

6<sup>to</sup> Seminario

# Acercamiento Tecnológico

*Codelco Digital: Construyendo la Minería del Futuro*

## Post-Accident Network Probe for Underground Mines

by Alexandre Cervinka

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# Agenda

- Problema
- Vision general de la red
- Sonda de red post-accidente
- Conclusion

# Problema

Redes e instrumentacion no disponible despues de derumbe, falla catastrofica o incendio por que:

- Cables estan cortado, deretidos, dañados, etc.
- Componentes de sistemas no tienen bateria respaldo propia. Dependen de una UPS cableada distante.
- Redes con pocos enlaces espacialmente independientes para llegar a superficie.
- Redes subteraneas sin capacidad de autoconfiguracion autonoma.
- Areas aisladas no tienen enlaces de respaldo.

# Son las redes inalámbricas realmente inalámbricas?

	<b>MineTrax<sup>®</sup></b> <small>by Newtrax</small>	Wi-Fi Mesh	Fiber/CAT5 + Wi-Fi	VHF/UHF Leaky Feeder
Access link	Wireless	Wireless	Wireless	Wireless
Backhaul link	Wireless	Wireless	Wired	Wired
Power supply	Wireless	Wired	Wired	Wired

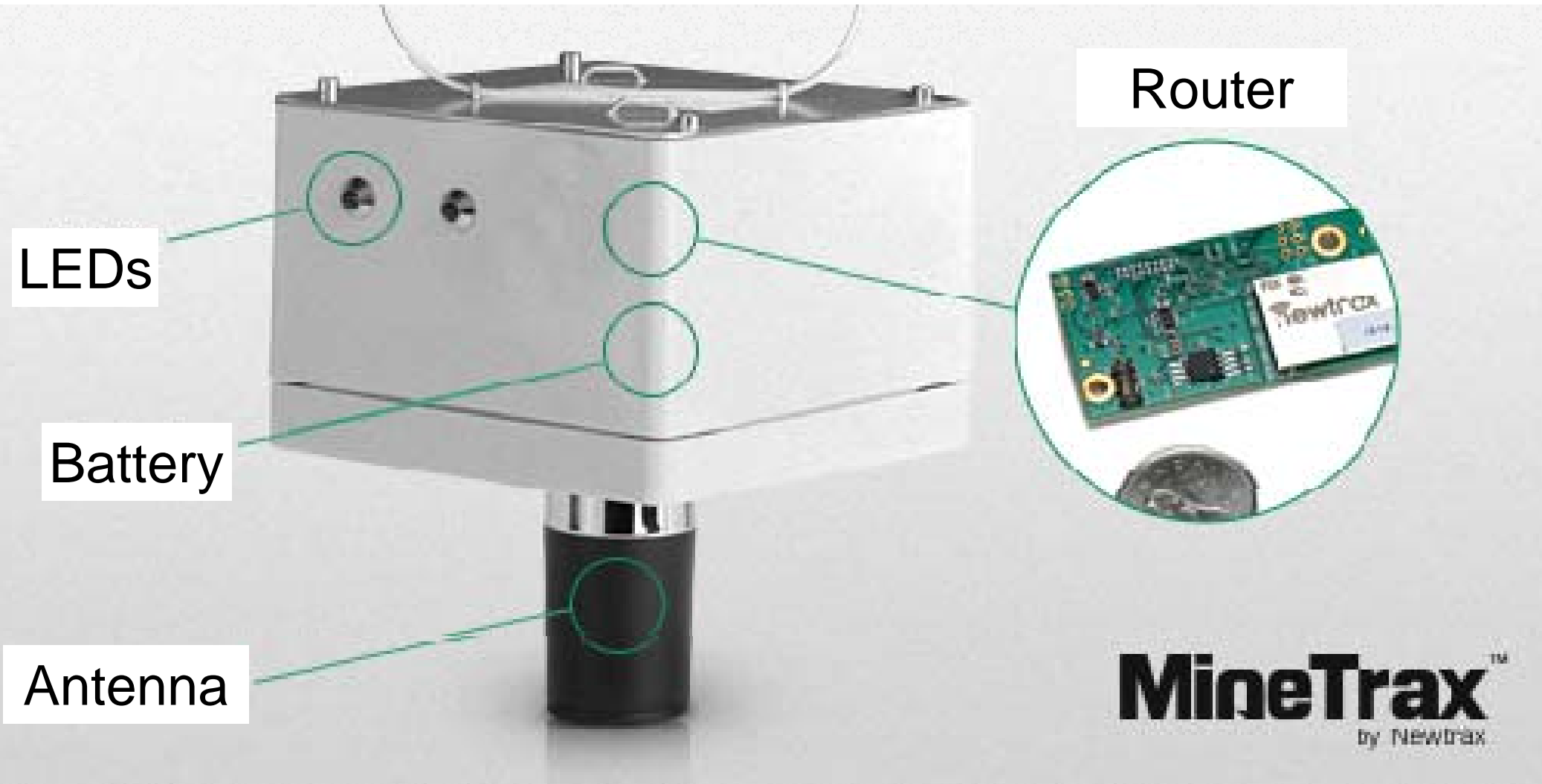
# Beneficios de redes 100% inalámbricas

- Requiere instaladores de baja capacitación
- Instalación rápida no interrumpe la producción
- No desbalanceará fuentes de energía existentes
- No vulnerable a daños al cable de energía
- Supervivencia post-accidente

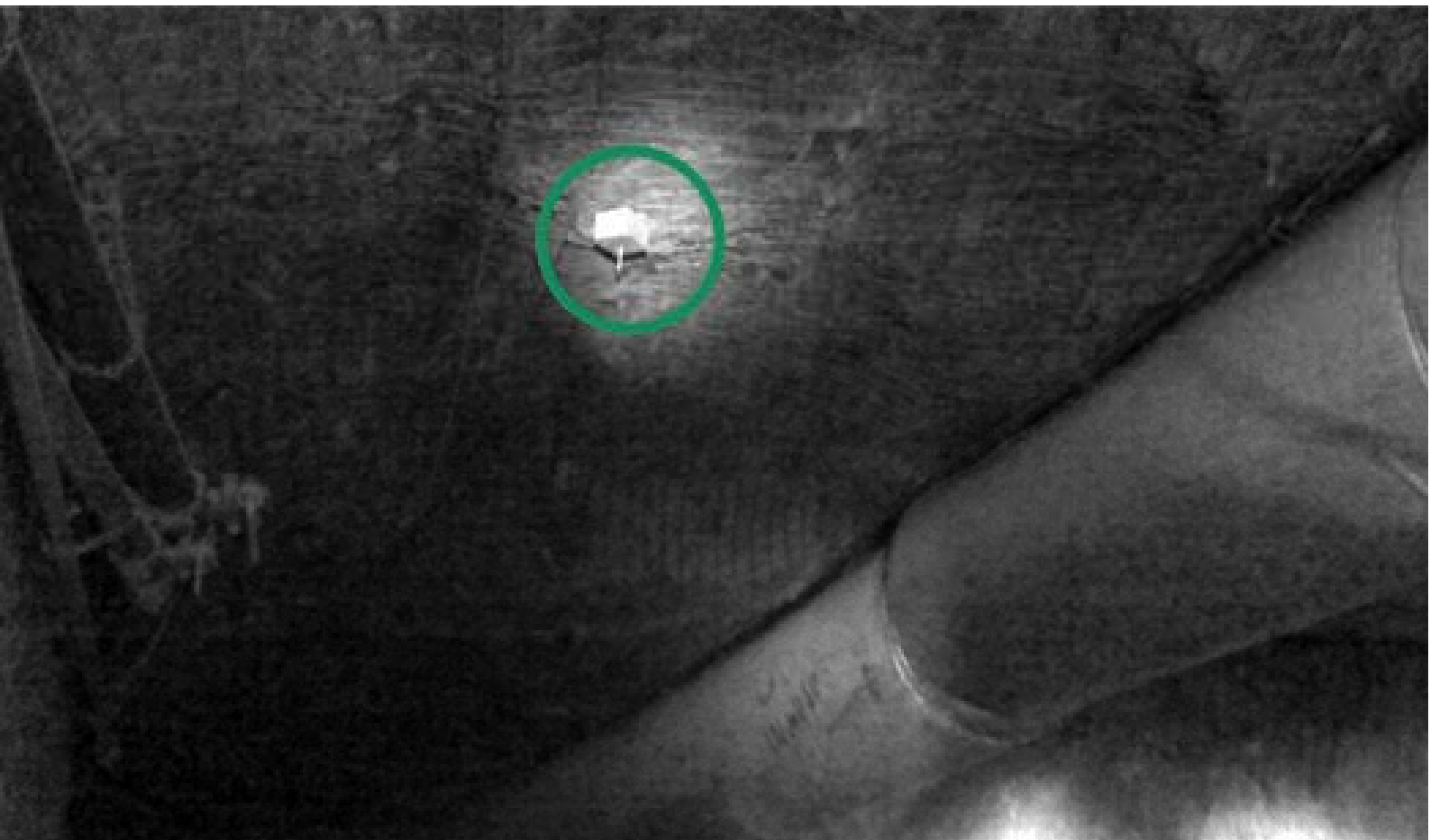
# Que puede hacer por usted la red post-accidente?

	<b>MineTrax<sup>®</sup></b> by Newtrax	Medium Frequency	Through-The-Earth
Surface to underground communications	Yes	Yes	Yes
Underground to surface communications	Yes	Yes	No if > 500m
Tracking	Yes	No	No
Ground stability sensor network	Yes	No	No
Air quality sensor network	Yes	No	No

# Wireless Network Nodes (autonomous battery life up to 10 years!)

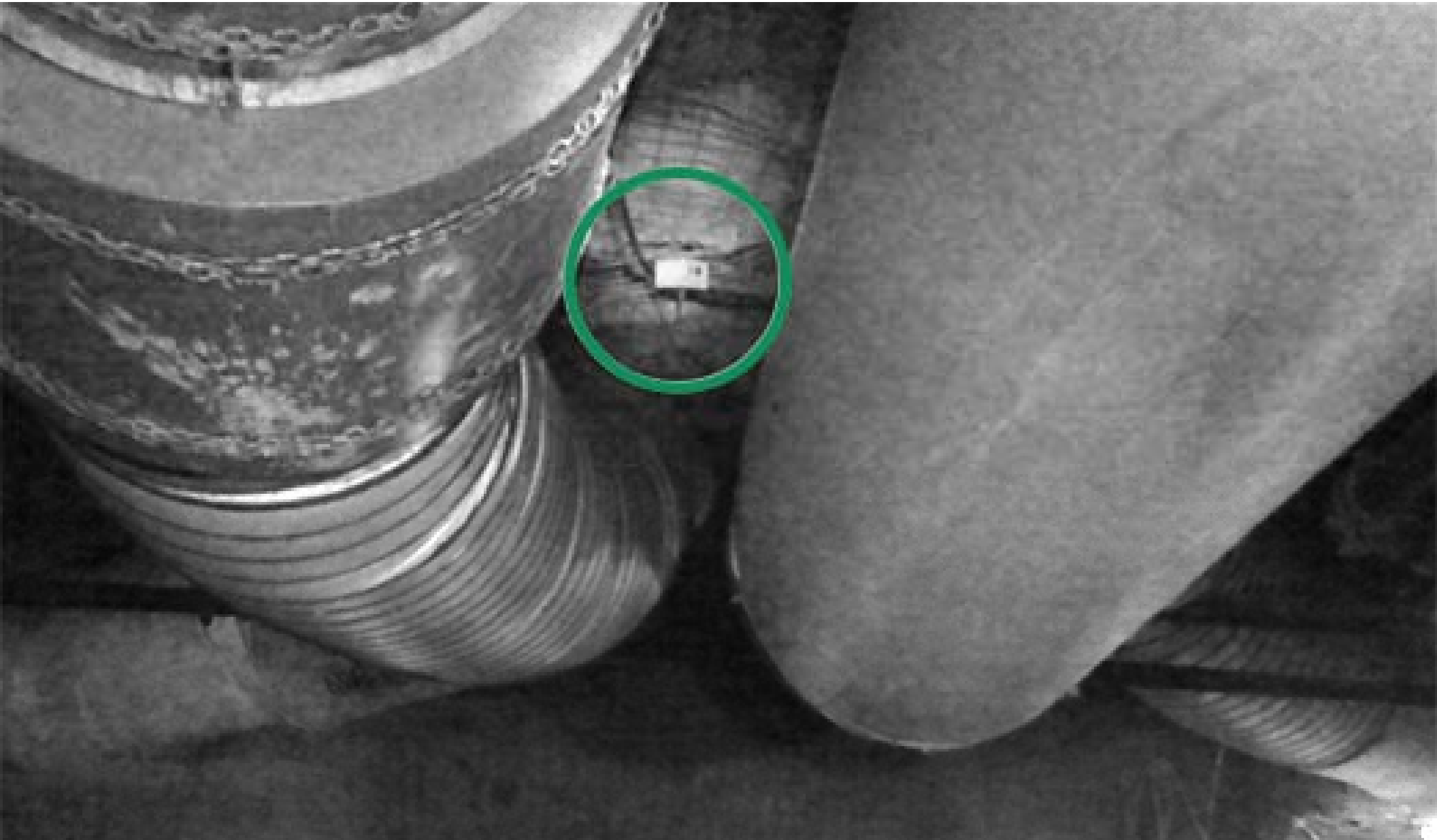


Installed in seconds with only a tie-wrap!





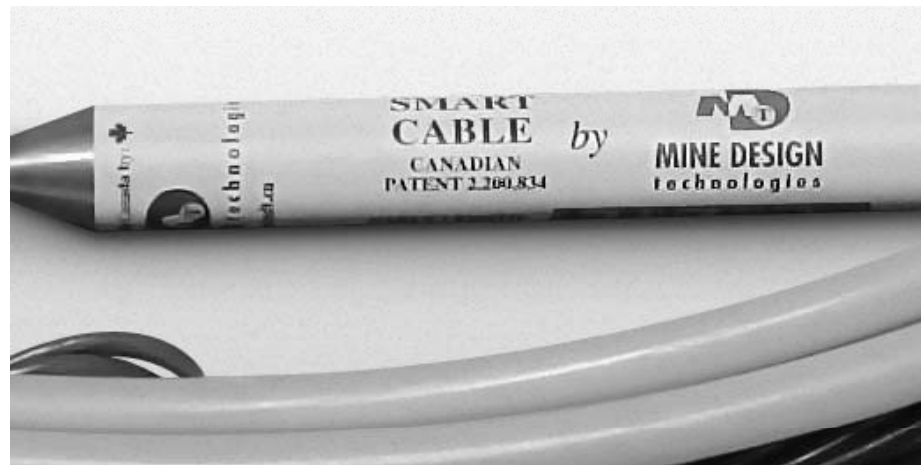
Installed in seconds with only a tie-wrap!



Installed in seconds with only a tie-wrap!



# Battery-powered Wireless Nodes for Geotechnical Instruments



**Mine Design**  
technologies

# Battery-powered Wireless Nodes with Gas Detectors

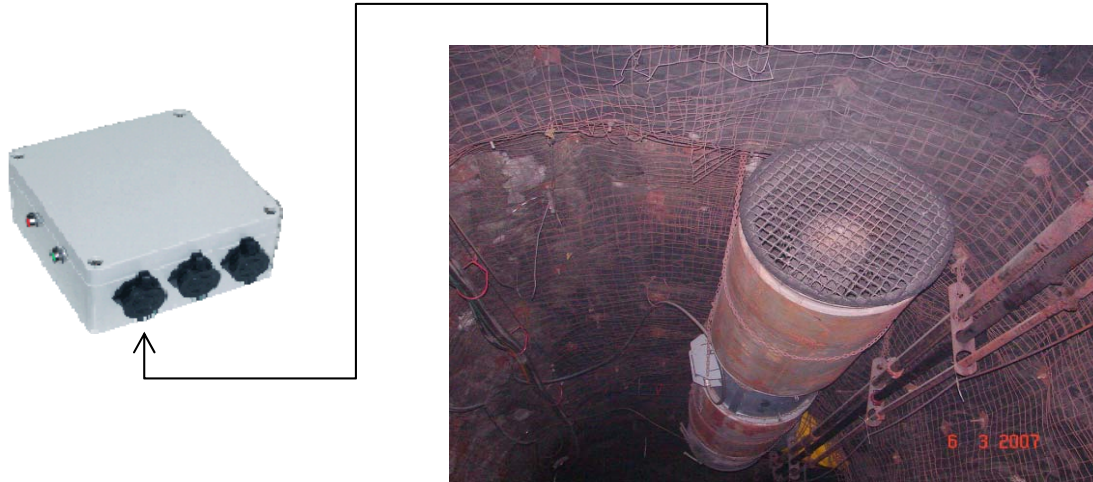


(Autonomy > Calibration period)

# Battery-powered Wireless Nodes for generic SCADA (Modbus, I/Os)



# Battery-powered Wireless Nodes for generic SCADA (Modbus, I/Os)



Remote control and monitoring of fans



Remote control and monitoring of pumps



Los módulos de MineTrax en las intersecciones de rampa/nivel que detecta la entrada/salida de personal

Lámpara minera con módem MineTrax

MineTrax puede concentrar los datos y enviarlos a las superficie via un puerto de leaky feeder alimentada por CA

Comedor/Refugio

MineTrax puede concentrar los datos y enviarlos a las superficie via un puerto de Ethernet alimentada por CA

Infraestructura de leaky feeder

Los módulos de MineTrax que funcionan con baterías se instalan en segundos con sólo una cintilla

Bomba en sumidero

MineTrax SCADA RTU

Infraestructura de fibra óptica

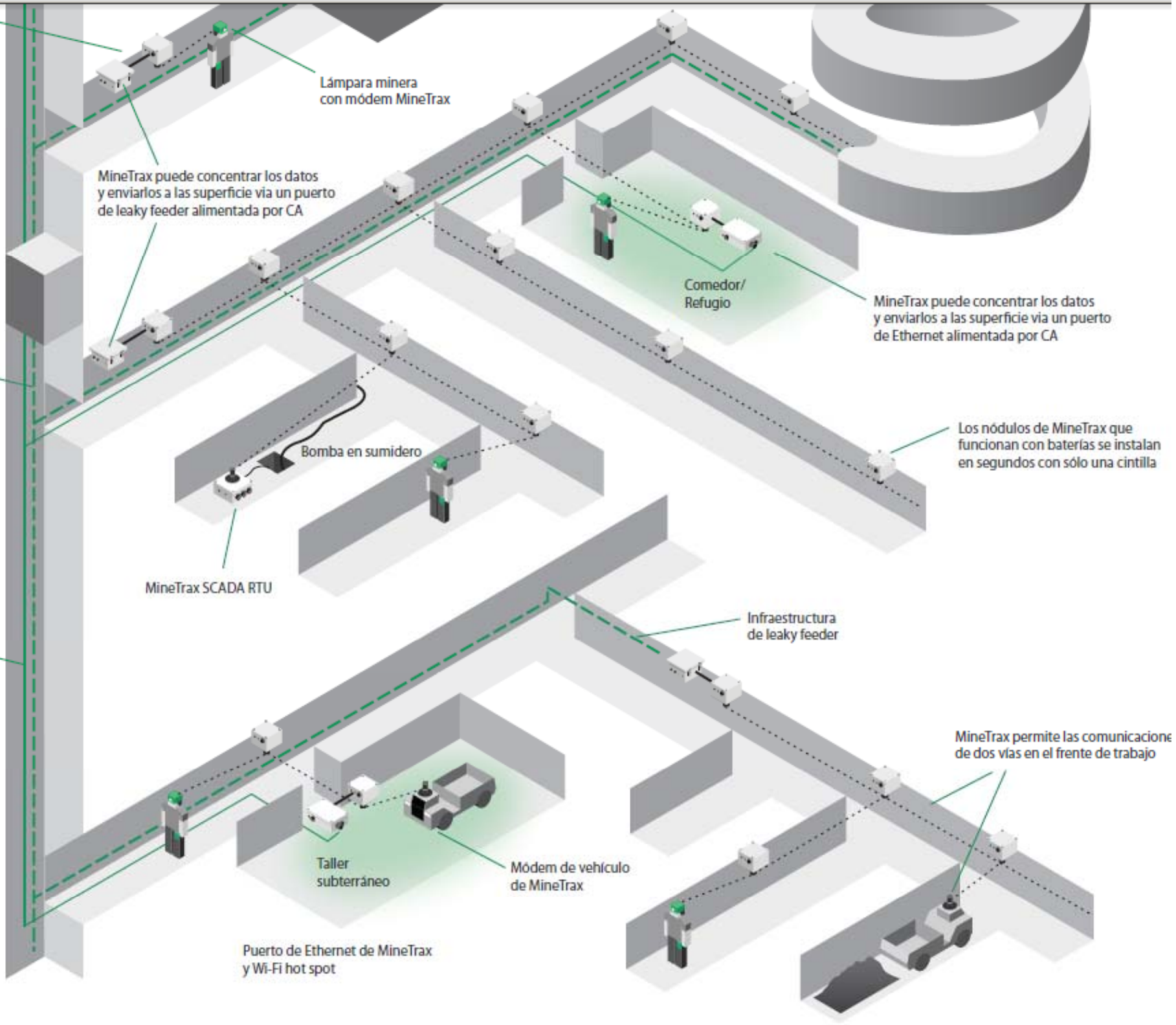
Infraestructura de leaky feeder

MineTrax permite las comunicaciones de dos vías en el frente de trabajo

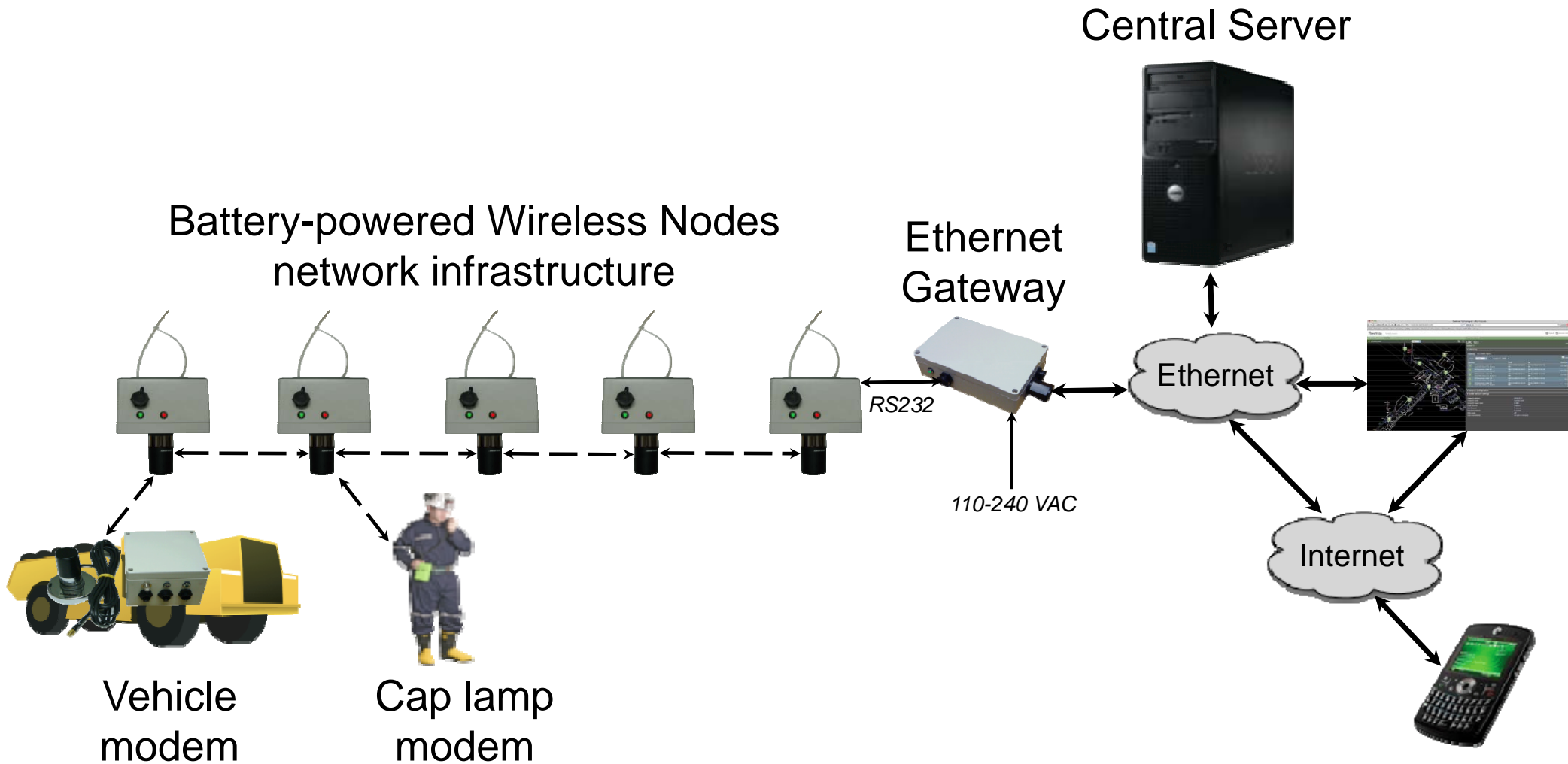
Taller subterráneo

Módem de vehículo de MineTrax

Puerto de Ethernet de MineTrax y Wi-Fi hot spot

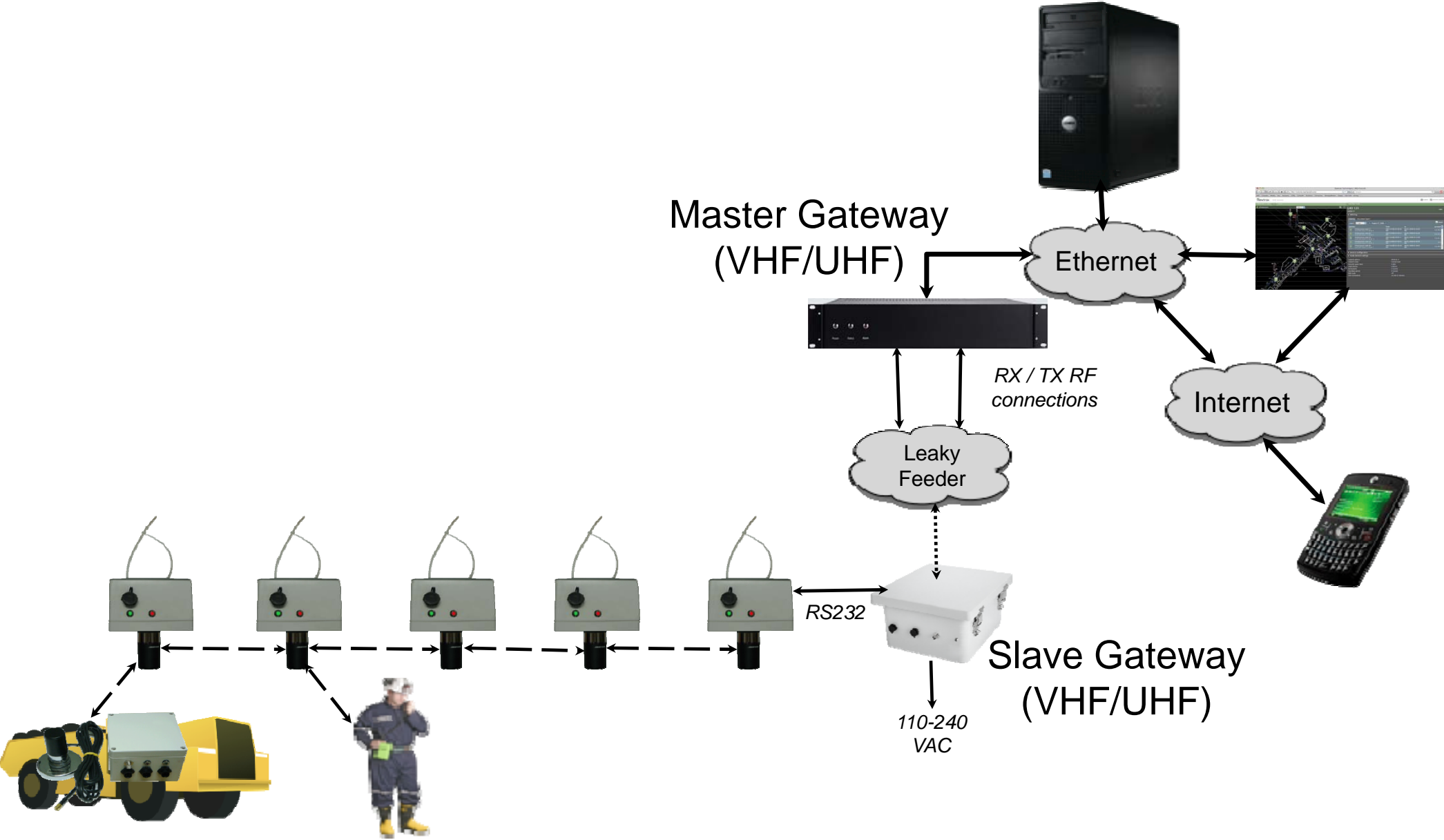


# Option to inter-network with Ethernet/Wi-Fi

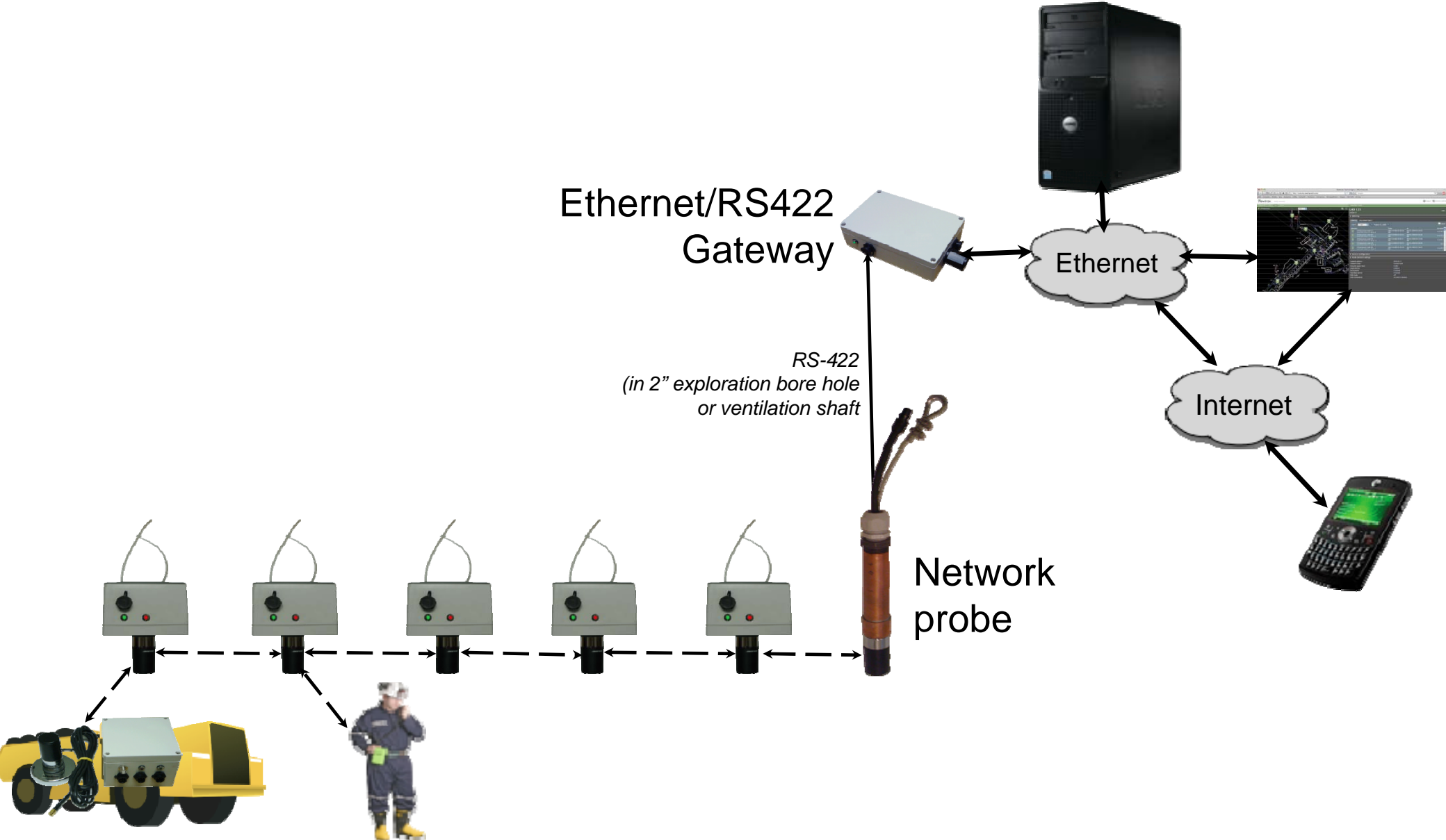




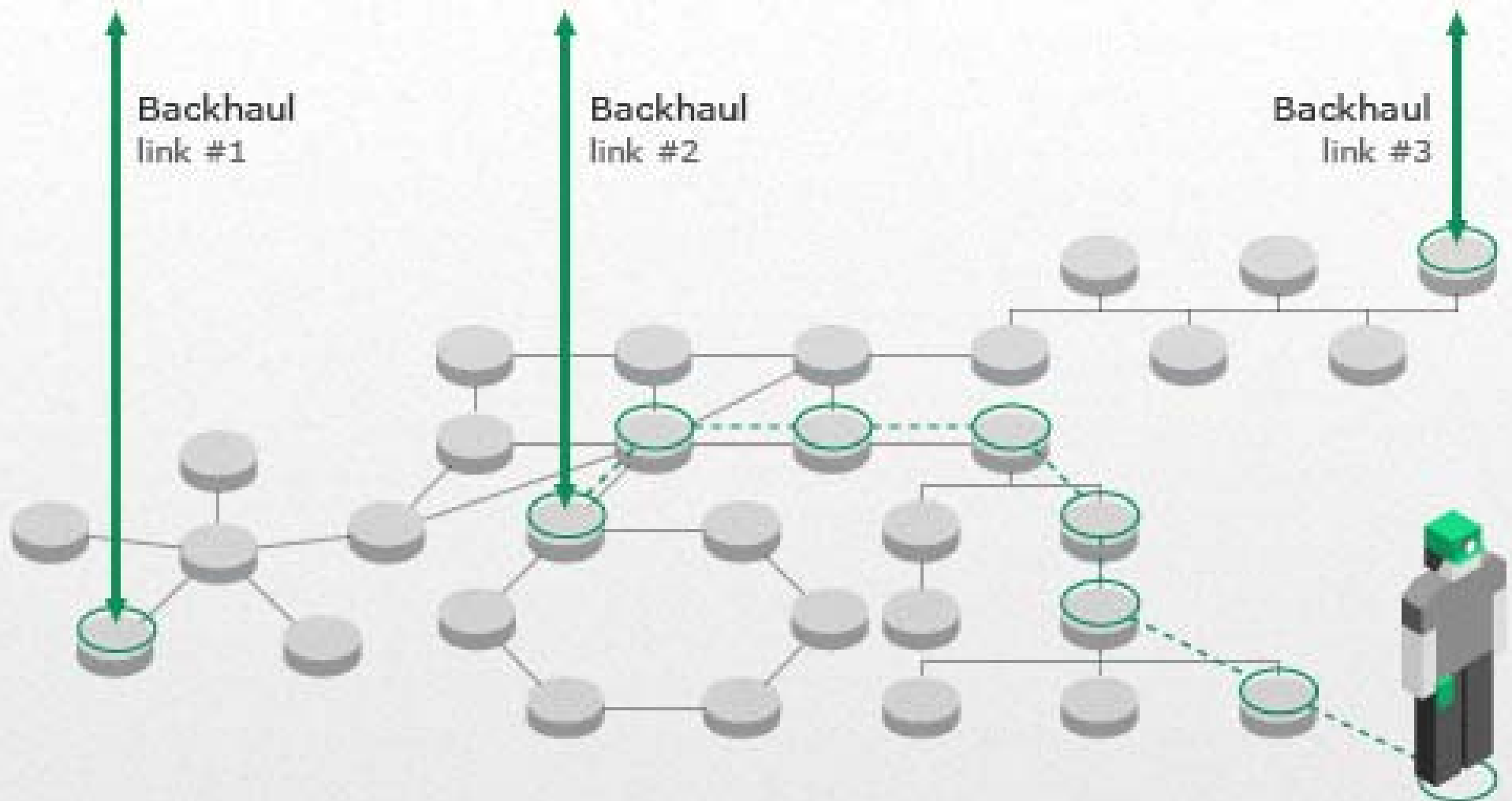
# Option to inter-network with Leaky Feeder



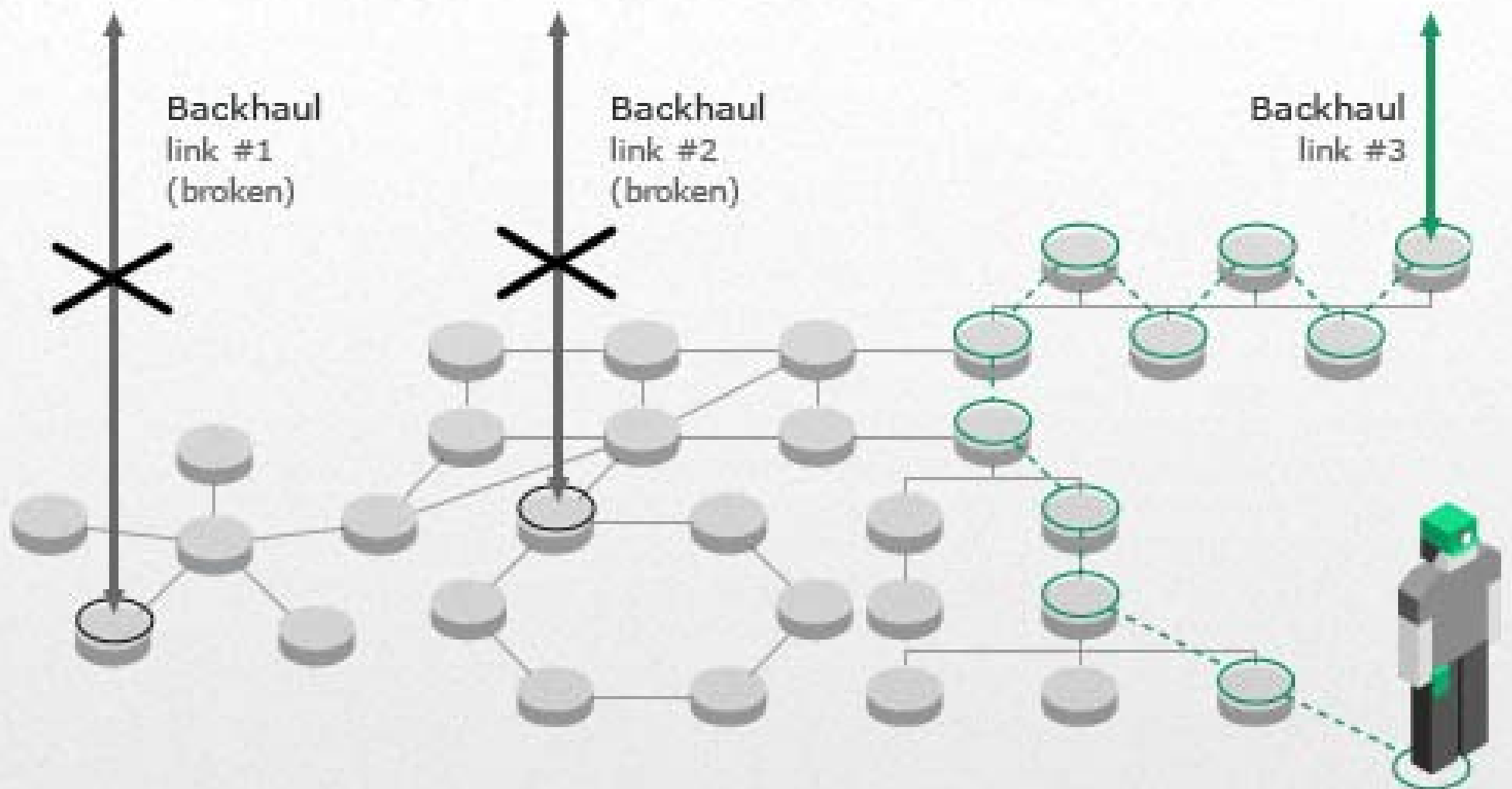
# Option to backhaul with RS422 network probe



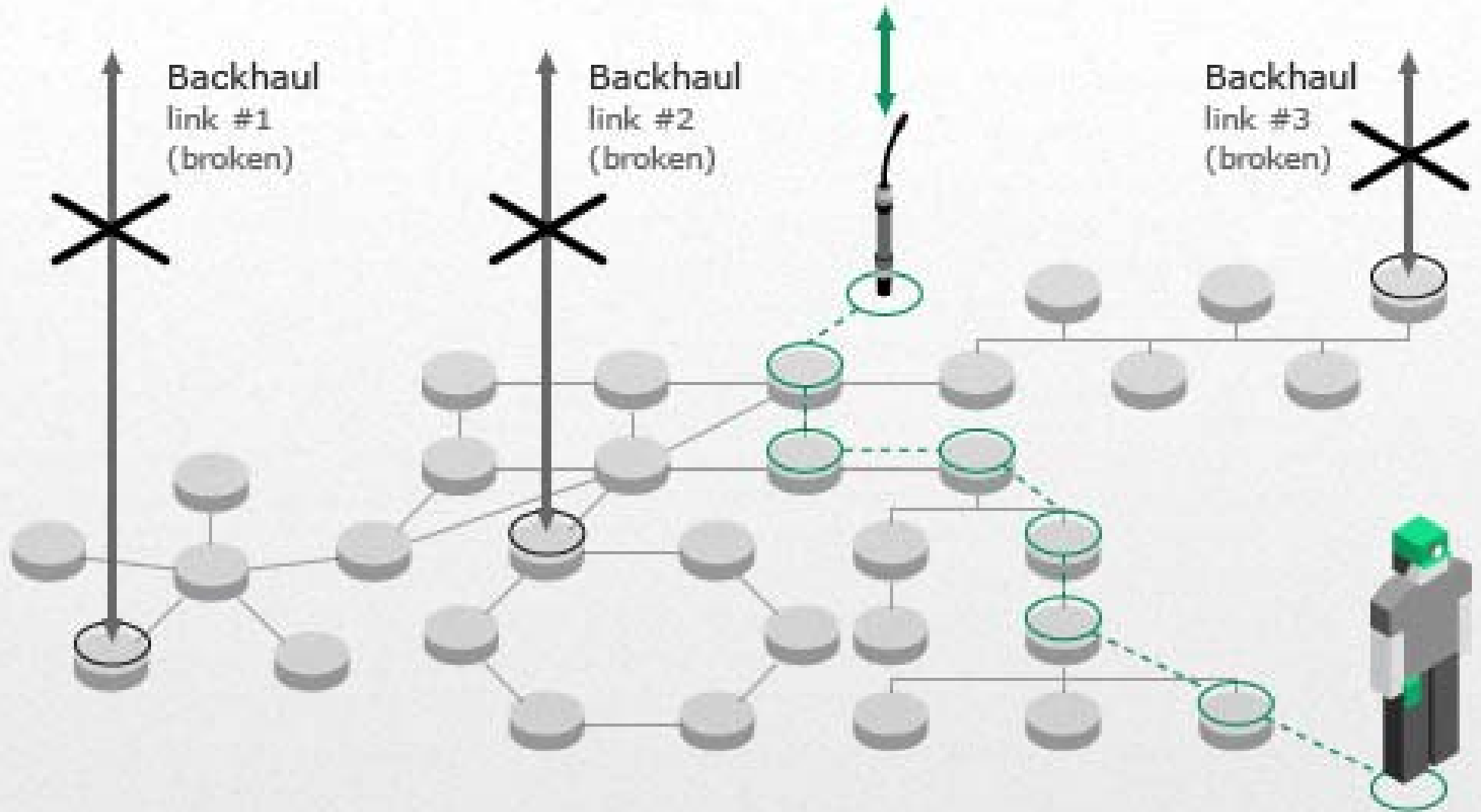
# Network with spatially diverse backhaul links



# Network self-heals if at least 1 backhaul link survives in post-accident isolated area



If all backhaul links are broken, network probe can be used to re-establish communications



Los módulos de MineTrax en las intersecciones de rampa/nivel que detecta la entrada/salida de personal

Lámpara minera con módem MineTrax

MineTrax puede concentrar los datos y enviarlos a las superficie via un puerto de leaky feeder alimentada por CA

Comedor/Refugio

MineTrax puede concentrar los datos y enviarlos a las superficie via un puerto de Ethernet alimentada por CA

Infraestructura de leaky feeder

Los módulos de MineTrax que funcionan con baterías se instalan en segundos con sólo una cintilla

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MineTrax SCADA RTU

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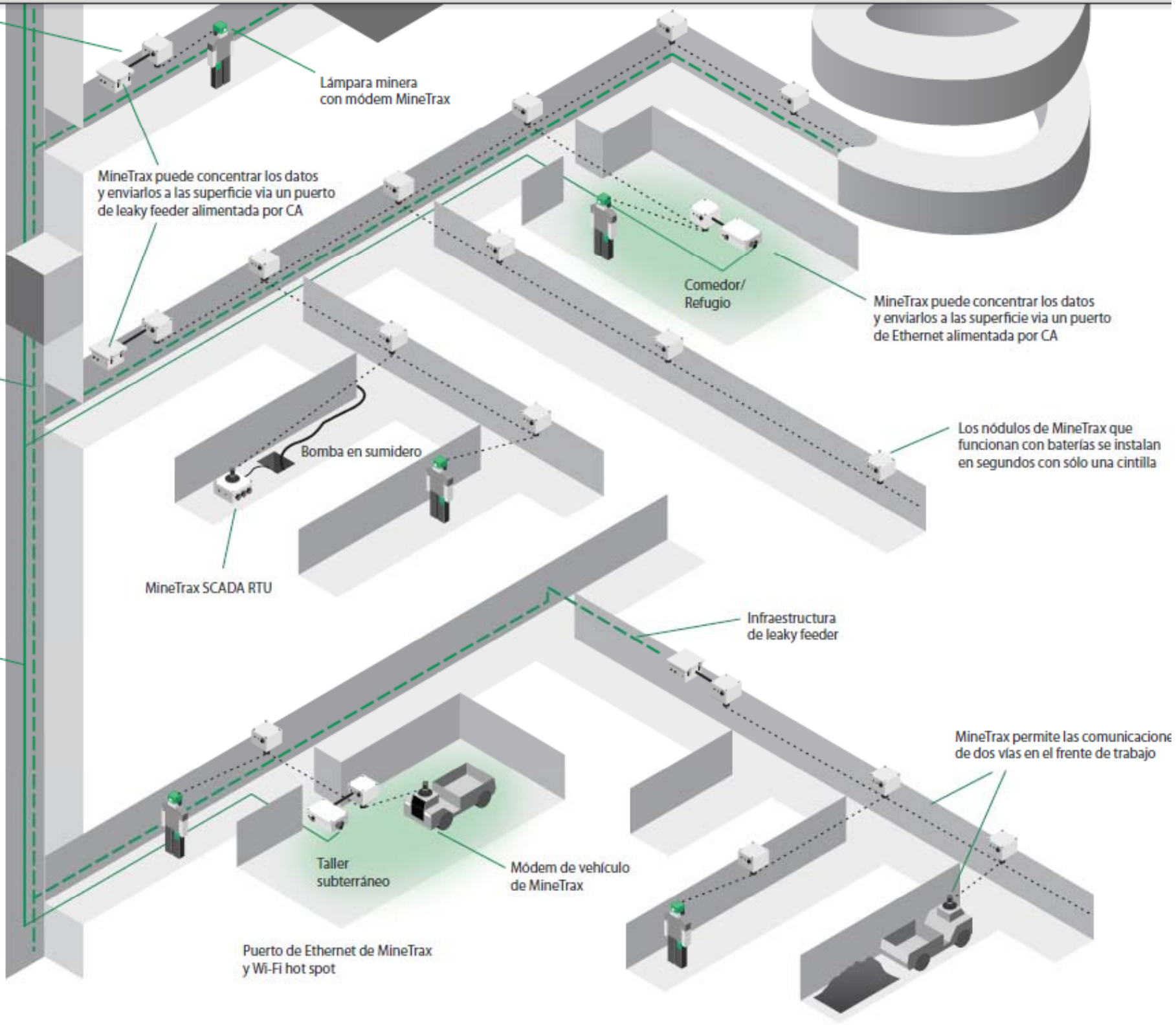
Infraestructura de leaky feeder

MineTrax permite las comunicaciones de dos vías en el frente de trabajo

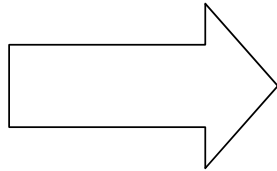
Taller subterráneo

Módem de vehículo de MineTrax

Puerto de Ethernet de MineTrax y Wi-Fi hot spot



# Cordless cap lamp with tag

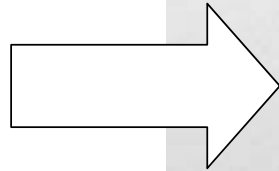


**MineTrax**<sup>®</sup>  
by Newtrax





# Corded cap lamp with simple two-way emergency communication interface



**MineTrax**<sup>®</sup>  
by Newtrax

**JANNATEC**  
Technologies



# Corded cap lamp with texting interface



 **JANNATEC**  
Technologies

**MineTrax**<sup>®</sup>  
by Newtrax

# Demo of quick find

The screenshot displays the Newtrax Web Console interface. At the top, the browser address bar shows the URL `http://dashboard.newtrax.com/`. The page header includes the Newtrax logo, the text "Web Console", and a "Miner & Vehicle finder" search bar containing the letter "Y". To the right of the search bar are buttons for "all vehicle location", "logout", and "account settings".

The main interface is divided into two sections. On the left, under the "network" tab, there is a list of nodes with columns for "label", "location - ID", and "RFID". The list includes "Infrastructure nodes", "terminal devices", and "tracked devices". On the right, the "selected node" section is active, showing a list of options: "data log", "sensors configuration", and "node network settings". An "edit" button is visible in the top right corner of the selected node section.

At the bottom of the screen, there is a video player control bar with a timestamp of 00:03 and various playback controls.

# Demo of historical log of personnel location

The screenshot displays the Newtrax Technologies Web Console interface. The browser address bar shows the URL <http://dashboard.newtrax.com/>. The page header includes the Newtrax logo, "Web Console", and a "Miner & Vehicle finder" search bar with a "find" button. On the right side of the header, there are links for "all vehicle location", "logout", and "account settings".

The main content area is divided into two sections. The left section, titled "network", contains a sidebar with a tree view of device categories: "Infrastructure nodes", "terminal devices", and "tracked devices". The "tracked devices" category is currently selected. The right section, titled "selected node", displays a configuration menu with three expandable options: "data log", "sensors configuration", and "node network settings".

At the bottom of the screen, there is a video player control bar with a progress indicator showing "00:05".

# Demo of texting

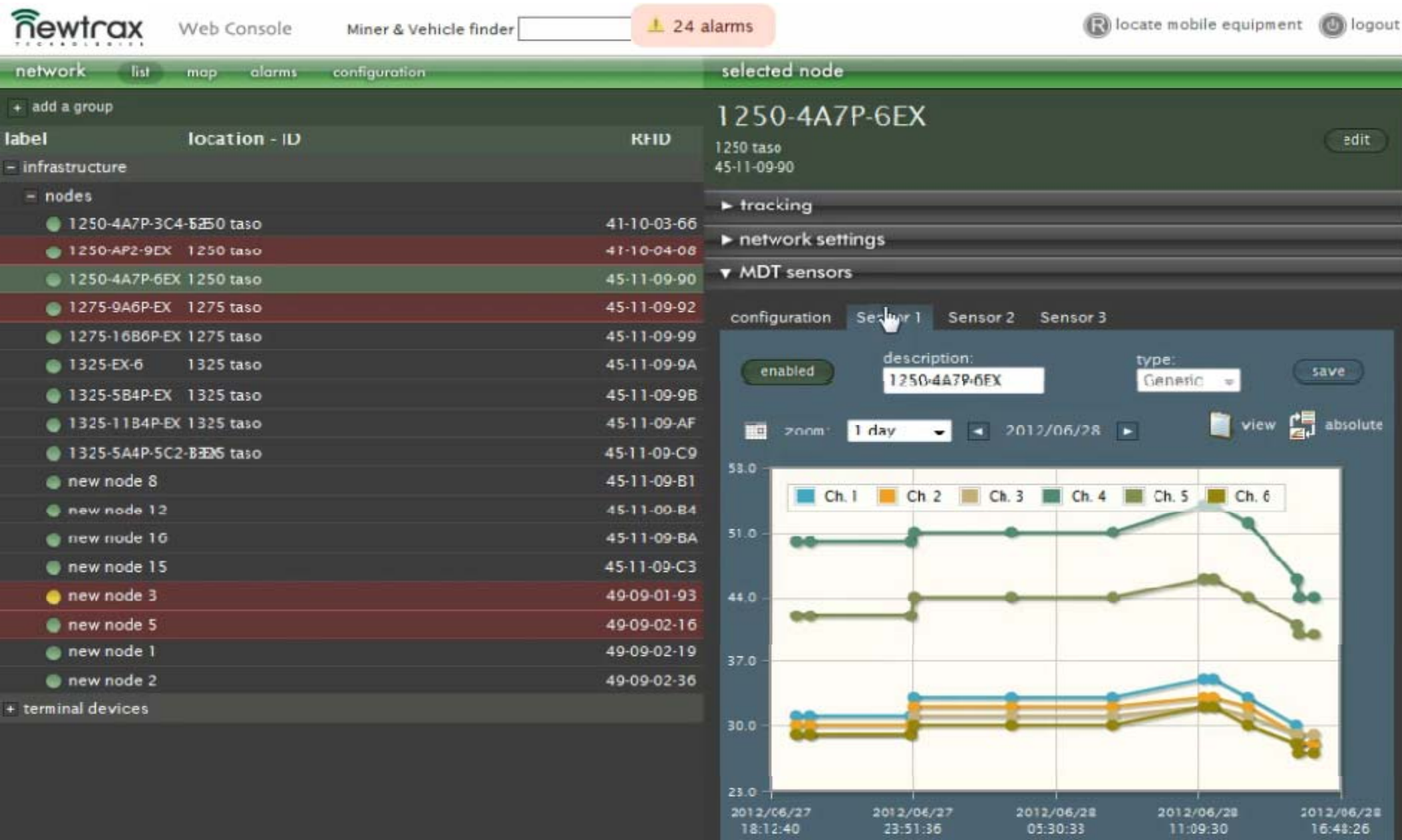
The screenshot displays the Newtrax Technologies Web Console interface. At the top, the browser address bar shows the URL `http://dashboard.newtrax.com/`. The page header includes the Newtrax logo, the text "Web Console", and a "Miner & Vehicle finder" search bar with a "find" button. On the right side of the header, there are links for "all vehicle location", "logout", and "account settings".

The main navigation menu is located below the header and includes "network", "list", "map", and "alarms". The "network" section is currently active, and a sub-menu is open showing "add a group", "infrastructure nodes", "terminal devices", and "tracked devices".

The central area of the interface is titled "selected node" and contains an "edit" button. Below this title, there are three expandable sections: "data log", "sensors configuration", and "node network settings".

At the bottom of the screen, there is a video player control bar with a timestamp of 00:04 and various playback controls.

# Ground stability monitoring



# Air quality monitoring

newtrax Web Console mobile devices finder  locate mobile equipment log

network **list** map alarms configuration emergency selected node

+ add a group

label

- infrastructure
  - + leaky feeder gateways
  - + ethernet gateways
  - + nodes
  - + SCADA RTU
  - + Jessica
  - + Fortuna
  - + Centerario W
  - Bonanza Y Veta Nueva E
    - Detector de gas
      - Rampa Bonanza 224C Crucero (SO2) Detector de gas (SO2) 16-10-02-62
      - Rampa Bonanza 224C Crucero (CO) Detector de gas (CO) 16-10-02-05
      - Rampa Bonanza 224C Crucero (O2) Detector de gas Oxygen (O2) 16-10-03-06**
      - Rampa Bonanza 224C Crucero (NO2) Detector de gas (NO2) 16-10-03-09
    - 2240 Rampa Bonanza (a 2130) entrada 41-10-03-CD
    - 2240 Rosario 41-10-03-E4
    - 2240 Bonanza Plaza taller electrico 41-10-03-E5
    - 2240 Bonanza comedor y taller 41-10-03-FE
    - 2240 Rampa Bonanza metalero Carrilla 41-10-04-13
    - 2240 Bonanza FTE 41-10-04-20
    - 2240 Rampa Bonanza (a 2340) 41-10-04-82
    - 2240 Bonanza (LF - SP) 41-10-04-81
    - 2240 Bonanza interseccion 41-10-04-84

**Rampa Bonanza 2240 Crucero (O2)** edit

Detector de gas Oxygen (O2)  
16-10-03-06

- ▶ tracking
- ▶ network settings
- ▼ gas sensors
  - port 1: O2  sensor data configuration advanced
  - enabled  description: Sensor  connected
  - zoom: 1 day 2011/11/29 auto-refresh  view

Volume Celsius

gas value (Volume) temperature

# Red Optima = Leaky Feeder + Wi-Fi + **MineTrax**<sup>®</sup> by Newtrax

- En areas donde cables son vulnerable a sufrir daños.
- Cuando especialistas electricos o TI no estan disponible en tiempos requeridos para extender o reparar la red de cables.
- Cuando una gran cantidad de sensores o actuadores deben ser implementados en forma distribuida, en red y en linea.
- Cuando se requiere conectividad persistente en el frente de trabajo y periferica, porque repetidores que funcionan con una autonomia de solo un turno no es tan practico.
- Si todos requieren comunicacion de Emergencia basica y no todos tienen equipos de radio comunicacion o VoIP phone.
- Si varios servicios son requeridos post-accidente.

# Thank you for your time!

## Questions?

Alexandre Cervinka, CEO, Newtrax Technologies Inc.

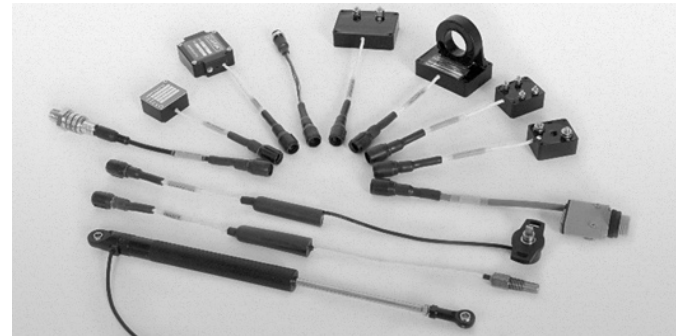
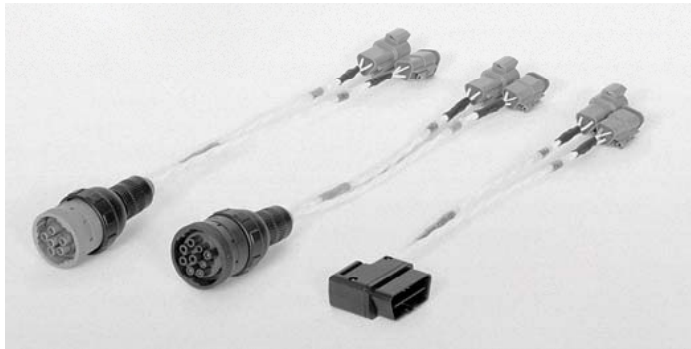
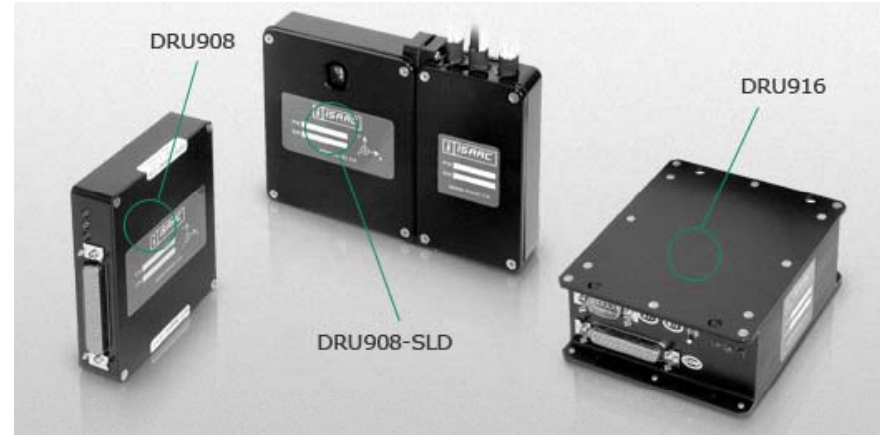
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Distributor in Chile: Pablo Gallyas, Gallyas Telecom S.A.

[gallyasp@gallyas.cl](mailto:gallyasp@gallyas.cl) / +56 9 8888 3759



# Other Application: Vehicle modem, data logger and sensors



**MineTrax**<sup>®</sup>  
by Newtrax

**i** **ISARAC**  
INSTRUMENTS

# Real-time data for maintenance, production and dispatch management

newtrax TECHNOLOGIES Web Console Miner & Vehicle finder  find 1 alarm locate mobile equipment logout

network list map **alarms** configuration emergency selected node

## active alarms

select all alarms

- Apr 21, 10:33 - Vehicle w/ ISAAC Vehicle Telemetry System Shutdown: Low Coolant Level High Turbo Turbine Inlet Air Temperature Derate: High Engine Oil Temperature Warning: High Exhaust Temperature High Intake Manifold Pressure Low Jacket Water to Engine Oil Temp Diff High System Voltage High Pressure Fuel Line Broken

value back to normal state

acknowledge

## alarm log

zoom: 1 day 2011/04/21

alarm acknowledgment	triggered alarm duration
Apr 21, 10:33 - Vehicle w/ ISAAC Vehicle Telemetry System Shutdown: Low Coolant Level Warning: High Exhaust Temperature High Engine Oil Temperature High Intake Manifold Pressure superuser@newtraxtech.com on Apr 21, 10:36	Apr 21, 10:33 -

## Vehicle w/ ISAAC

16-10-02-65 edit

- tracking
- network settings
- engine hour meter

### status

#### engine information

last updated	2011/04/21, 10:33:45
engine hours	2543.25

### reports

#### maintenance alarms

engine codes notification

zoom: 1 day 2011/04/21 legend CSV export

	2011/04/21 10:34:52	2011/04/21 10:33:44	2011/04/21 10:33:43	2011/04/20 14:05:39
total warning alarms <span style="color: yellow;">▲</span>	0	5	3	0
total derate alarms <span style="color: orange;">◆</span>	0	1	0	0
total shutdown alarms <span style="color: red;">■</span>	0	2	1	0
engine hours	2543.25	2543.25	2543.25	2543.25
engine speed (RPM)	1748.5	1748.5	1748.5	1748.5
high exhaust temperature	<span style="color: green;">●</span>	<span style="color: yellow;">▲</span>	<span style="color: yellow;">▲</span>	<span style="color: green;">●</span>
high altitude (atmospheric pressure)	<span style="color: green;">●</span>	<span style="color: green;">●</span>	<span style="color: green;">●</span>	<span style="color: green;">●</span>
air filter plugged	<span style="color: green;">●</span>	<span style="color: green;">●</span>	<span style="color: green;">●</span>	<span style="color: green;">●</span>
engine overspeed	<span style="color: green;">●</span>	<span style="color: green;">●</span>	<span style="color: green;">●</span>	<span style="color: green;">●</span>
low engine coolant temperature	<span style="color: green;">●</span>	<span style="color: green;">●</span>	<span style="color: green;">●</span>	<span style="color: green;">●</span>

# Report on location of all mobile equipment at beginning of shift

The screenshot displays the Newtrax Technologies Web Console interface. The browser address bar shows the URL `http://dashboard.newtrax.com/`. The page header includes the Newtrax logo, 'Web Console', and a 'Miner & Vehicle finder' search bar with a 'find' button. On the right side of the header, there are links for 'all vehicle location', 'logout', and 'account settings'. The main navigation bar contains 'network', 'list', 'map', and 'alarms' tabs, with 'selected node' currently active. Below the navigation, there is a '+ add a group' button and a table with columns for 'label', 'location - ID', and 'RFID'. The table lists three categories: 'Infrastructure nodes', 'terminal devices', and 'tracked devices'. To the right of the table, there is an 'edit' button and a configuration menu with options: 'data log', 'sensors configuration', and 'node network settings'. At the bottom left, a system tray shows a timer at '00:03' and several utility icons.

# Report on production of load-haul-dump cycles

The screenshot displays the Newtrax Web Console interface. At the top, the browser address bar shows the URL `http://dashboard.newtrax.com/`. The page header includes the Newtrax logo and navigation links for 'network', 'list', 'map', and 'alarms'. On the right side of the header, there are links for 'logout' and 'account settings'. The main content area is titled 'selected node' and features a table with columns for 'label', 'location - ID', and 'RFID'. An 'edit' button is located in the top right corner of the table. Below the table, there are three expandable sections: 'data log', 'sensors configuration', and 'node network settings'. The interface is dark-themed with green accents. A system tray at the bottom left shows a timer at 00:16 and various utility icons.

# Open architecture example: Haulage truck productivity report in Excel

