

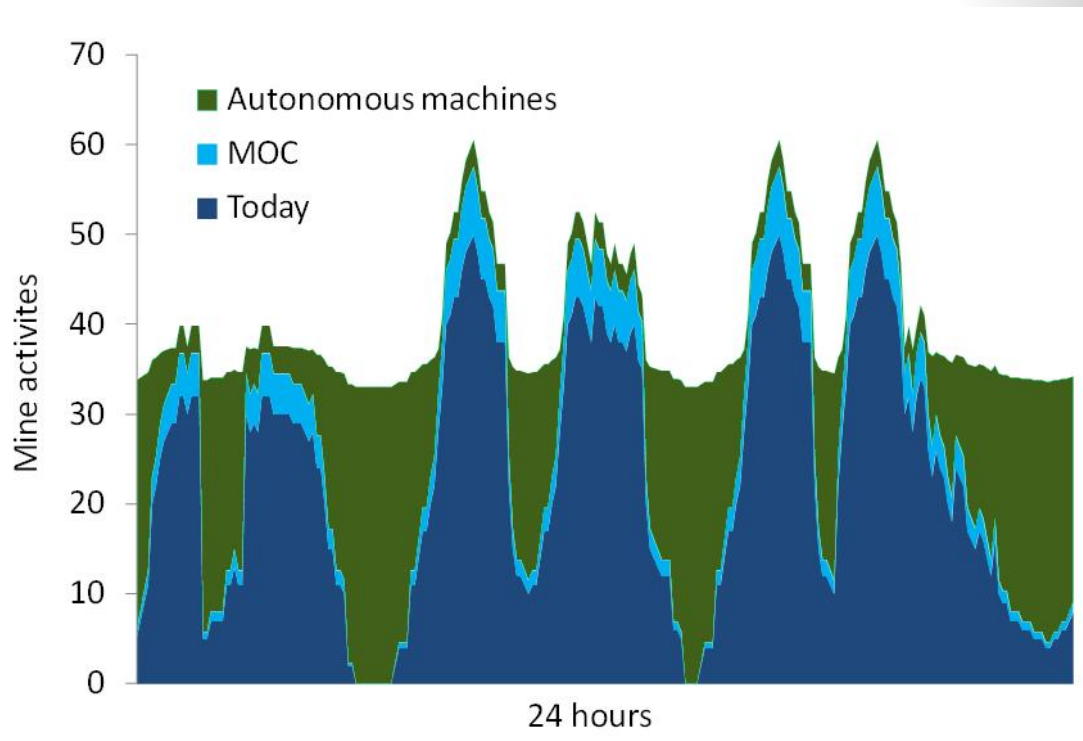
Mine Automation

Next, Next Level of Mining

Peter Burman
Program Manager,
Boliden Mine Automation Program,
Boliden AB



Underground mine Production potential in 10 year



Transparent and visualised production

BOLIDEN

In the beginning it was all dark ...

BOLIDEN



Adding mine radio helped a lot

BOLIDEN



As introducing low band data

BOLIDEN



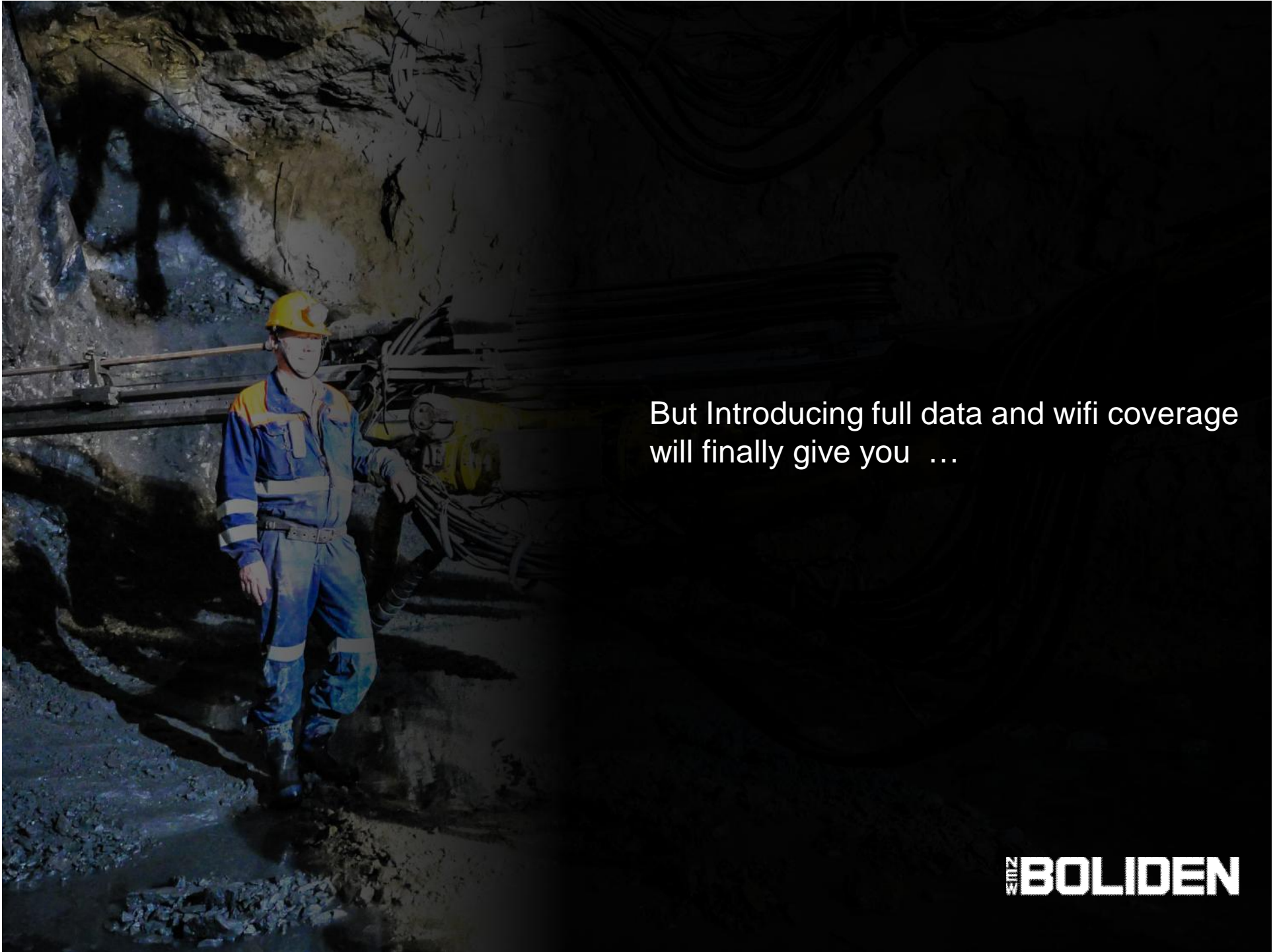
Data network (fiber etc) to “hot spots”

BOLIDEN



Some have dataloggers on machinery

BOLIDEN



But Introducing full data and wifi coverage
will finally give you ...

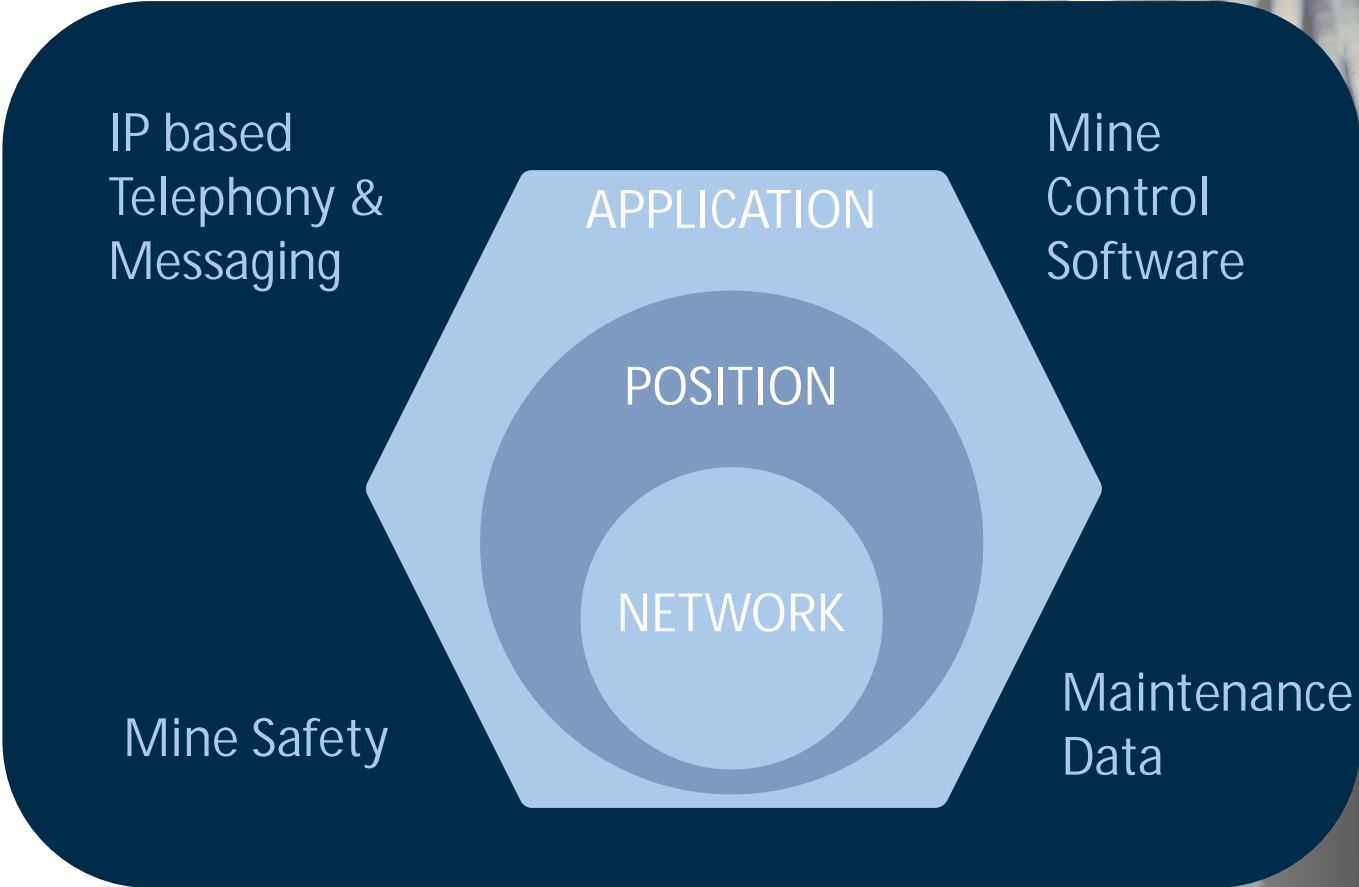
BOLIDEN

... The full picture ...

 **BOLIDEN**

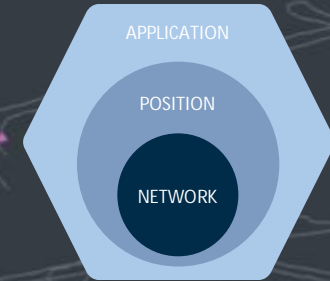


Focus areas for Mine Automation ...



BOLIDEN

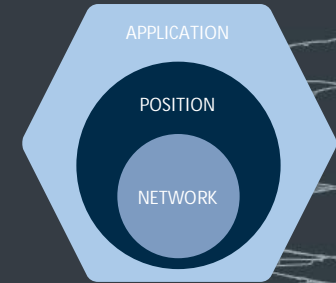
... >350 Accesspoints in the mine ...



BOLIDEN

[962m] -

... Positioning ...

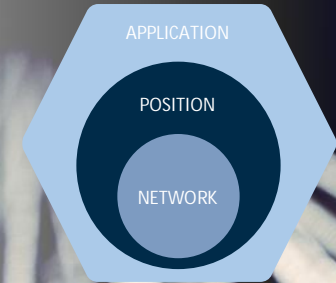


TRIMBLE BOLIDEN



Positioning

- Effect

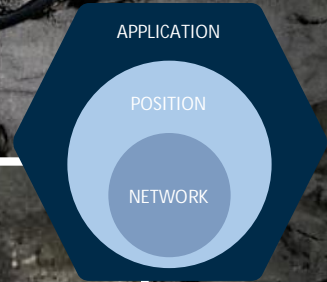


Not just position of machines and people...

- Ventilations based on machines emissions and position
- Rescue operation with simulation
- Maintenance based on height meters
- Gas mileage optimization for trucks based on load and height meters
- Rescue chamber optimization based on actual resource locations.
- Automated verification of machine work position
 - right machine at the right face...
- Trace ore and other materials
- Analysis of traffic patterns
- Maintenance of roads based on vibrations in machines
- Etc etc

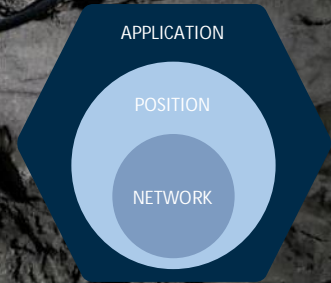
Positioning is a service for other services...

IP Telephony



BOLIDEN

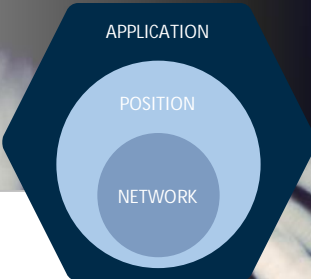
IP Telephony



This is the "killer Application!"

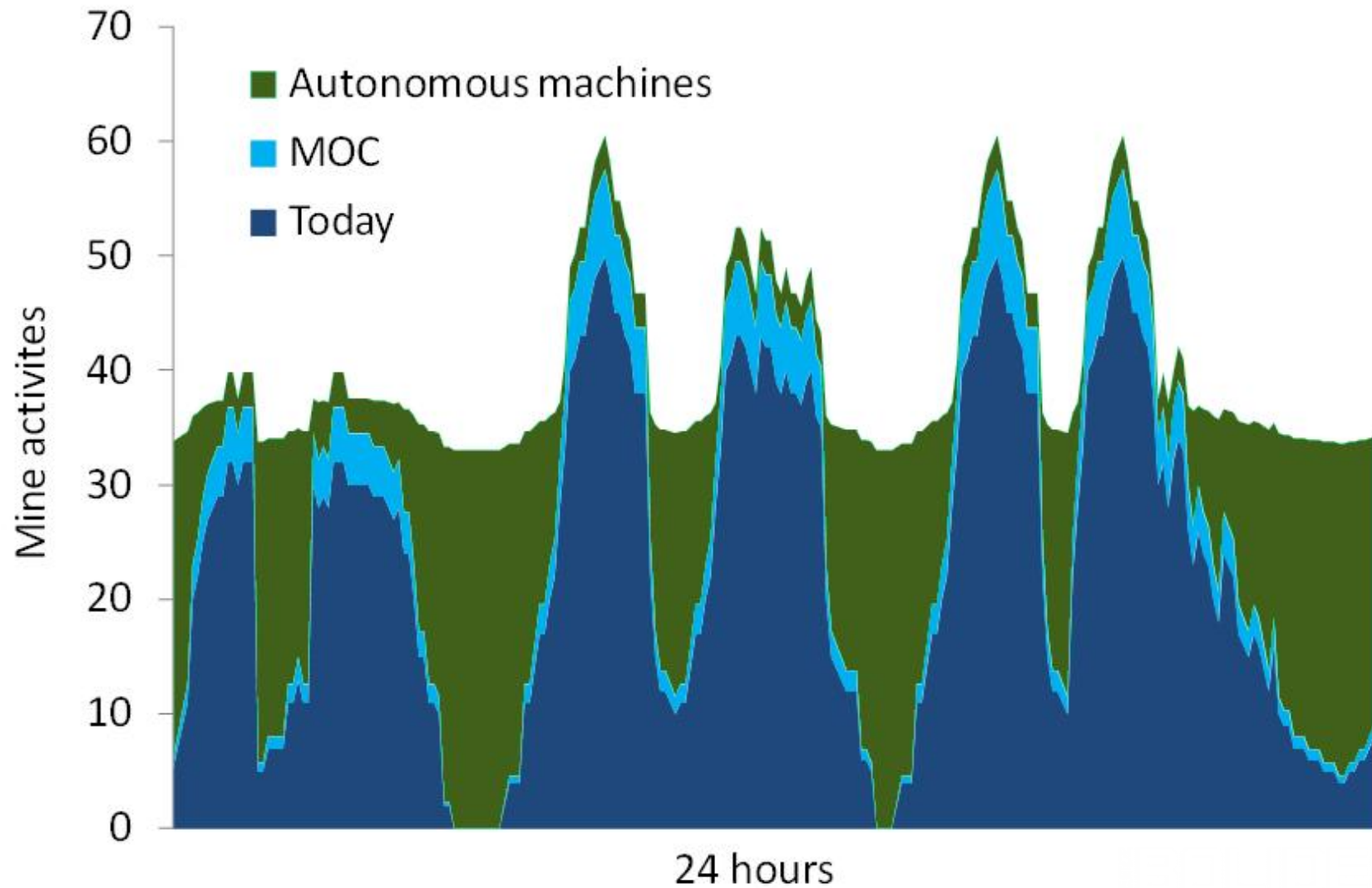
As long as people need voice communication they will work hard to build and maintain the Wifi network

Maintenance Data



Too much data and Too little information

Underground mine Remember this picture?



Dig this: I operated a giant excavator from 2,500km away

An Oculus Rift VR headset and a 4G network in Spain let CNET's Roger Cheng control earth-moving heavy equipment in Sweden.

by Roger Cheng [@RogerWCheng](#) / March 5, 2015 10:09 AM PST

29 / [f](#) 1.2K / [t](#) 373 / [in](#) 315 / [g+](#) / [more +](#)

presented by [#DitchAndSwitch](#)



CNET Editor Roger Cheng controlling an excavator in Sweden -- while at a conference in Barcelona.

Sarah Tew/CNET

VOLVO

Construction Equipment

ERICSSON

BOLIDEN

”Platooning” Trucks

Collective action



A recently completed European project led by Volvo has explored using cars and lorries simultaneously. Its platoons cruised at 85 km/h (50mph) with a gap between each vehicle of 6m. The study vehicles put in some 10,000 km of road



Wikipedia

Predictions^[edit]

Autonomous vehicles are still a developing technology; a large number of companies and researchers have speculated about future developments and the possible effects of the cars.

By 2016, Mercedes plans to introduce "Autobahn Pilot" aka Highway Pilot, the system allows hands-free highway driving with autonomous overtaking of other vehicles.^[81]

By 2016, [Mobileye](#) expects to release hands-free driving technology for highways.^[82]

By early 2017, the US Department of Transportation hopes to publish a rule mandating vehicle-to-vehicle (V2V) communication by an as-yet unspecified deadline.^[83] GM says that by the 2017 model year, the Cadillac CTS will be V2V equipped.^[84]

By 2018, Mobileye expects autonomous capabilities for country roads and city traffic.^[85]

By 2018, Nissan anticipates to have a feature that can allow the vehicle manoeuvre its way on multi-lane highways.^[86]

By 2020, Volvo envisages having cars in which passengers would be immune from injuries.^[87] Volvo also claims vehicles will effectively be "crash free."^[88]

By 2020, GM, Mercedes-Benz, Audi, Nissan, BMW, [Renault](#), Tesla and Google all expect to sell vehicles that can drive themselves at least part of the time.^{[59][89][90][91][92][93][94]}

2020, ABI Research forecasts that truly self-driving cars would become a reality by 2020 and that 10 million such new cars would be rolling out on to United States' public highways every year by 2032.^[95]

By 2020, Google autonomous car project head's goal to have all outstanding problems with the autonomous car be resolved.^{[96][97]}

By 2024, [Jaguar](#) expects to release an autonomous car.^[98]

By 2025, Daimler and Ford expect autonomous vehicles on the market.^{[99][100]} Ford predicts it will have the first mass-market autonomous vehicle, but released no target date for this.^[101]

By 2025, most new GM vehicles will have automated driving functions as well as vehicle-to-vehicle communication technology.^[102]



FOU Projects Overview

↔ Cooperation

↔-> Suggested Cooperation

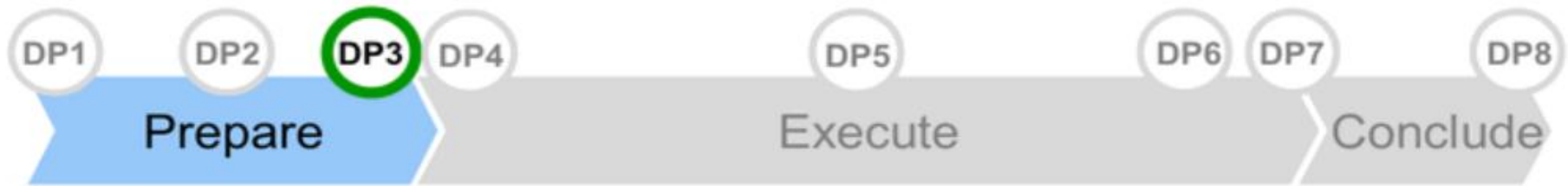
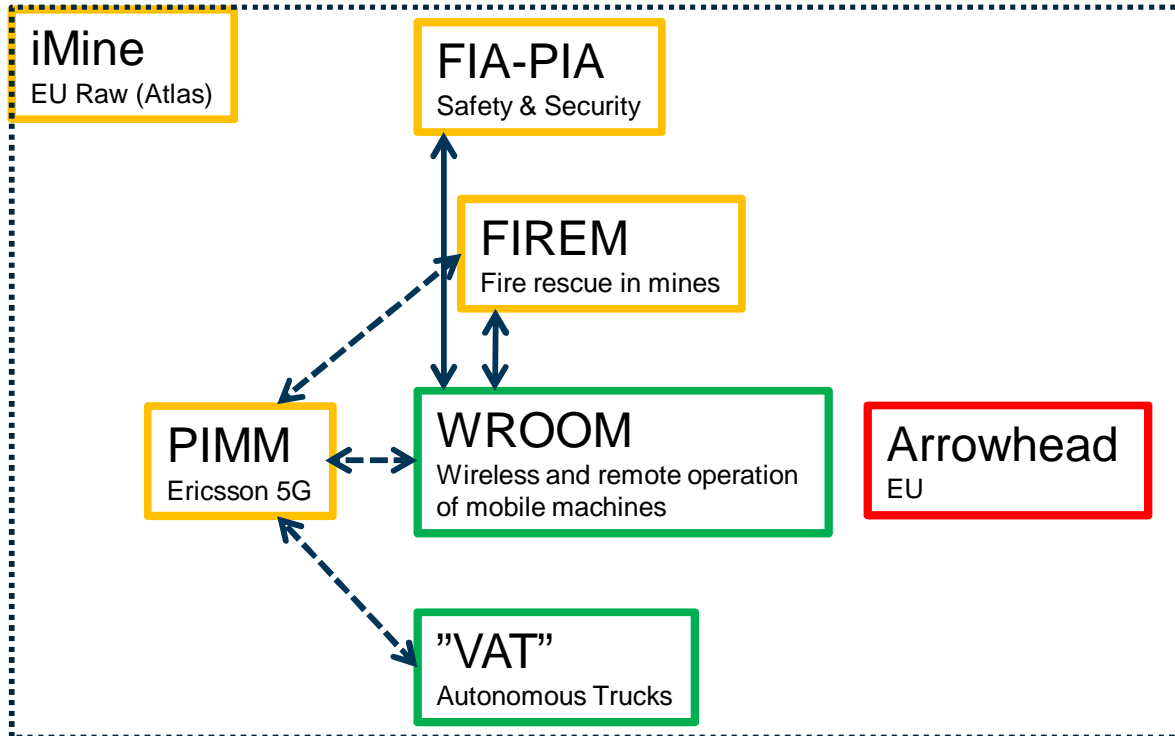
□ Prio 1

□ Prio 2

□ Prio 3

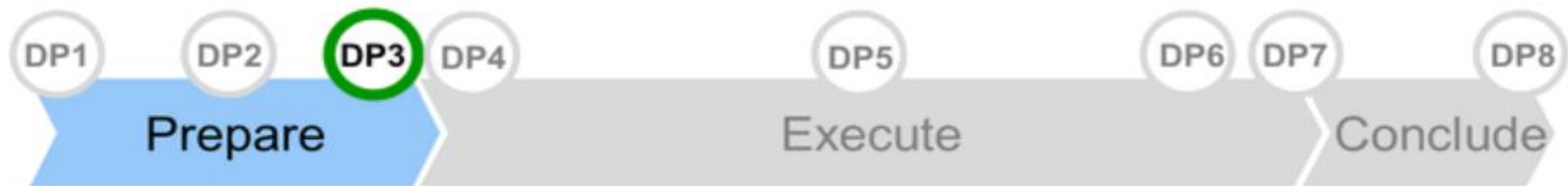
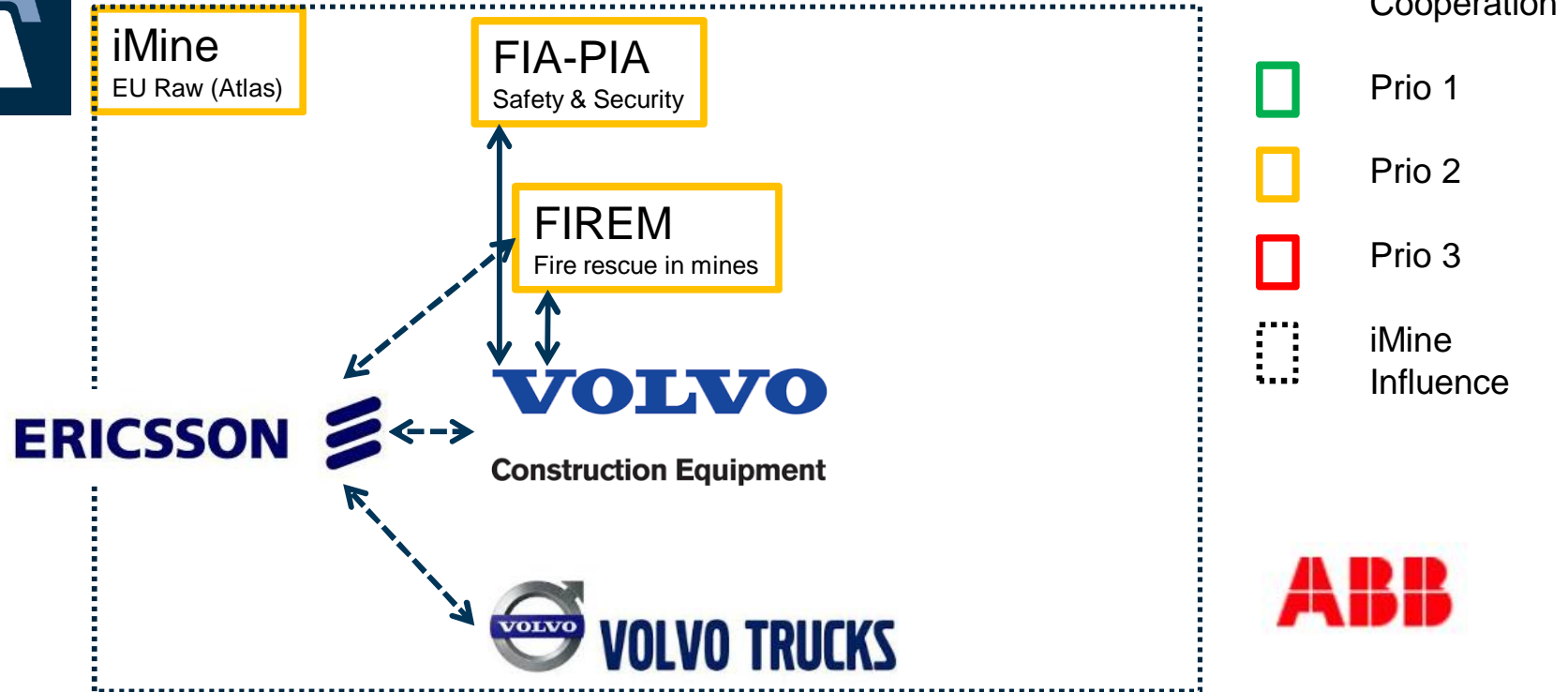
□ iMine Influence

EU Robotics
Prestudy





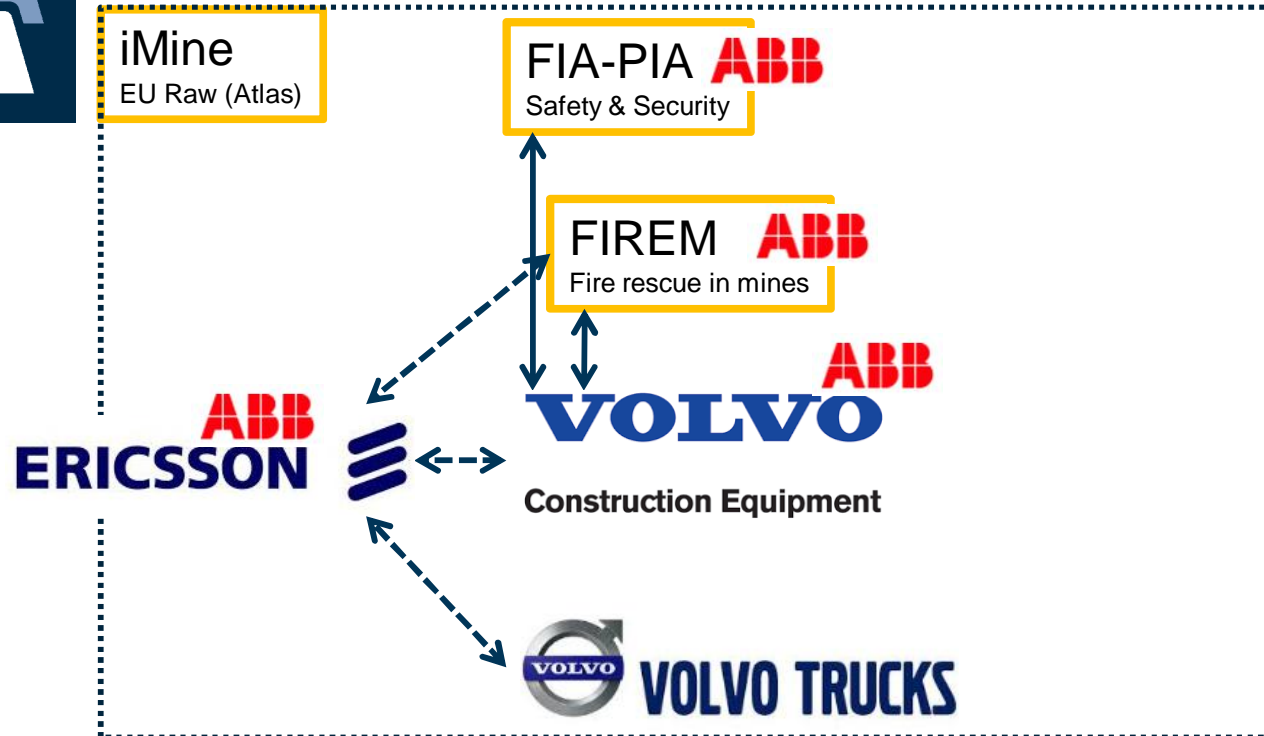
FOU Projects Overview



BOLIDEN



FOU Projects Overview



↔ Cooperation

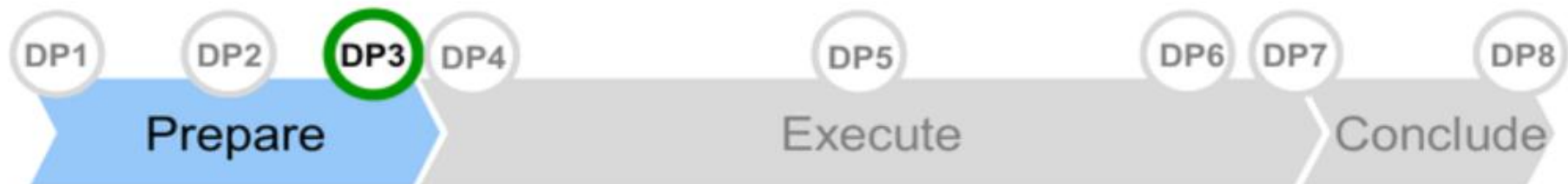
↔ Suggested Cooperation

□ Prio 1

□ Prio 2

□ Prio 3

□ iMine Influence



BOLIDEN

What to do until we have this new technology?

Great Potential in:



Sandvik AutoMine-Lite for LHDs



Atlas Copco Boomer Autodrill



Emergency



It is not all about money ...





 **mobilaris**
finding people matters...



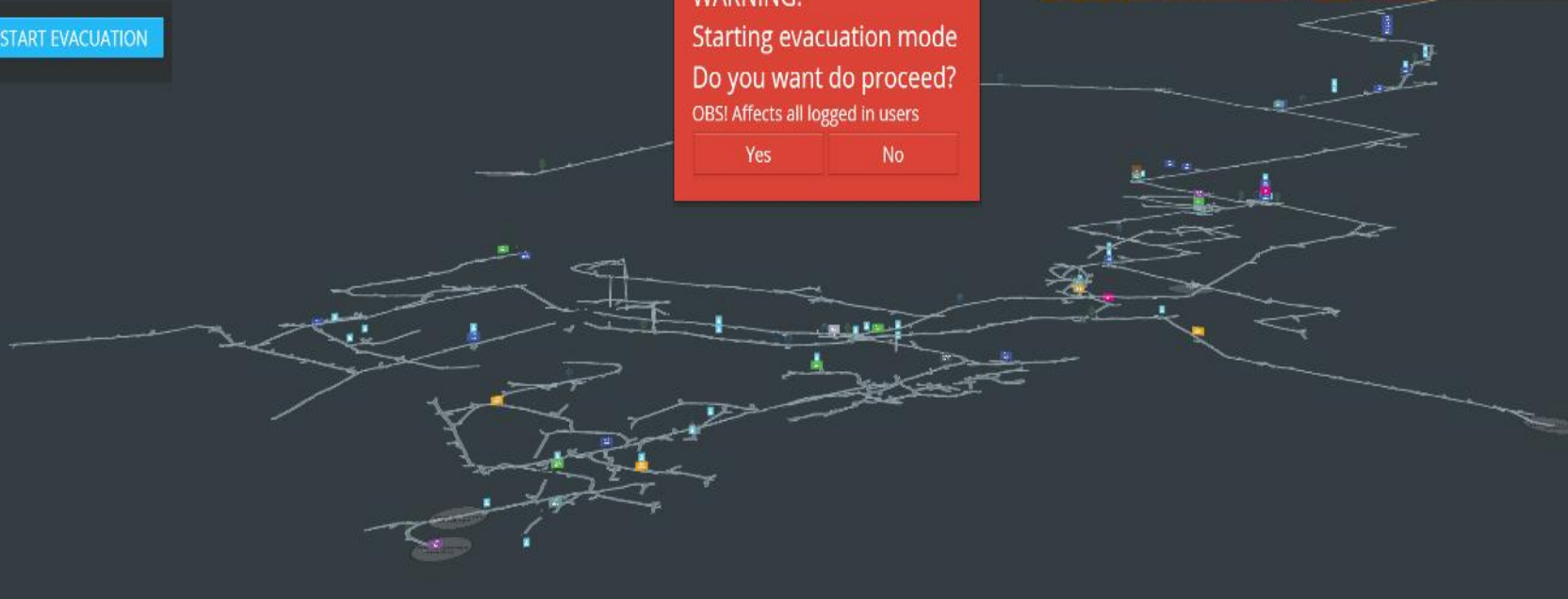
THE RESCUE LEADER PUTS THE SYSTEM INTO EVACUATION MODE



WARNING!
Starting evacuation mode
Do you want do proceed?
OBS! Affects all logged in users

Yes No

START EVACUATION





THE EVACUATION PROCESS IS CONTROLLED BY THE CHECKLIST

THE FIRST STEP IS TO SEND OUT THE EVACUATION MESSAGE



Send new evacuation message

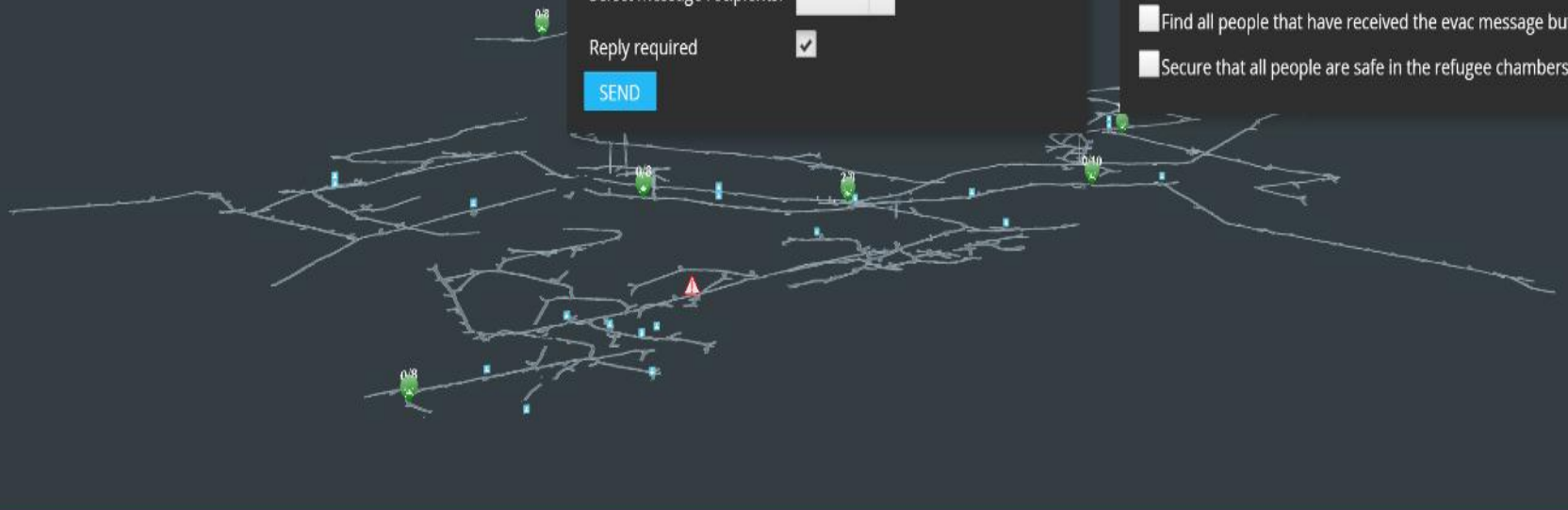
Message text:

Select message recipients: Handsets

Reply required

SEND

- ### Evacuation checklist
- Send out evacuation messages to all personnel in the mine
 - Alert 911
 - Find all people that have not received the evac message
 - Find all people that have received the evac message but not acknowledged
 - Secure that all people are safe in the refugee chambers





THE FIRST STEP IS TO SEND OUT THE EVACUATION MESSAGE

Send new evacuation message

Message text:

*** FIRE IN THE MINE!!! EVACUATE !!!

Select message recipients:

Handsets

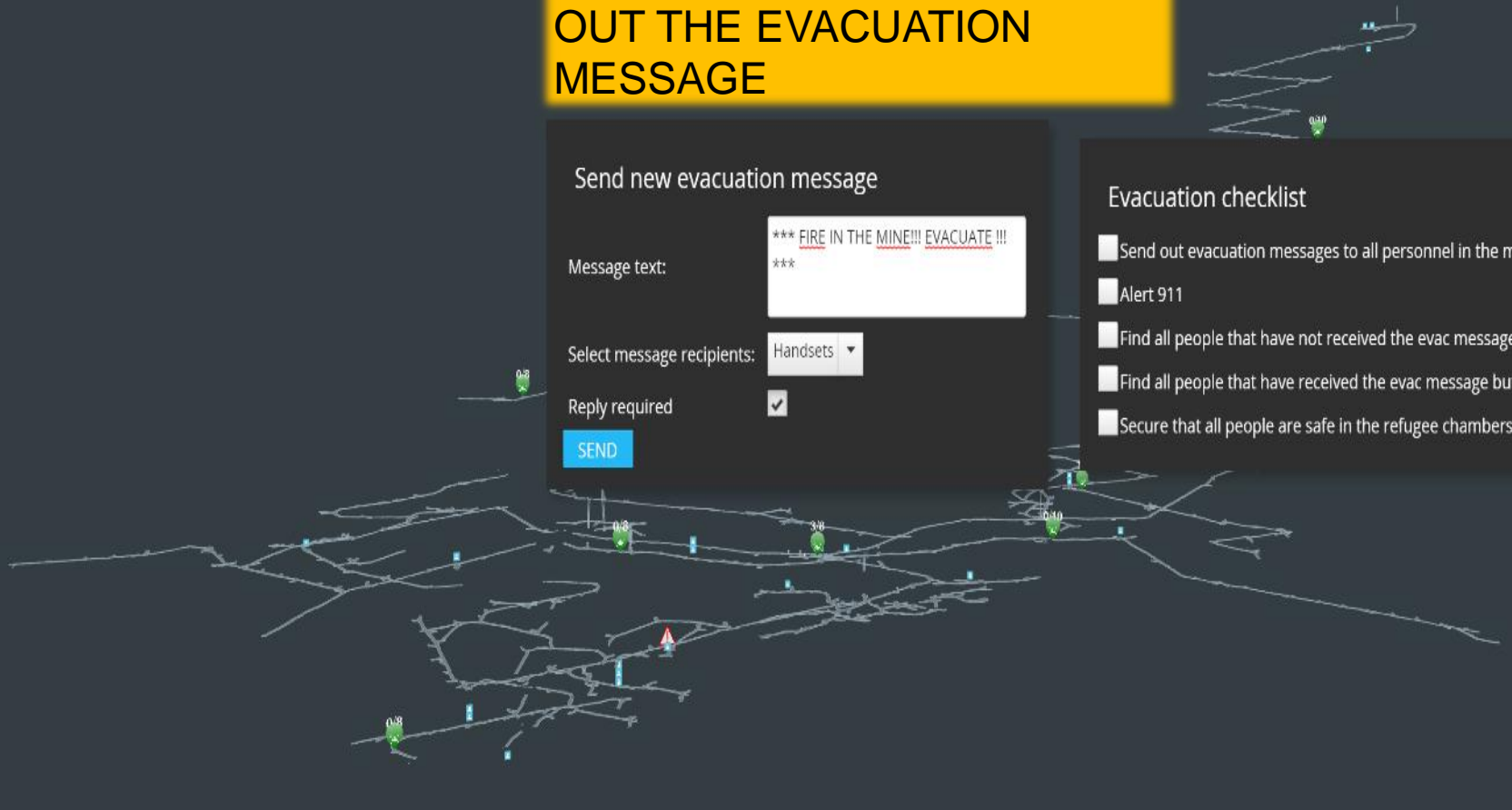
Reply required



SEND

Evacuation checklist

- Send out evacuation messages to all personnel in the mine
- Alert 911
- Find all people that have not received the evac message
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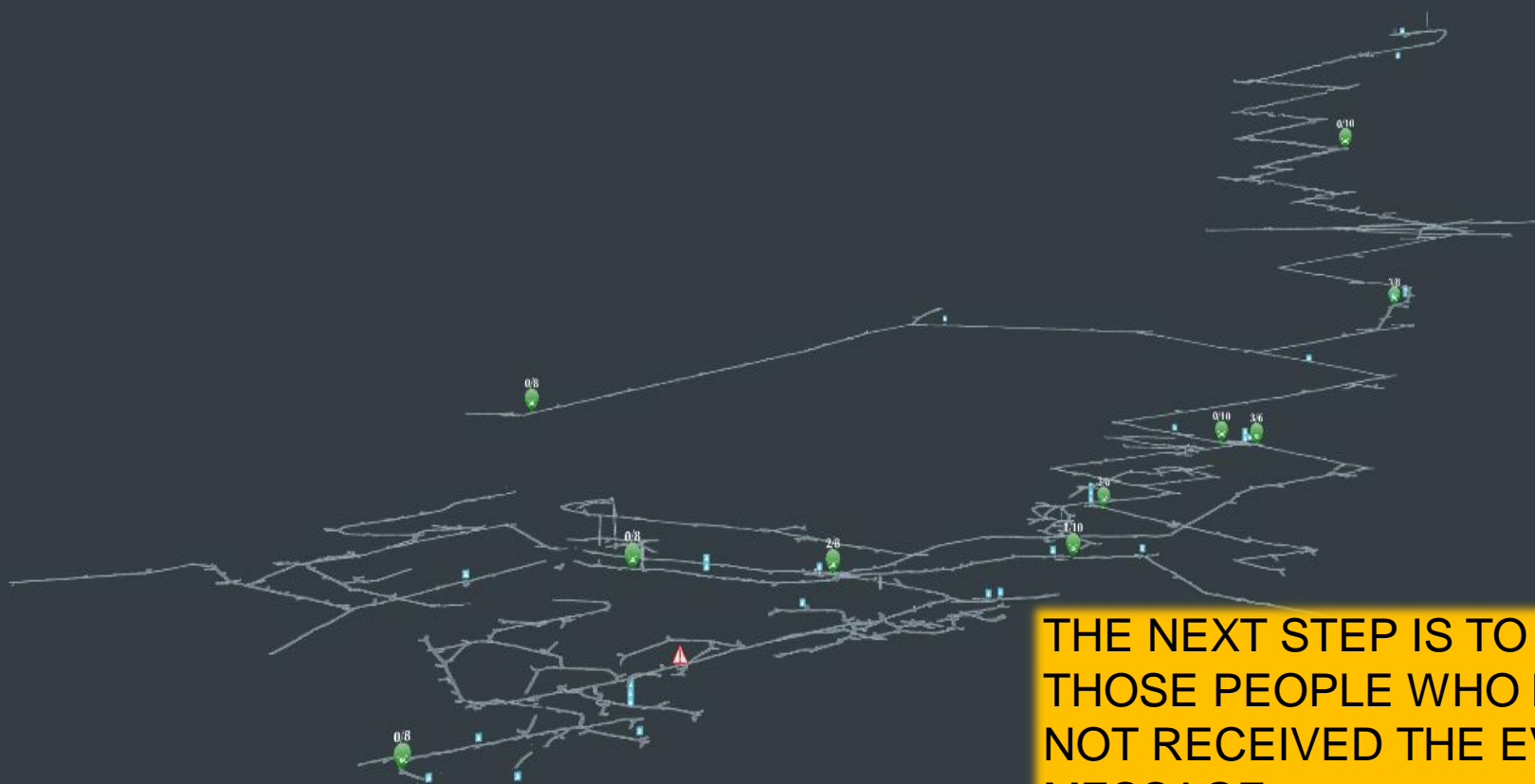


[-650m] Kristineberg

112/1109/ 245

Evacuation checklist

- Send out evacuation messages to all personnel in the mine
- Alert 911
- Find all people that have not received the evac message
- Find all people that have received the evac message but not acknowledged
- Secure that all people are safe in the refugee chambers



THE NEXT STEP IS TO FIND THOSE PEOPLE WHO HAVE NOT RECEIVED THE EVAC MESSAGE

00:04:10

EVACUATION!

Personnel Underground: 50

Messages: 50

| | | | | | |
|---------|------------|------------|------------------|--------------|---------|
| Safe: 2 | Unknown: 8 | Unsafe: 40 | Acknowledged: 15 | Received: 30 | Sent: 5 |
|---------|------------|------------|------------------|--------------|---------|

- Send out evacuation messages to all personnel in the mine
- Alert 911



Search results

Searched for: Personnel unknown found: 8

| | | |
|-----------------------------------|---------|--------|
| Edwin Fjellner | Telefon | 2s |
| Mikael Stenberg | Telefon | 2s |
| auto-registered (Ascom Tateco AB) | Telefon | 4s |
| Jane Djerf | Telefon | 4s |
| Susanne Linder | Telefon | 6s |
| Sune Stenvall | Telefon | 7s |
| Christer Andersson | Telefon | 1m 52s |
| Ulf Renström | Telefon | 1m 52s |

Asset information

General Advanced

| | |
|---------------|-----------------------------------|
| NAME | Susanne Linder |
| MAIL | 4657@kriunitecm.boliden.internal |
| PHONE NUMBER | 4657 |
| DESCRIPTION | auto-registered (Ascom Tateco AB) |
| TYPE | Telefon |
| STATUS | ONLINE |
| ADDRESS | |
| LOCATE | |
| FOLLOW IN MAP | |
| SEND MESSAGE | |
| MARK AS ME | |

EDIT RSSI CHART

PIC ONE OF THEM, SUSANNE, AND FIND HER

THE LIST SHOWS PEOPLE THAT HAVE NOT RECEIVED THE EVAC MESSAGE, THEY MUST BE MANUALLY FOUND

[-668m]
1724/1963/ 666

Evacuation checklist

- Send out evacuation messages to all personnel in the mine
- Alert 911

Asset information

General | Advanced

| | |
|---------------|-----------------------------------|
| NAME | Susanne Linder |
| MAIL | 4657@kriunitecm.boliden.internal |
| PHONE NUMBER | 4657 |
| DESCRIPTION | auto-registered (Ascom Tateco AB) |
| TYPE | Telefon |
| STATUS | ONLINE |
| ADDRESS | |
| LOCATE | |
| FOLLOW IN MAP | |
| SEND MESSAGE | |
| MARK AS ME | |

EDIT | RSSI CHART

LOCATE SUSANNE AND SEARCH FOR THE NEAREST COLLEAGUE TO HER

00:08:45 **EVACUATION!** Personnel Underground: 50 Messages: 50

Safe: 20 Unknown: 10 Unsafe: 20 Acknowledged: 20 Received: 30 Sent: 3

[-668m]

1707/1953/ 666

Search results

Searched for: telefon 1707/1953-666

| Description | Type | Distance | Age |
|-----------------------------------|---------|----------|-----|
| Robin Nyström | Telefon | 10.0 | 9s |
| Inge Eriksson | Telefon | 976.0 | 8s |
| Jane Djerf | Telefon | 1156.0 | 9s |
| Dennis Bjurén | Telefon | 2178.0 | 10s |
| Karl-Eric Marksén | Telefon | 2178.0 | 9s |
| auto-registered (Ascom Tateco AB) | Telefon | 2219.0 | 8s |
| Ingela Grundström | Telefon | 2228.0 | 10s |
| Susanne Linder | Telefon | 2228.0 | 11s |
| Staffan Stenman | Telefon | 3083.0 | 22s |
| Mattias Holmberg | Telefon | 3083.0 | 12s |
| auto-registered (Ascom Tateco AB) | Telefon | 3147.0 | 10s |
| Fredrik Larsson | Telefon | 3147.0 | 8s |
| Viktor Löfdahl | Telefon | 3147.0 | 12s |
| Peter Nilsson | Telefon | 3482.0 | 9s |
| Johanna Solfeldt | Telefon | 3557.0 | 9s |
| Tony Lundgren | Telefon | 3789.0 | 8s |

Evacuation checklist

- Send out evacuation messages to all personnel in the mine
- Alert 911

Asset information

General Advanced

NAME Robin Nyström
MAIL 4836@kriunitecm.boliden.internal
PHONE NUMBER 4836
DESCRIPTION auto-registered (Ascom Tateco AB)
TYPE Telefon
STATUS ONLINE
ADDRESS
LOCATE
FOLLOW IN MAP
SEND MESSAGE
MARK AS ME

Send message to asset

MESSAGE

Robin! Du måste hjälpa oss att hitta Susanne!

SEND MESSAGE CANCEL

SELECT ROBIN WHO IS CLOSEST TO HER AND ASK HIM TO FIND HER

01:11:37

EVACUATION!

Personnel Underground: 50

Messages: 50

Safe: 45 Unknown: 4 Unsafe: 1 Acknowledged: 41 Received: 4 Sent: 5

[-787m] Kristineberg

1707/1953/ 666

Evacuation checklist

- Send out evacuation messages to all personnel in the mine
- Alert 911
- Find all people that have not received the evac message
- Find all people that have received the evac message but not acknowledged
- Secure that all people are safe in the refugee chambers



AND SO THE EVACUATION
CONTINUES UNTIL ALL ARE SAFE



mobilaris
finding people matters...

01:25:38

EVACUATION!

Personnel Underground: 50

Messages: 50

Safe: 50 Unknown: 0 Unsafe: 0 Acknowledged: 45 Received: 0 Sent: 5

In the beginning it was all dark ...

EMZ BOLIDEN

Thank You!



Boliden Mine Automation

For more info please contact: peter.j.burman@boliden.com

BOLIDEN