





MINING DIESEL






**The Industrial Internet of Things (IoT) and Low Power Wide Area Networks (LPWAN) – Advances in real-time monitoring to increase production and improve health and safety**

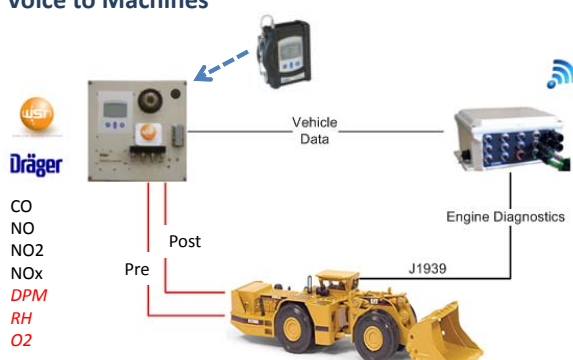

  




**October, 2017**



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**Onboard Emission Monitoring – Giving Voice to Machines**





  

  

Engine Load  
 Engine Temp  
 Exhaust Temp  
 Exhaust Backpressure  
 Oil Temp  
 Oil Pressure  
 RPM  
 Fuel Temp  
 Fuel Pressure  
 Etc.


**Human Health & Hygiene**

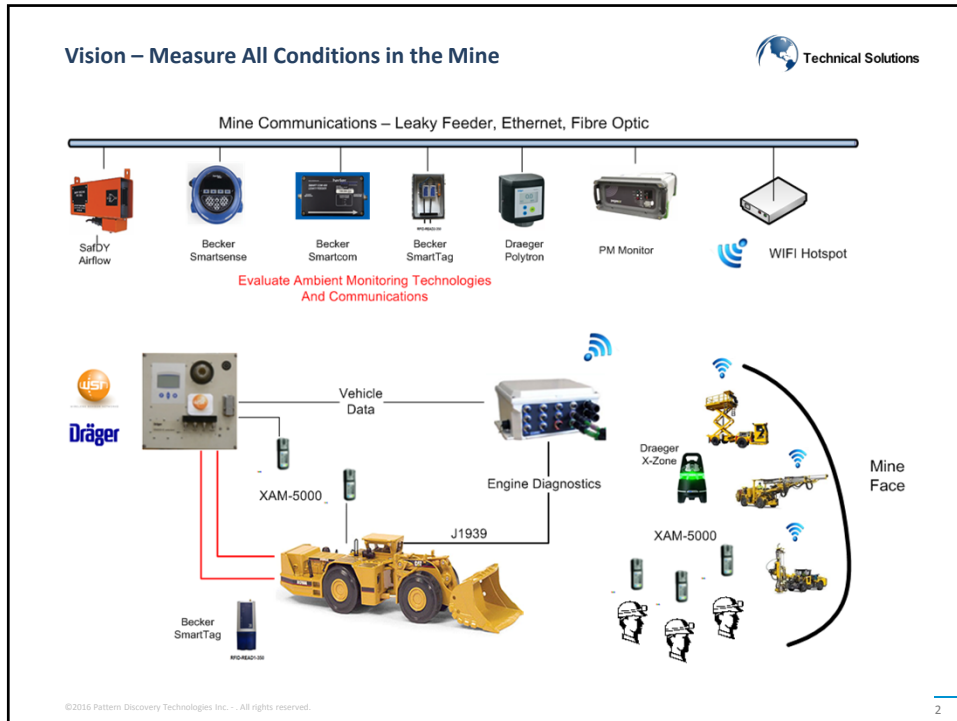


**Maintenance**



**Ventilation**







### Challenges in Communications

Technical Solutions

- Wired Networks
- Cellular Communications
- Satellite Communications
- WiFi
- Bluetooth
- Routers
- Relays
- Large Distances
- Interference
  - Power
  - Barriers
  - Machinery
  - Corners
- Quality of service
- Harsh Environments (Mine Face)


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One of the largest organizations for applied research in Europe


- 69 institutes and research units
- 24,500 staff
- \$2.5 billion total annual research budget.
- 20,000+ patent families (e.g. MP3...)
- MIOTY Team from Fraunhofer IIS
- Funded by Fraunhofer Venture and Innovator Programs in HQ


















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## MIOTY™ - LPWAN

### Low Power Wide Area Network

### Game Changer for IoT




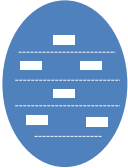
- Star network (point to point) with central receiver/base station
- Worldwide operation (868/915 MHz radio frequency) – **your private network on a licensed free spectrum**
- Network Capacity >1.5 Million Messages/Day @ 200kHz Bandwidth
- Open source for end devices – integration of legacy systems and open standards for new

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## MIOTY™ – Setting a new standard






**Unique Data Communication**

- Fraunhofer patented Telegram Splitting
- Narrowband communication




**Scalability**

- Up to 1,500,000 messages/day
- All connected devices with full range




**High Range**

- Long distance data communication
- 5km in urban and up to 15km in rural area



**Power Efficiency**

- Longer Operation time, smaller battery
- Low power with only 17,5 µWh per Message




**Quality of Service**

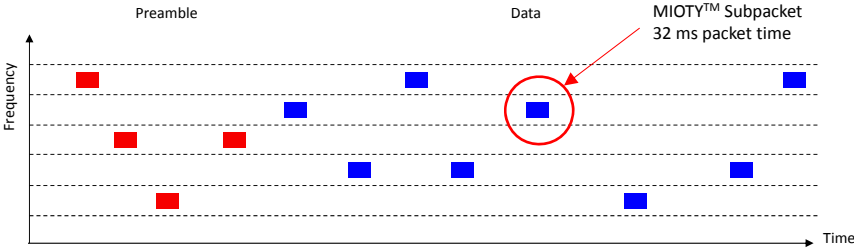
- Unmatched Interference Immunity in a crowded spectrum
- Multi-layer Security – network level and end-to-end user data encryption

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## Fraunhofer MIOTY™

### Key advantage over existing technologies





- **Telegram-Splitting:** Spreading Packet over time and frequency (subpackets)
- Transmitting single subpackets provides far better power efficiency due to massively reduced transmission length
- Extremely robust transmission since every single subpacket comes with separate synchronization symbols for highest detectability
- FEC (forward error correction) compensates for loss of up to 50% of subpackets

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## MIOTY™: Enabling a New Generation of Mining Communications






# NORCAT

UNDERGROUND CENTRE  
Sudbury, Ontario



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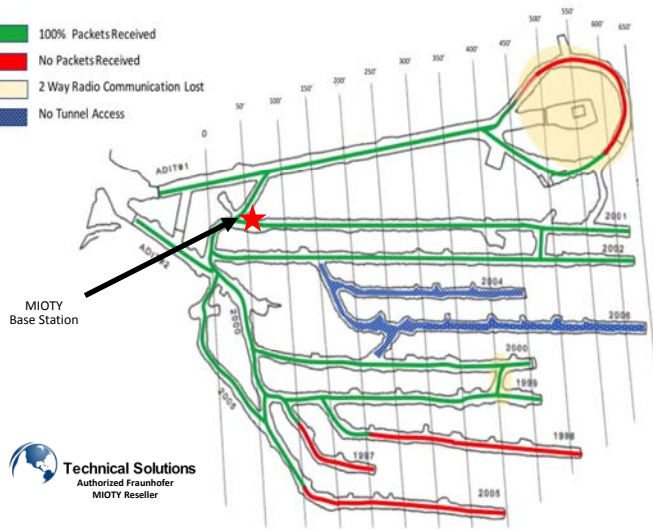


### Test 1 - Initial Install

March 2017

- 1 MIOTY™ IoT Hub
- Achieved 85% coverage of entire mine without consideration for equipment location or antenna optimization
- Successful packet connectivity through extreme conditions (steel vent doors, no line of sight, severe bends and corners).

- 100% Packets Received
- No Packets Received
- 2 Way Radio Communication Lost
- No Tunnel Access







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**Test 2 – Optimization**  
March 2017

- 2 MIOTY™ IoT Hubs
- Additional base station and simple antenna extensions achieved 100% coverage in all areas of the mine
- **MIOTY™ system is 1/10th the cost of traditional communications systems for better coverage**

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**Applications in Underground Mining**

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## IIoT and LPWAN



## Questions and Answers