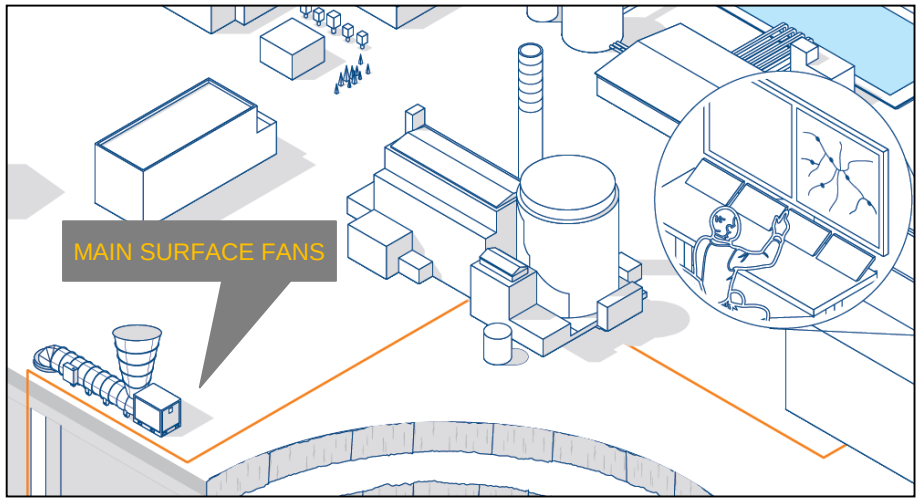
Moveable / Duct building

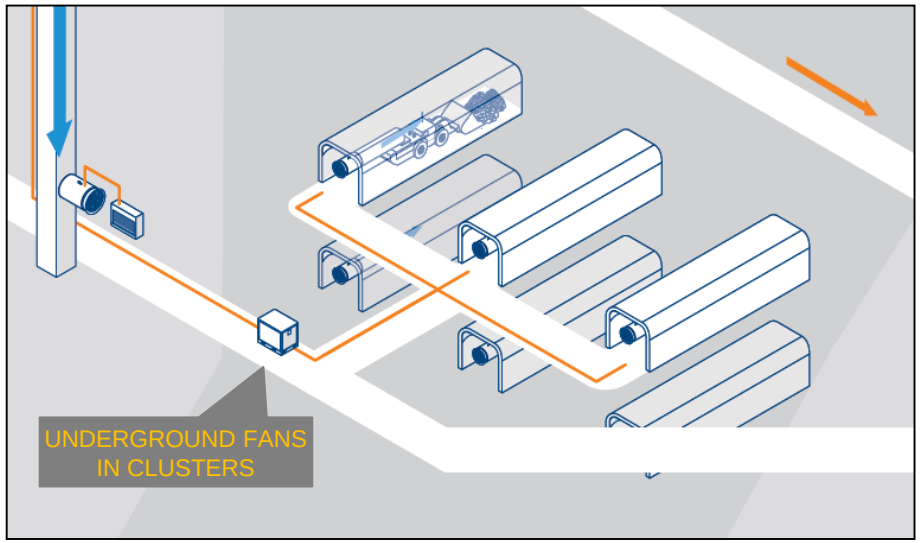
- System provides functions and procedures for moving and adding fans efficiently. No need for programming
- Built-in practical functions for duct building, expansion of ducts and more.

Other types and special functions

- Mine specific adaptions and requirements are easy to implement when all modules are built on System 800xA and 800xA standard engineering tools can be used

ABB Smart ventilation
Any Scale





Main surface fans

- Support for large surface fans with full redundancy
- Coordinated control of parallel fans control for optimal point of operation
- Control of burners or air coolers are coordinated with fans for air temperature control - minimizing energy consumption

Single fans and clustered fans

- Both single fans and clustered fans are supported with full functionality
- Standardized hardware modules for local intelligence controllers

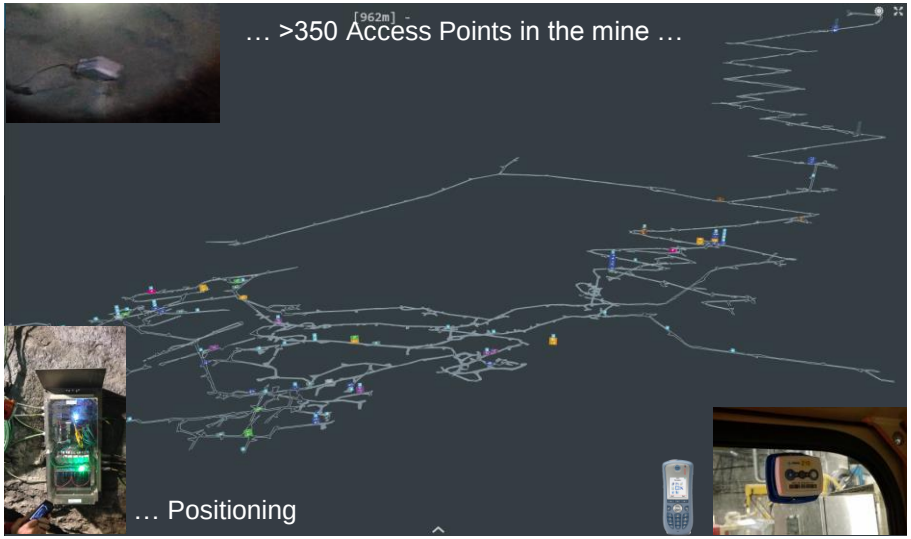
Example 1: Cut and fill stoping

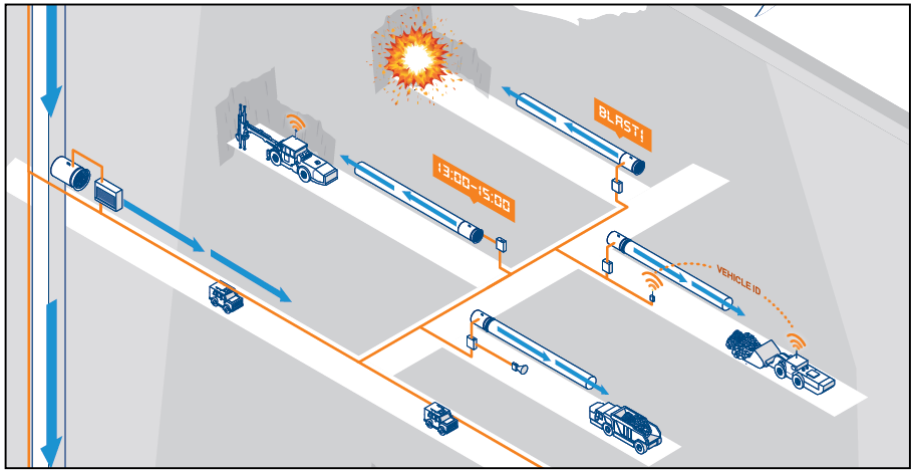
- Total number to be used for dimensioning: 120 fans
- Normally single or small clusters of fans

Example 2: Sub-level caving large scale

- Total number to be used for dimensioning: 700 fans
- Majority of fans in clusters - about 6-8 fans per cluster

ABB Mine Location Intelligence
Global Tracking System





Global Location Tracking

- Information from any global location tracking system can be used by ABB Smart ventilation to generate presence-driven ventilation demand calculation
- This can be used instead of, or in combination with, the Local vehicle tracking instrumentation

ABB Mine Location intelligence system

- Provides a complete location based decision system adapted to underground mines
- Reuse of your existing data/telecom solution into a technology agnostic RTLS solution
- ABB Smart ventilation integration provides an efficient way of configuration and maintaining ventilation zones

ABB Smart Ventilation
System overview - complete system supply

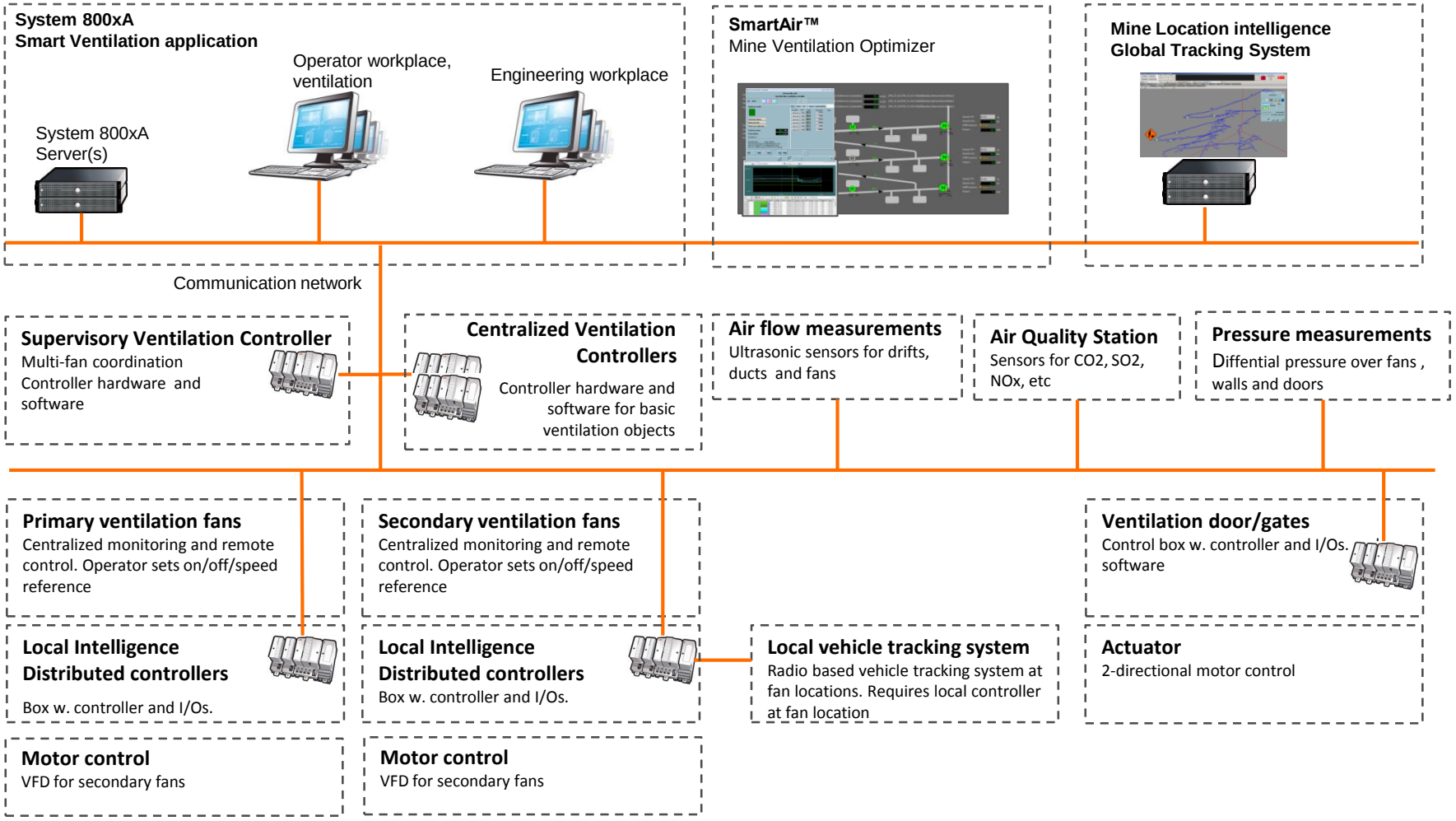
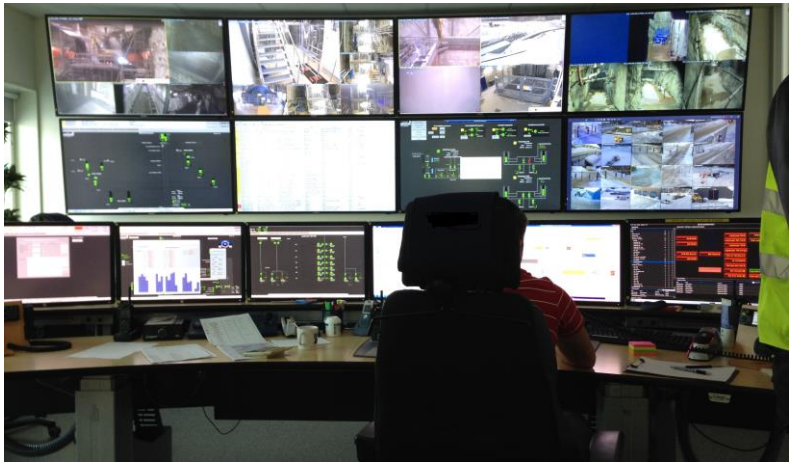
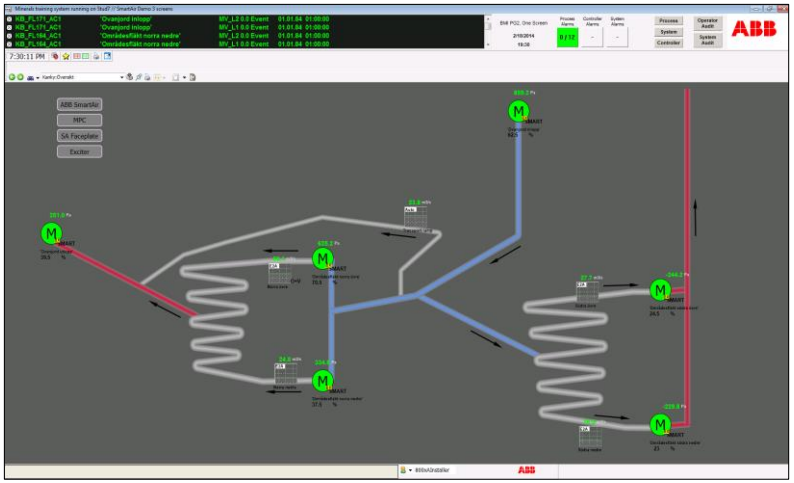


ABB Smart Ventilation
Software and user interface



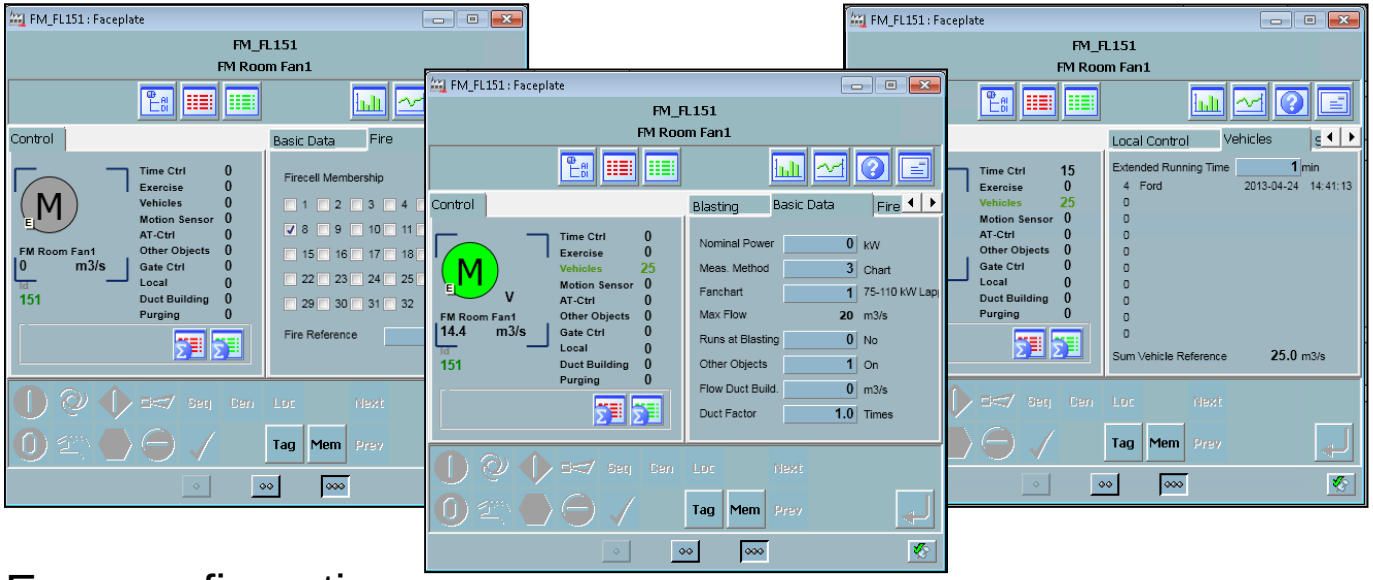


Operator workplace

- Graphical process displays
  - Ventilation overview layout
  - Main fans and heater/cooling equipment
  - Ventilation layout for each level/area
- Alarm and event
  - Alarm and event lists for whole ventilation and each area
  - Advanced alarm statistics for mine ventilation
- Production statistics displays – current & historical
  - Overall mine ventilation KPI's
  - Energy consumption total, area and down to each consumer
  - Run-time, energy statistics per fan and mode of operation
- Trends and logged data for all important data

ABB Smart Ventilation
Software and user interface

- **Easy overview**
  Fan operational data is presented in standardized faceplates, harmonized with ABB 800xA ”look-and-feel”.



- **Easy configuration**
  Normal fan configuration handled in HMI faceplate, no controller programming needed.

- **Easy re-configuration**
  Fans can be moved as one unit (Fan, VFD, Control equipment) when production ends in an area. Re-configuration in faceplate

ABB Smart Ventilation
Layout for LCU Single

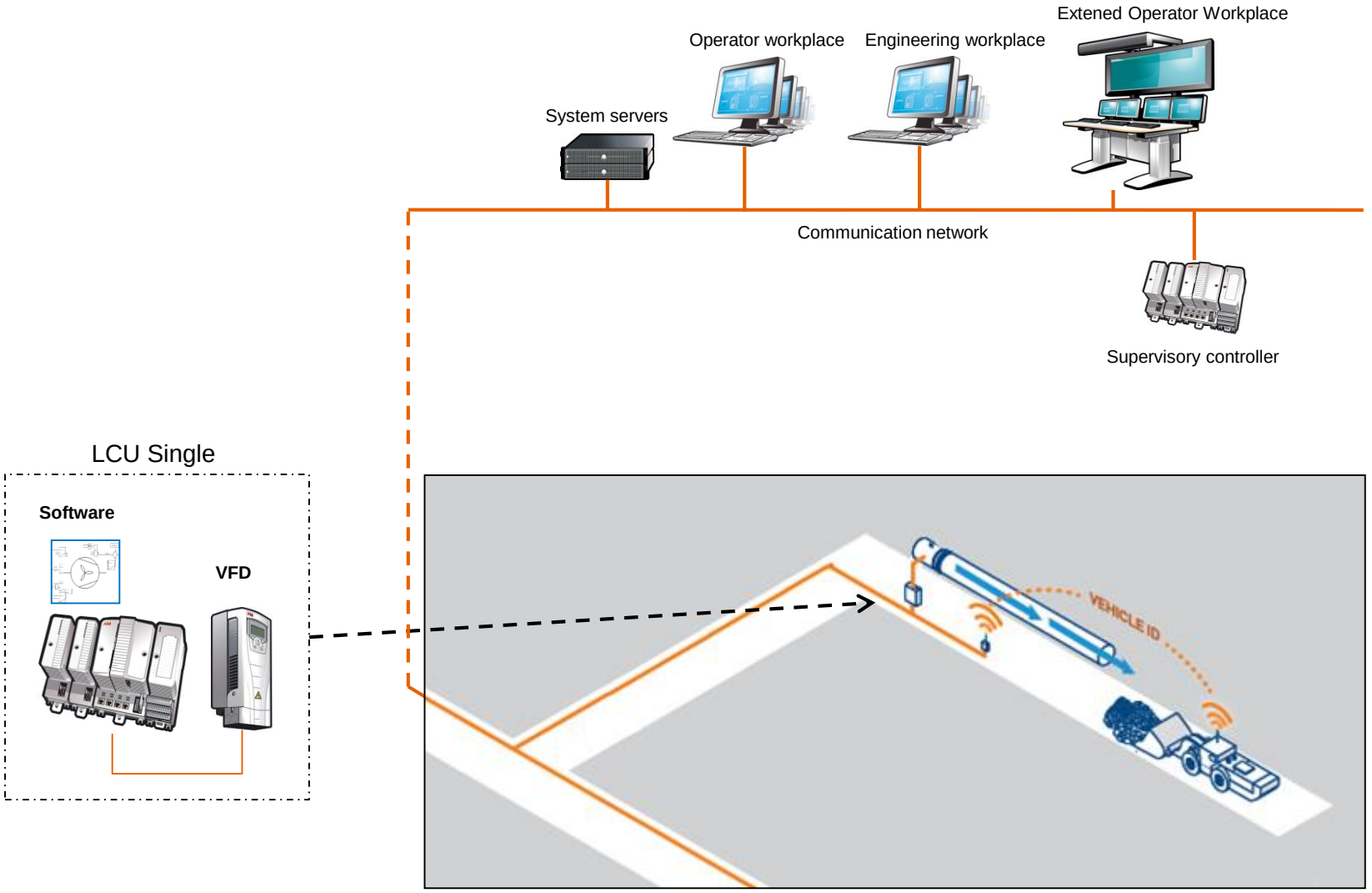


ABB Smart Ventilation
Layout for LCU Multiple

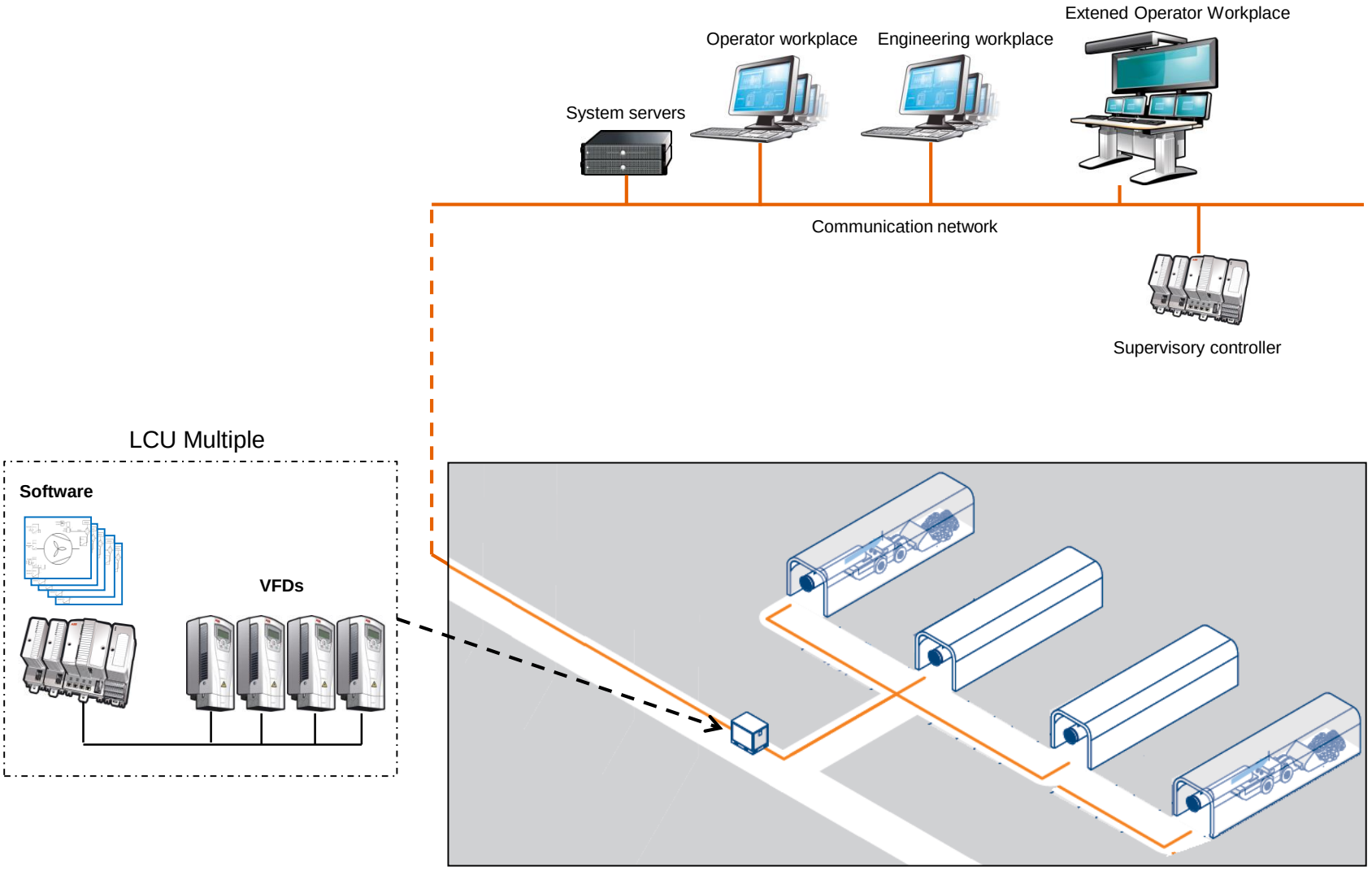


ABB Smart Ventilation
3rd Party PLC Integration

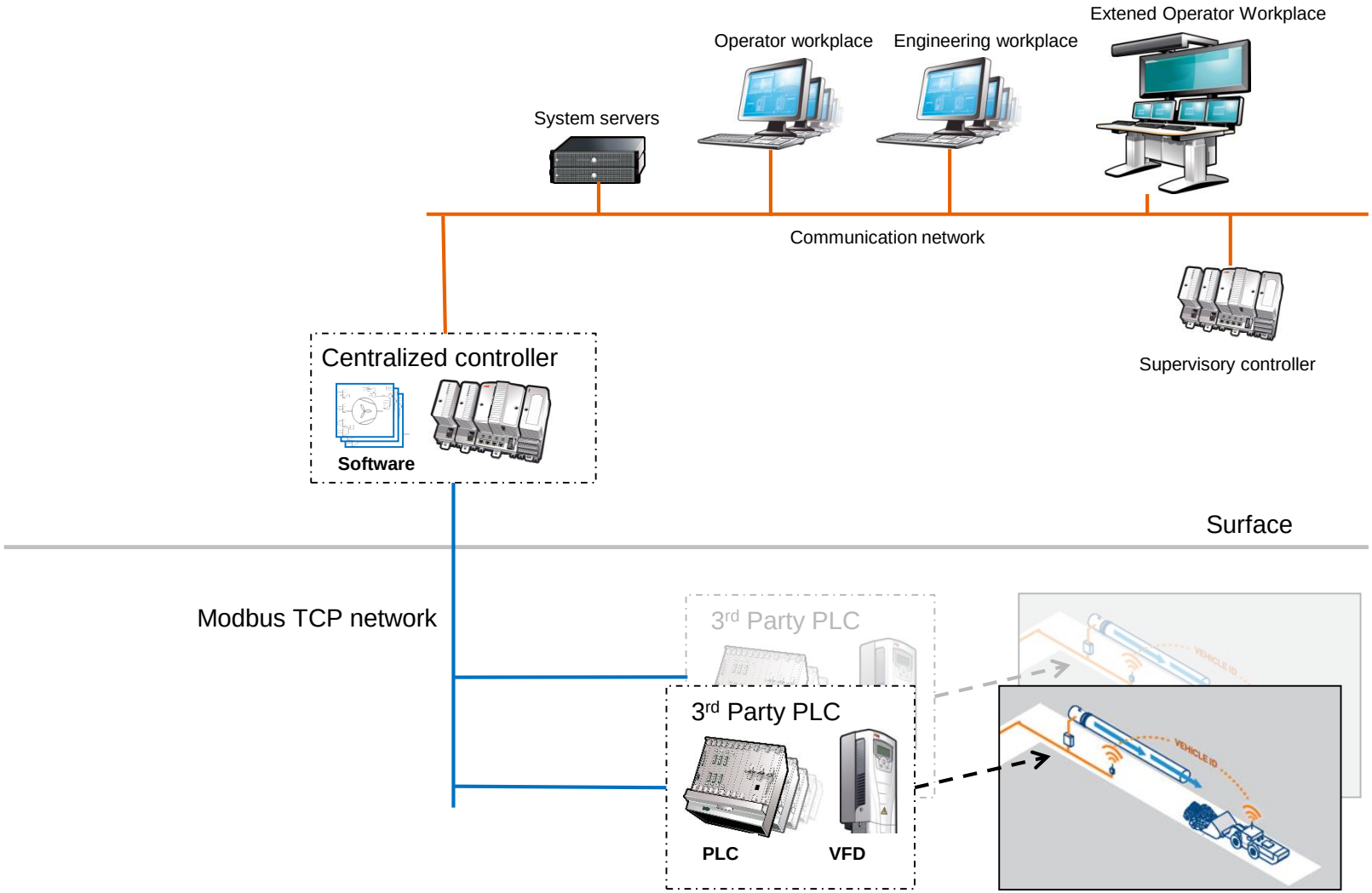
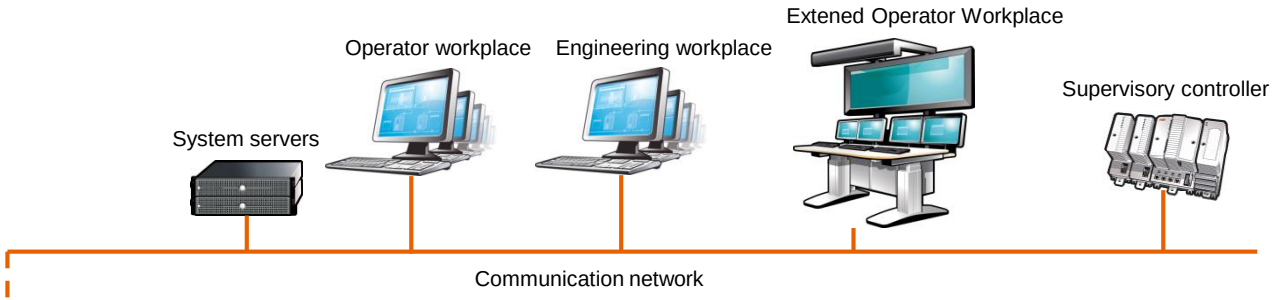


ABB Smart Ventilation
Layout for local mobile equipment detection



LOCAL CONTOLLER WITH COPY OF MOBLE EQUIPMENT LIST

Id	Vehicle Name	Air Demand	
1	Volvo Loader	13	m3/s
2	Drillo	11	m3/s
3	Volvo Loader	20	m3/s
4	Ford	25	m3/s
5	Hitachi	15	m3/s
6	AtlasCopco	16	m3/s

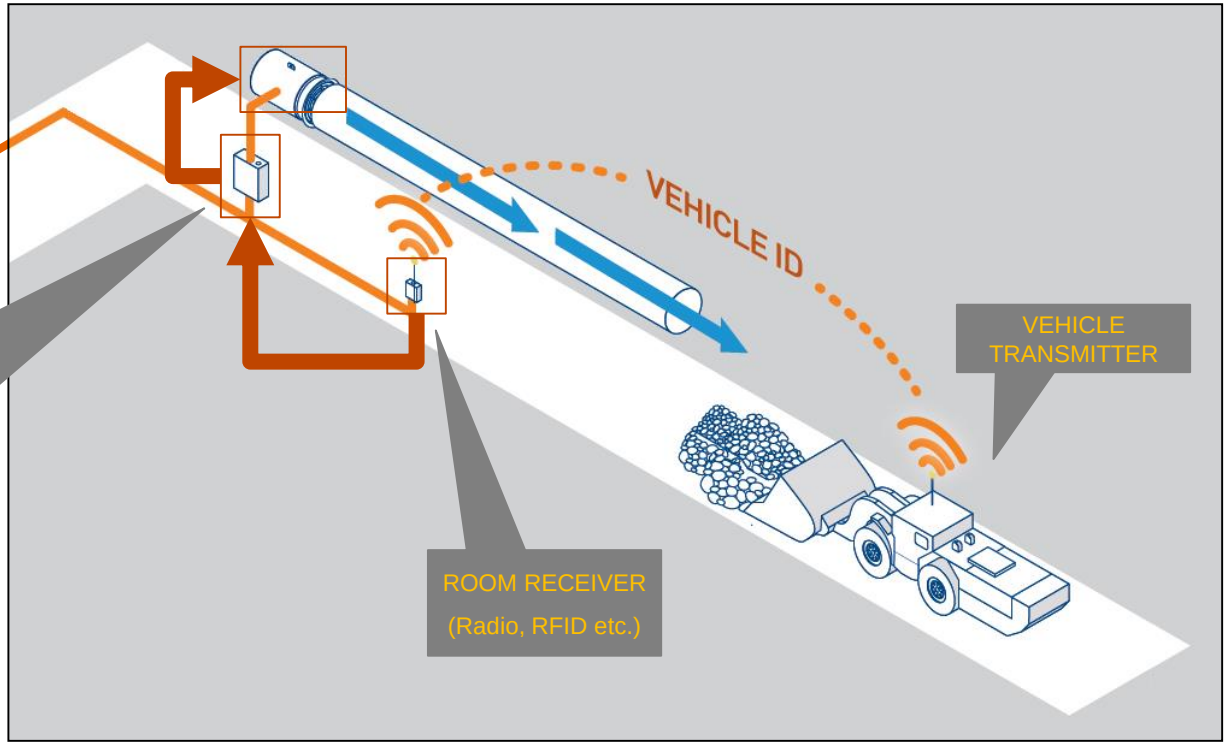


ABB Smart Ventilation
Layout with integration of Global tracking system

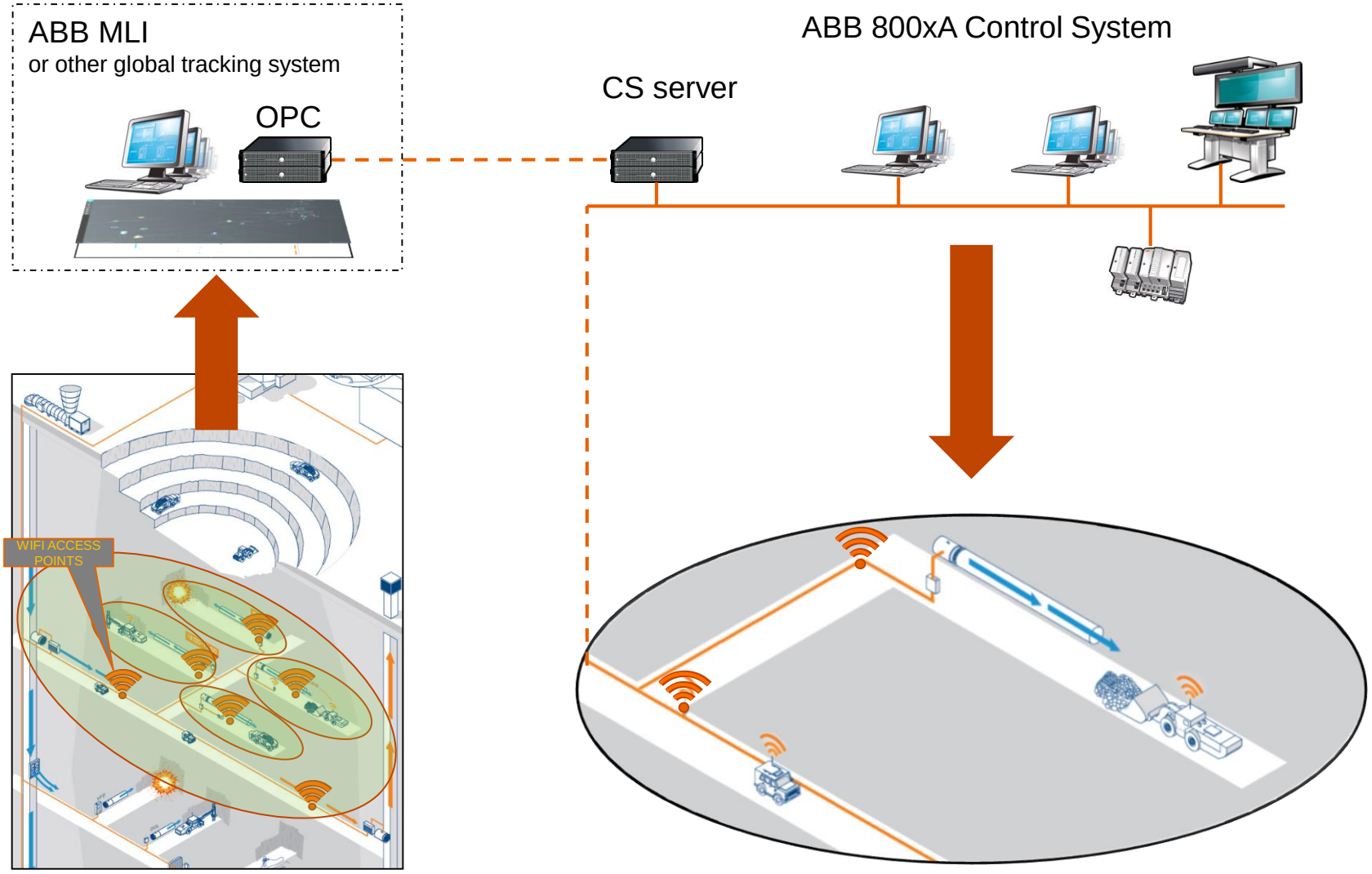
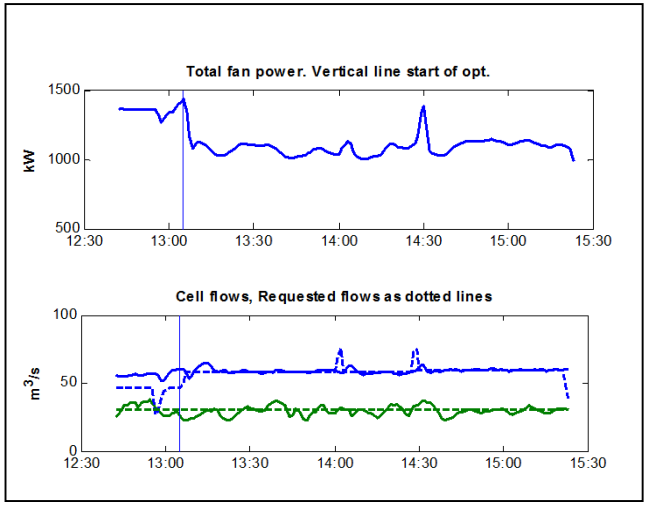
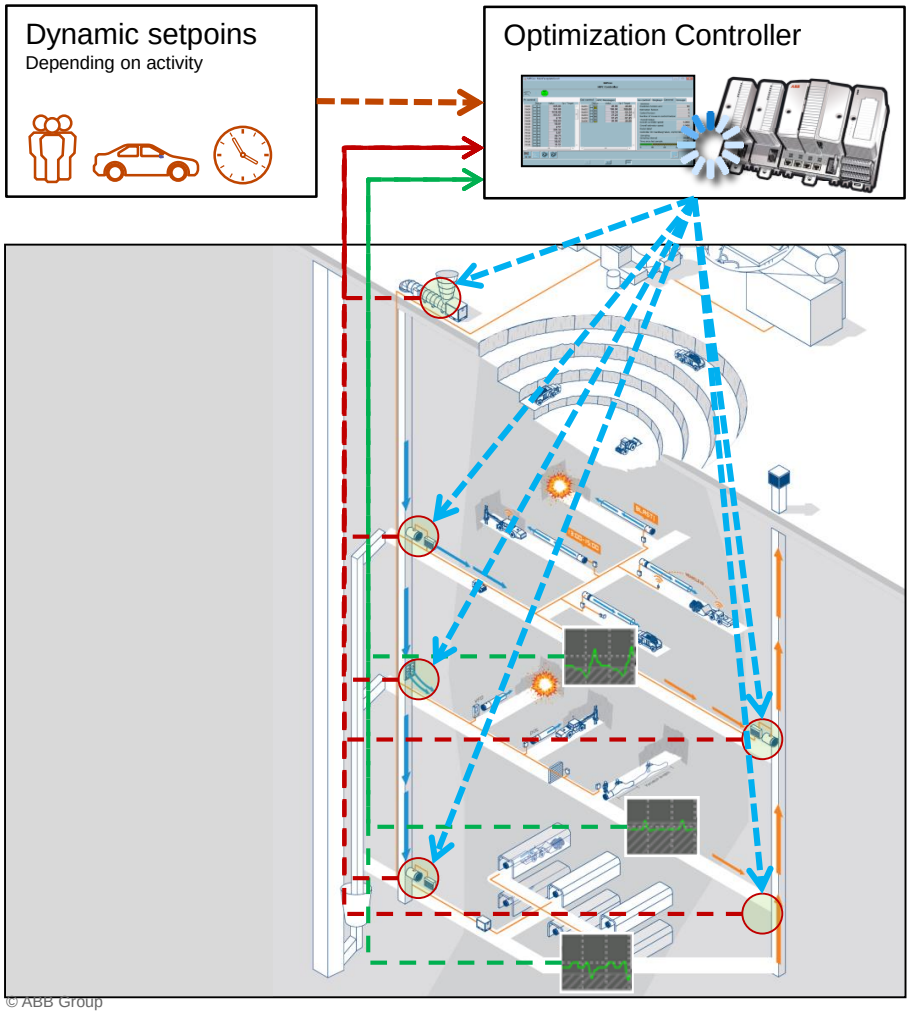


ABB Smart Ventilation
SmartAir™: online ventilation optimization



- A new and unique method for mine wide coordinated control of the main (primary) fans and booster fans
- Providing air needed for healthy working environment
- Model based approach, with models for airflows, pressures and fan powers
- Relies on feedback from field sensors
- Model parameters obtained empirically from operational data
- Can be implemented on top of any ventilation control solution.

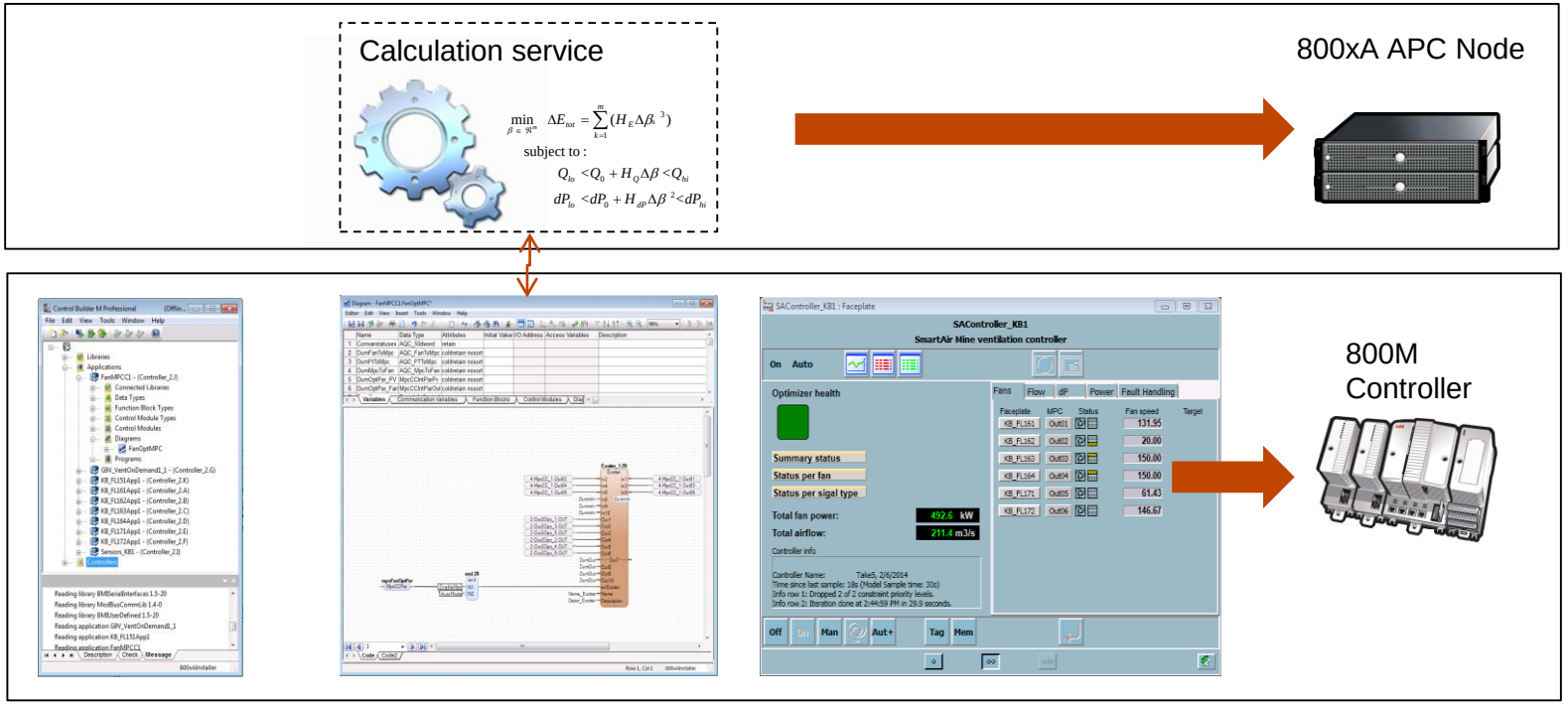
ABB Smart Ventilation
SmartAir: Mine-wide coordination



- Determine airflow requirements (manual or system generated)
- Collect measurements
  - Airflows, fan powers, differential pressures, equipment statuses…
- Solve optimization problem, considering constraints
  - To fulfill minimum airflows
  - To ensure safe fan operation points
- Set all main fan speeds in a coordinated manner

ABB SmartAir™
Built on ABB APC platform

- Implemented on ABB's Advanced Process Control (APC) platform
- Control logic built in Control Builder as a control module
- Calculation engine automatically created as a service, runs on dedicated APC node in the 800xA Control System



Different configuration for different needs

- Modular design enables adaptation to different mining operations and different ventilation layouts
- Versatile software application - the fan control software is prepared for a number of different needs which can be activated by the user
- Ventilation air flow demands can be controlled by different means: Air quality measurements, vehicle presence, time schedules or other events

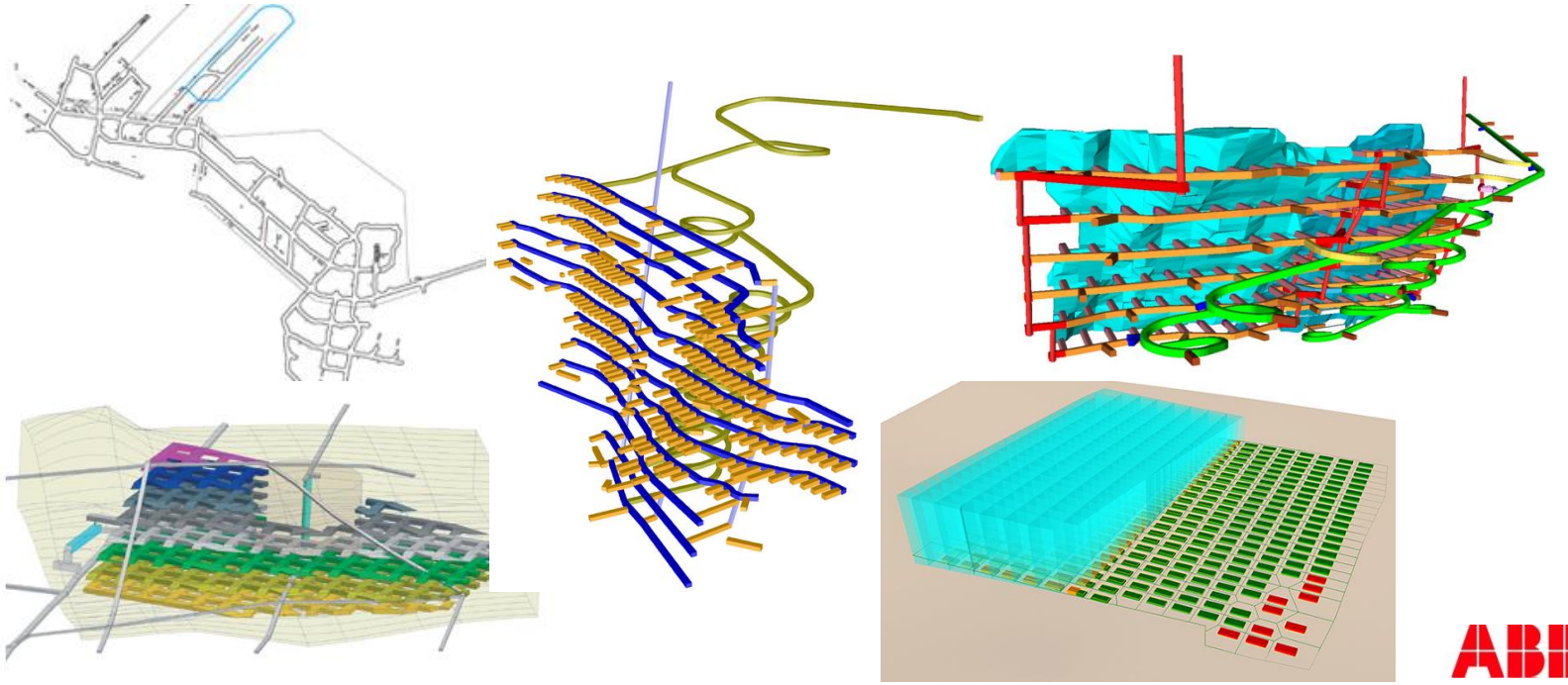
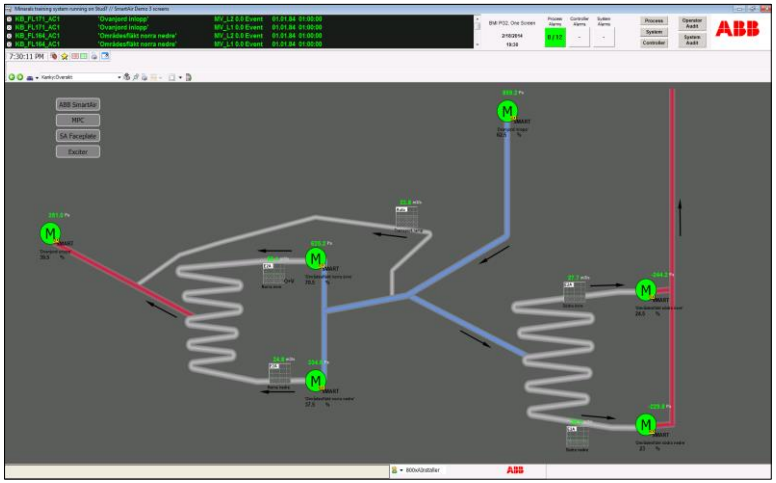
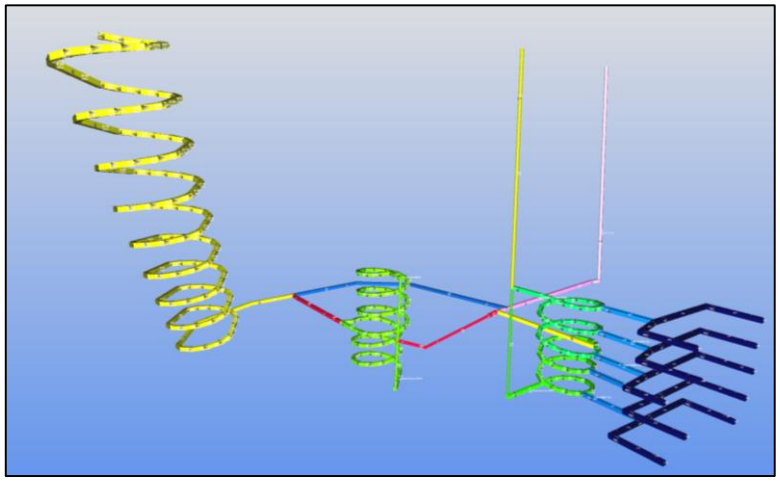


ABB Smart Ventilation
800xA Simulator for Mine Ventilation

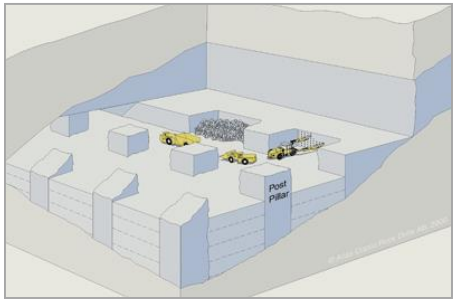


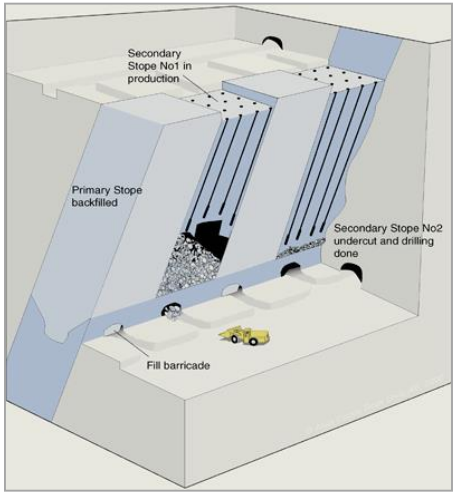


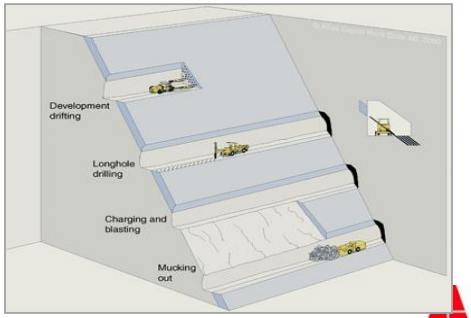
- Validate new ventilation layouts and control strategy in simulated environment enables optimal investment decisions
- Training operators in an identical operator environment as the real process gives maximum ventilation performance

ABB Smart Ventilation
Summary

- Builds on powerful integration platform 800xA
- Modular design
- Easy to expand
- Different needs coordinated throughout the ventilation system.
- Central configuration, local control.
- More efficient use of available infrastructure
- Proven customer installations in operation
- Possibility of mine-wide optimization of main fans







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