



Pipeline intrusion detection system (pids)

24 X 7 surveillance of send out pipeline

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Agenda

- 01** PIDS System Overview
- 02** Technical Details
- 03** Optasense System Details
- 04** Site Response to PIDS Alerts
- 05** Maintenance of PIDS System



- Benefits of PIDS system

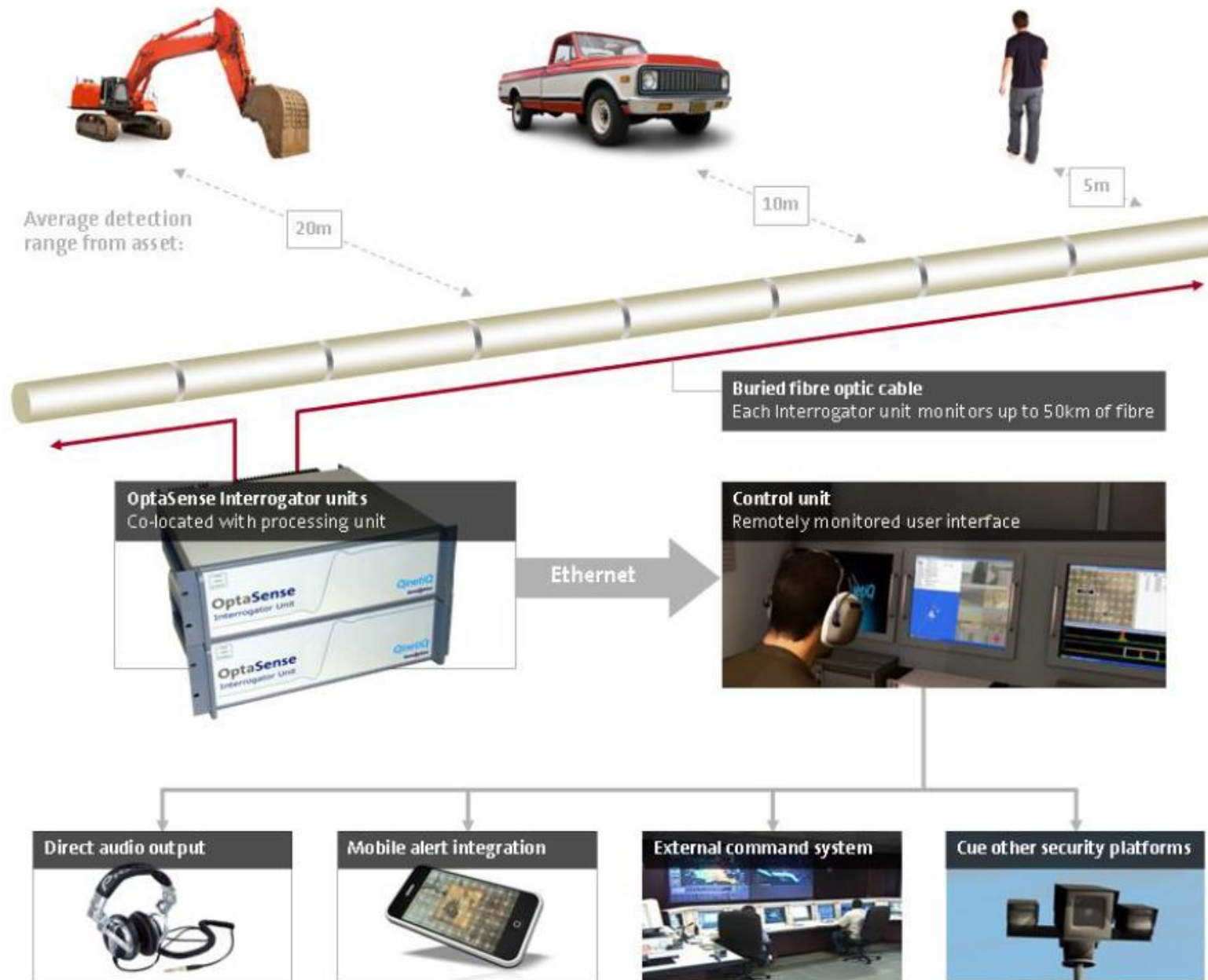
- Active 24 X 7
- Can be deployed using existing fibre infrastructure
- Remotely monitored
- Multiple segments can be monitored simultaneously
- Alerts available by mobile SMS
- Alerts to DCS/ Scada systems
- Can be integrated with CCTV system

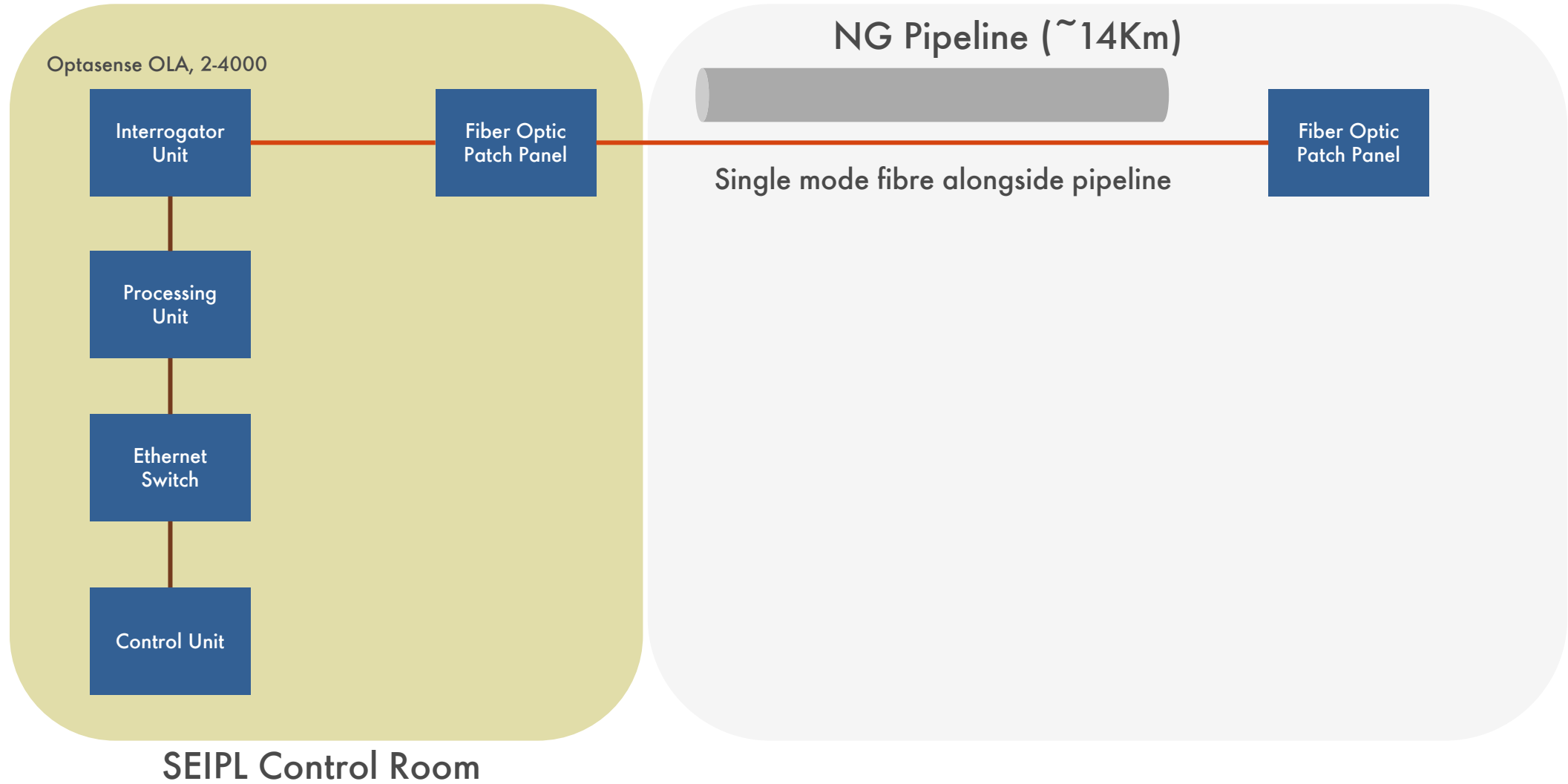
- Challenges

- False Alarms of activity
- Identification of alarm with different type than original
- Road vehicle, speed breaker, false alarms



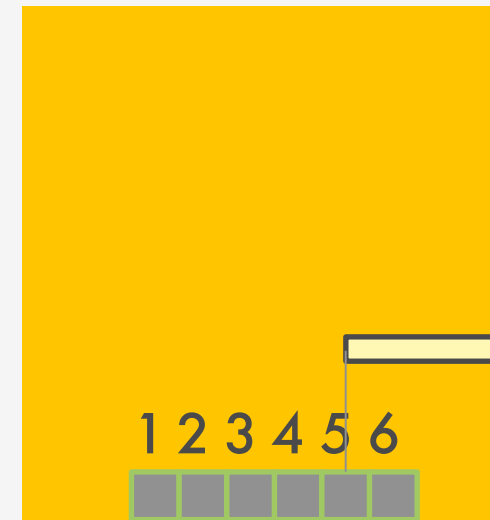
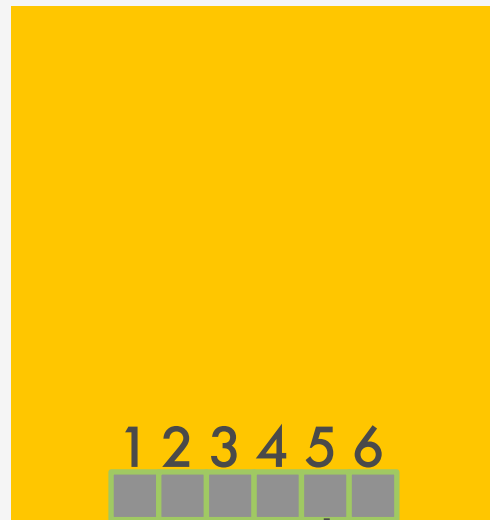
PIDS System overview



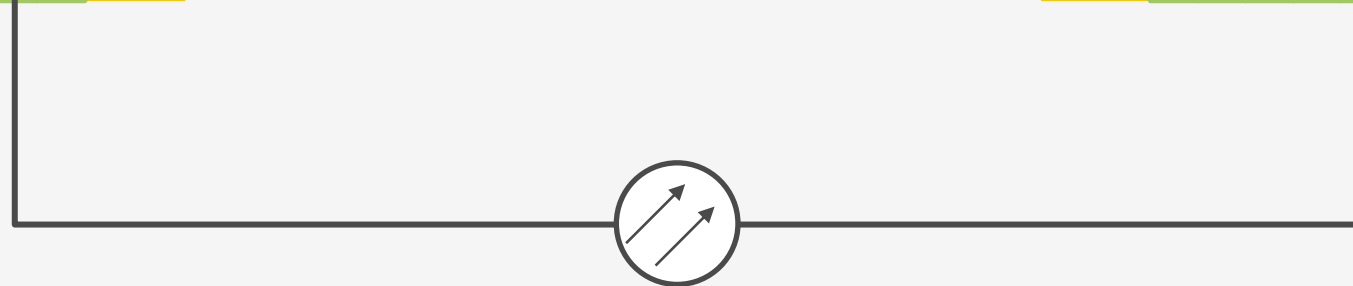


SEIPL CCR

GSPL



Fibre Termination unit



6 core Single Mode Fibre Optic Cable

The fibre termination unit is used to eliminate reflections from the end of fibre termination. It is spliced on to the end of the sensing fibre to suppress end reflections.



PIDS System overview

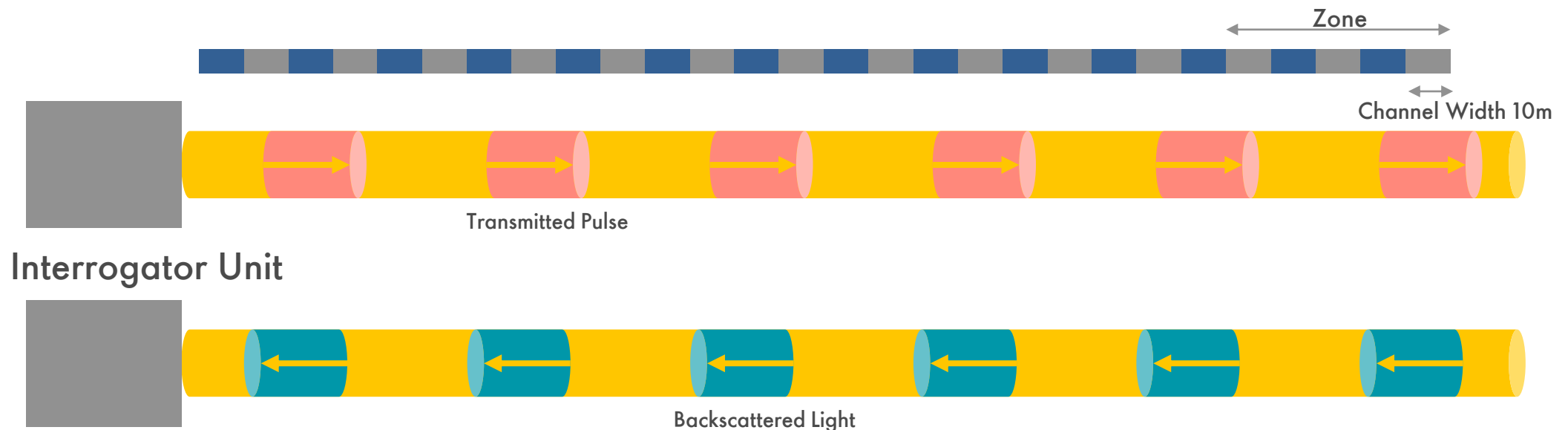


- **Make:** optasense, uk
- **Model:**
 - **Interrogator unit:** ola, 2-4000, for up to 40 km of fibre
 - **Processing server:** supermicro, 10-0114-r, linux 2.4.0 (centos)
 - **Control unit:** windows 10, optasense os-5.11.8
- **Year of installation:** 2014
- **Year of upgradation:** 2021

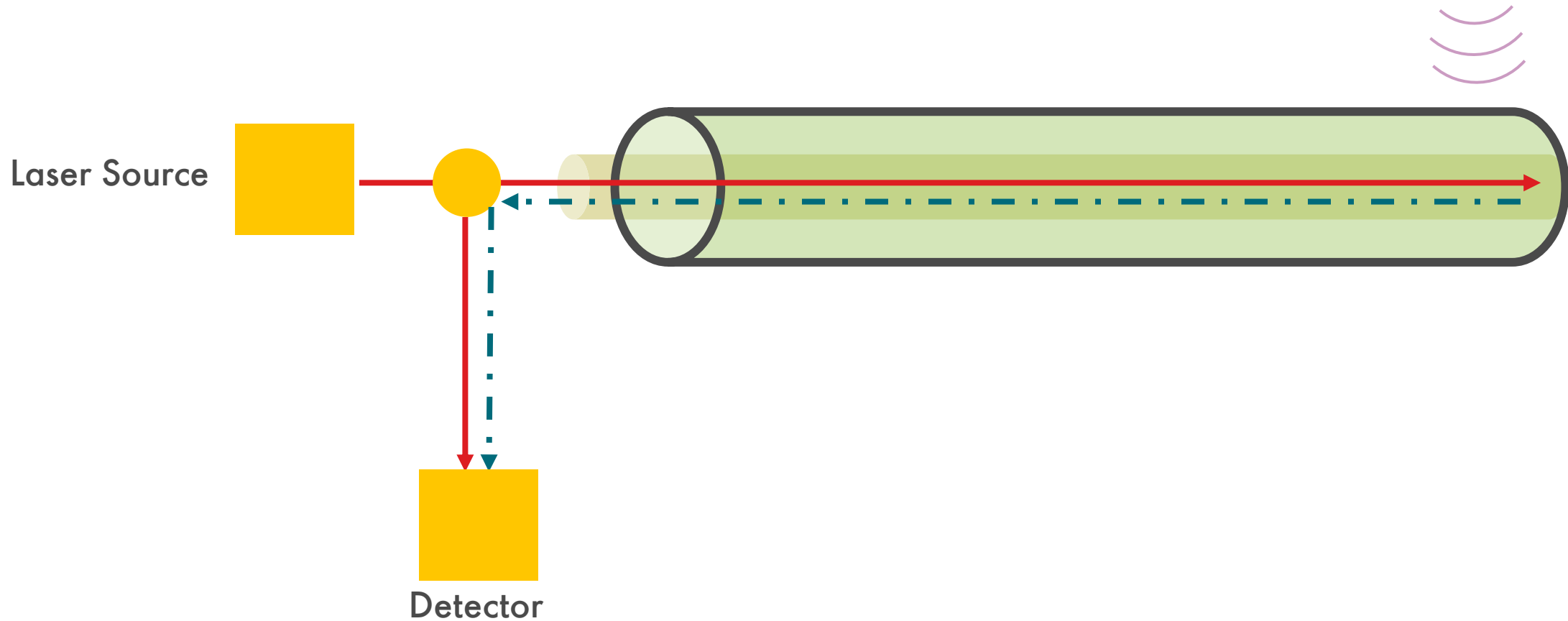


○ Distributed Acoustic Sensing

- Measurement Principle: Pulse of laser is transmitted from the interrogator unit into the fibre optic cable.
- Backscattered (Rayleigh Backscatter) light or reflections from individual points of the fibre length gives information of the interaction with localised acoustic energy (vibrations).
- The time sampled backscattered light gives accurate information of the mapped location.
- Acoustic disturbance on the fiber generates microscopic elongation or compression of the fiber (micro-strain), which causes a change in the phase relation and/or amplitude.
- Before the next laser pulse can be transmitted, the previous pulse must have had time to travel the full length of the fiber and for its reflections to return. Hence the maximum pulse rate is determined by the length of the fiber.



Coherent optical time domain reflectometry (c-otdr).



C-OTDR utilizes Rayleigh back-scattering, allowing acoustic frequency signals to be detected over long distances. The interrogator sends a coherent laser pulse along an optical fiber. Scattering sites within the fiber cause the fiber to act as a distributed interferometer with a gauge length like the pulse length (e.g. 10 meters).

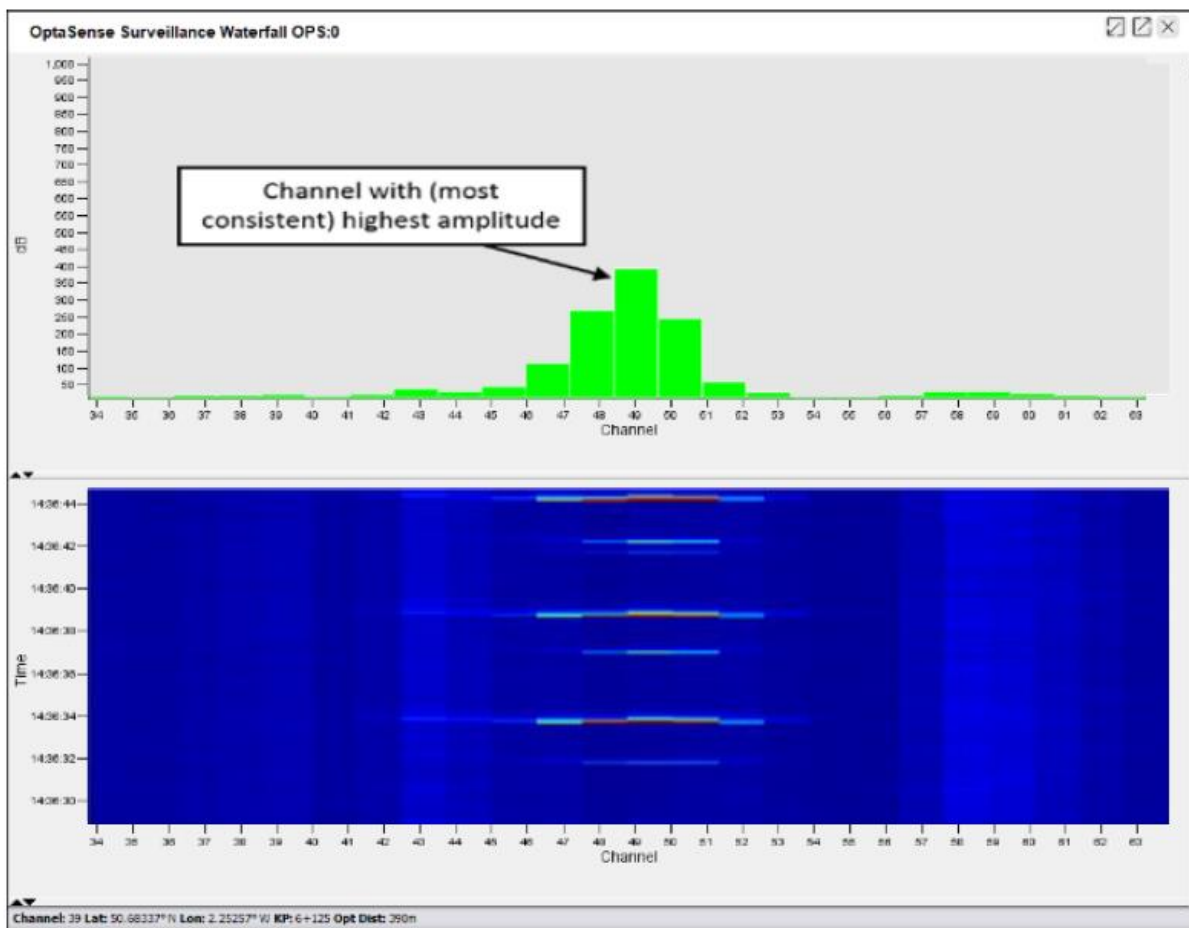


- Alerts are generated for following type of threats
 - Personnel Detector
 - Activity Alert
 - Vehicle Detector
 - Manual Digging Detector
 - Mechanical Digging Detector



Calibration

- Calibration is done using a standard 3Kg drop mass inside a tube.
- 10 sequential drops are performed at each channel location.
- Each Channel is calibrated using the information.

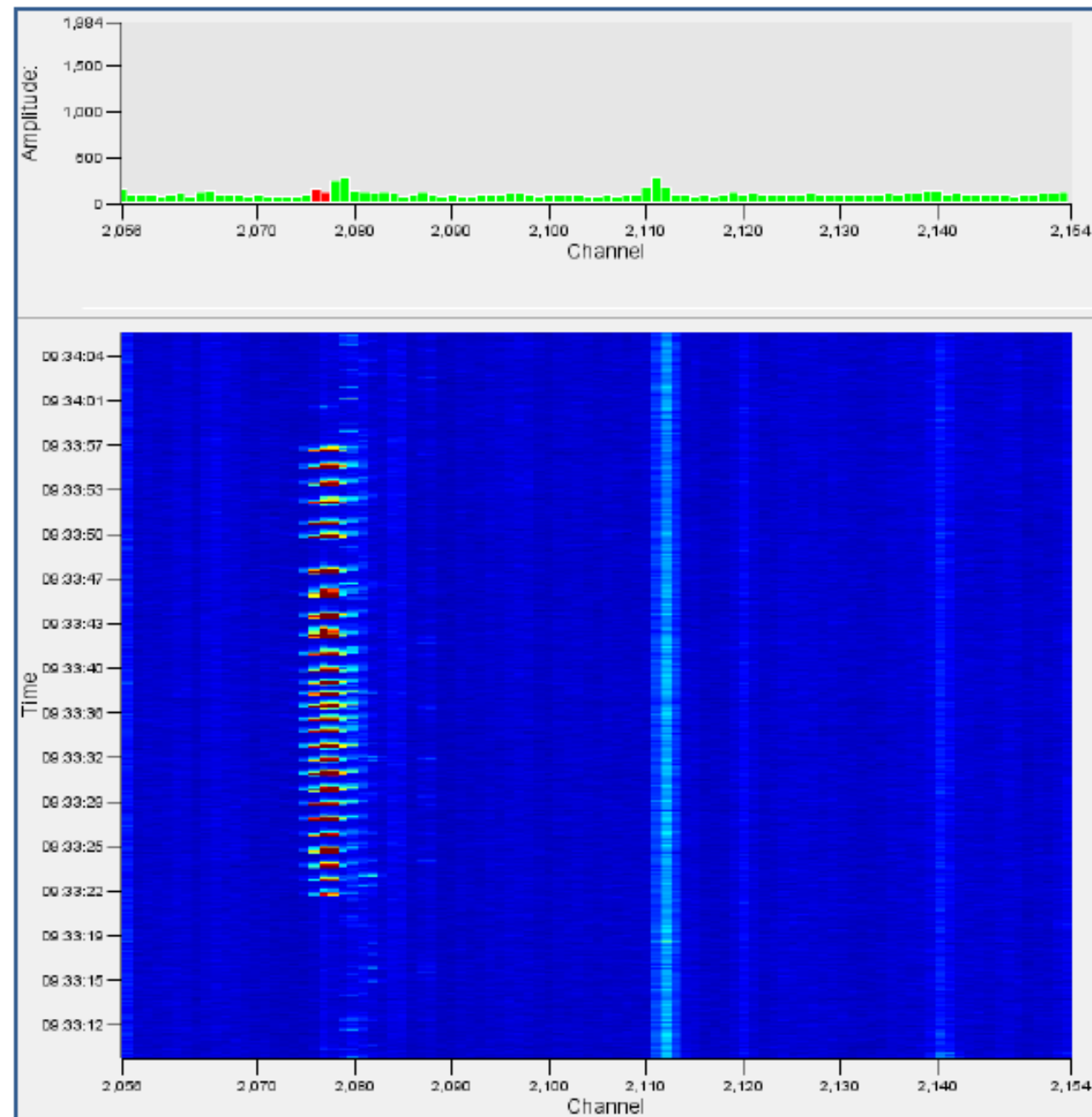


Calibration Tool

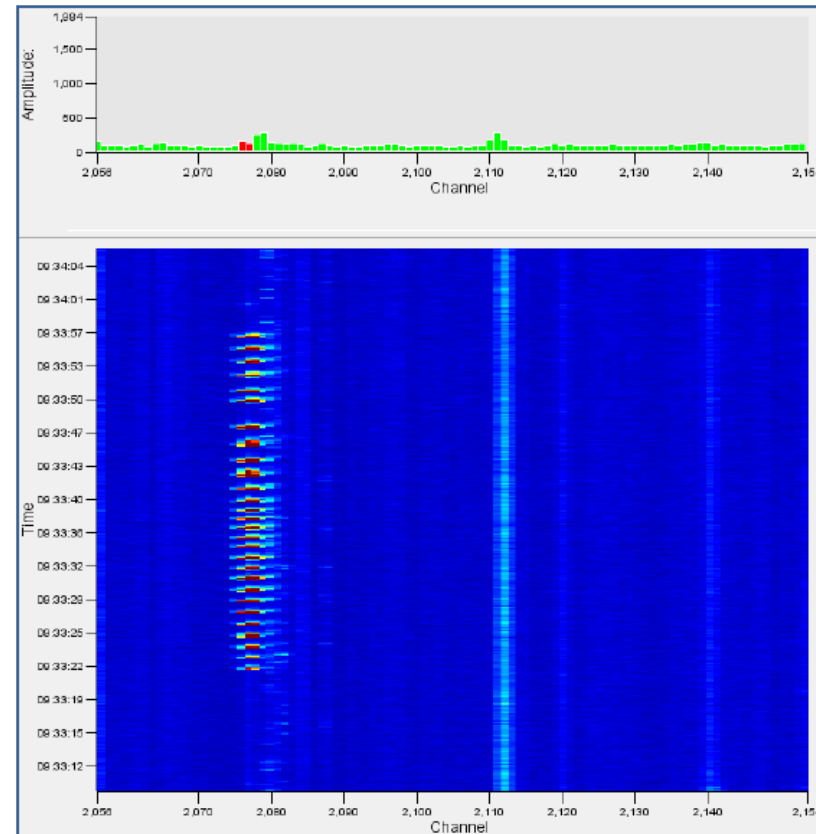
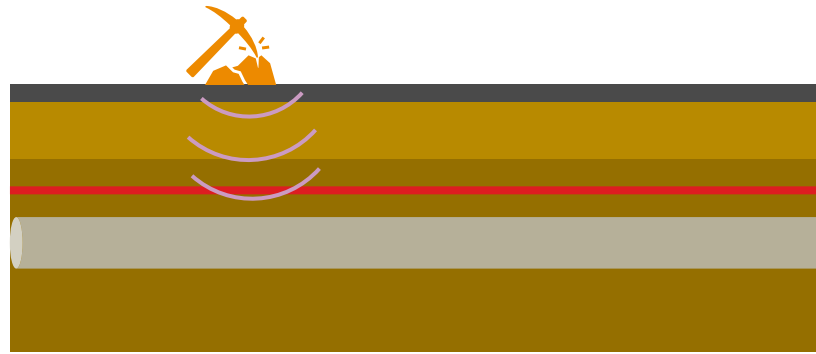


Manual Digging

- Manual digging comprises a series of short, sharp blows to the ground.
- There will be breaks, differences in frequency, but generally over a prolonged period we are looking for a series of individual impacts centered on a specific channel.

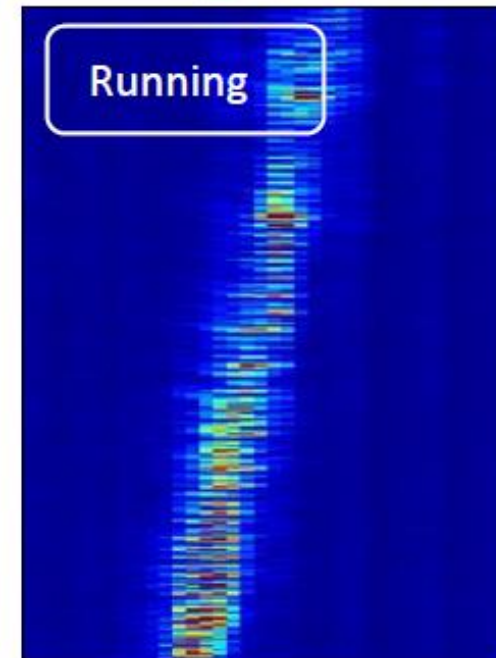
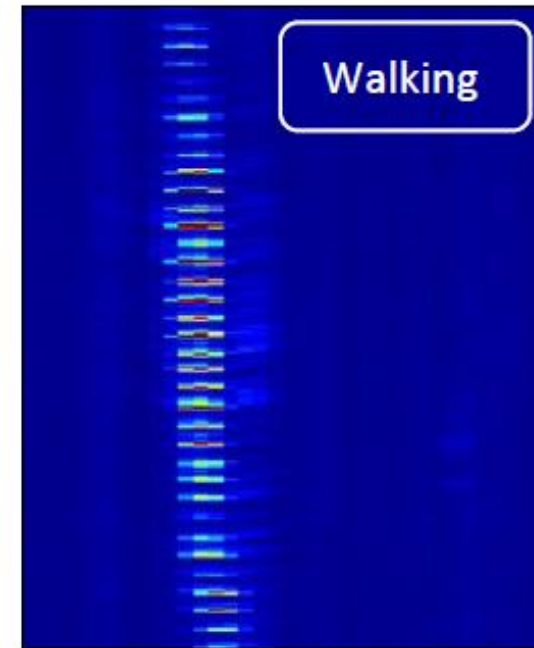


Manual Digging



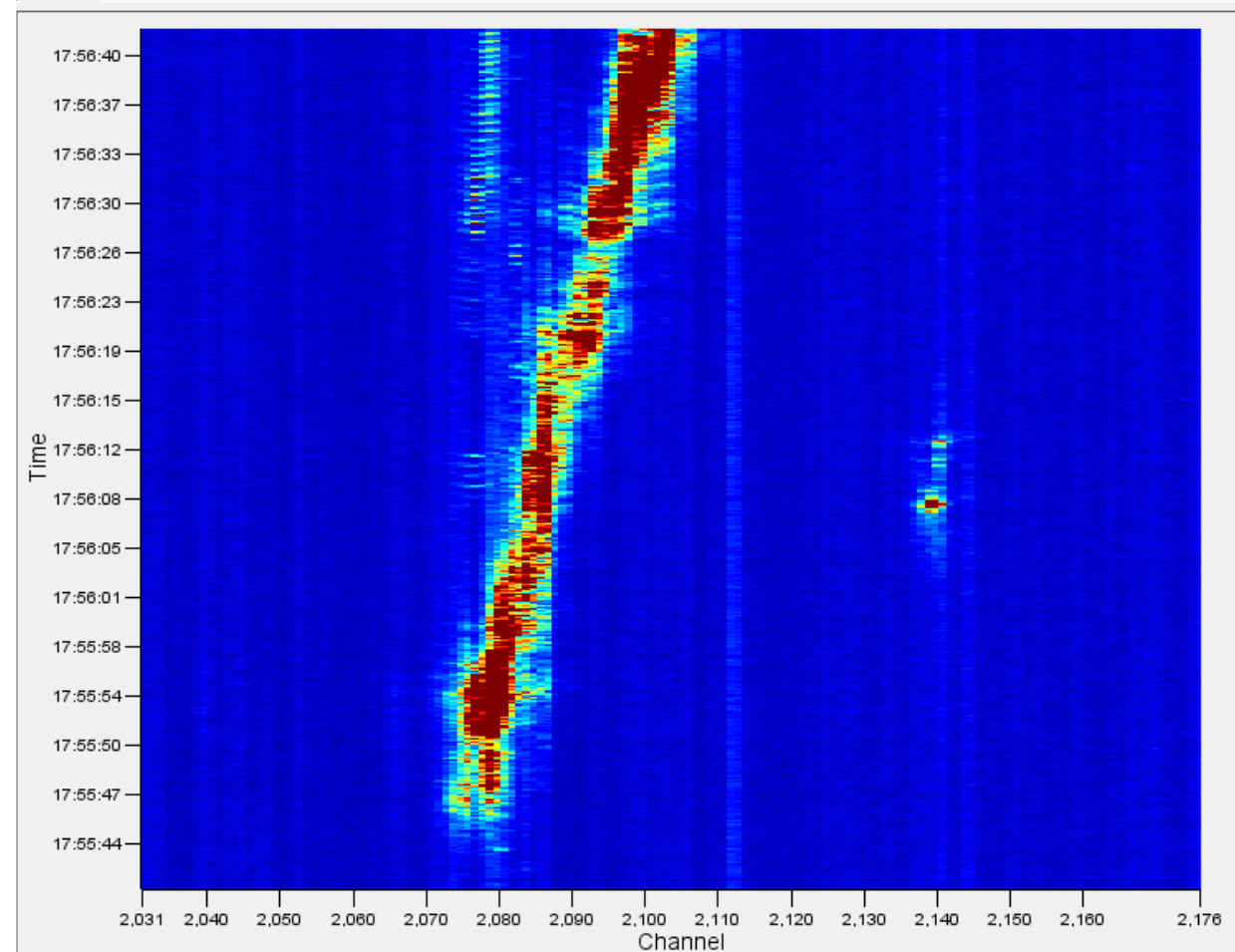
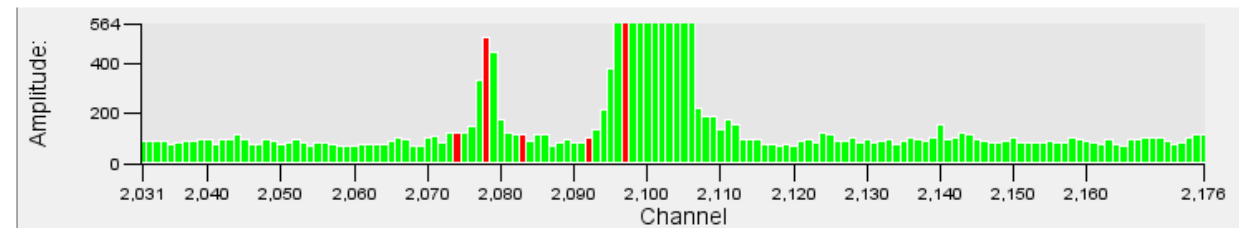
Personnel

- Like manual digging, walking appears acoustically as a series of rhythmic impacts on the ground.
- The sound levels are generally much lower however – only covering one or two channels and never too high in amplitude
- Running footsteps will appear stronger and will of course be faster

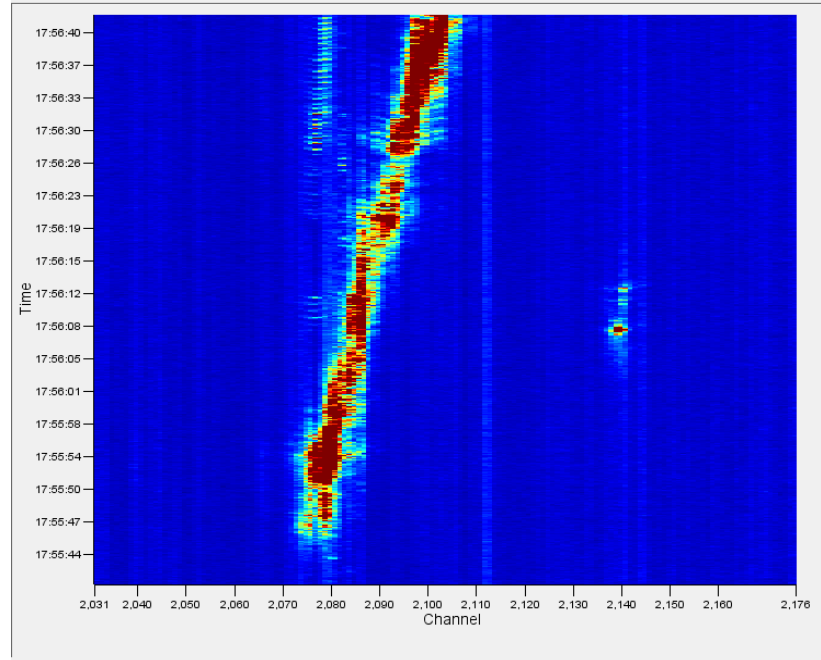
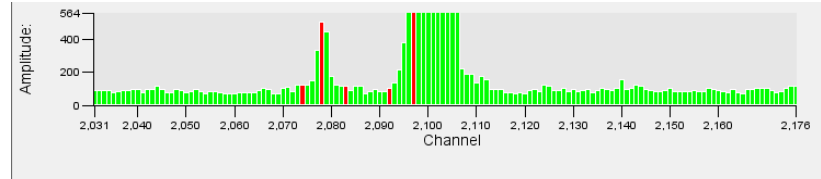
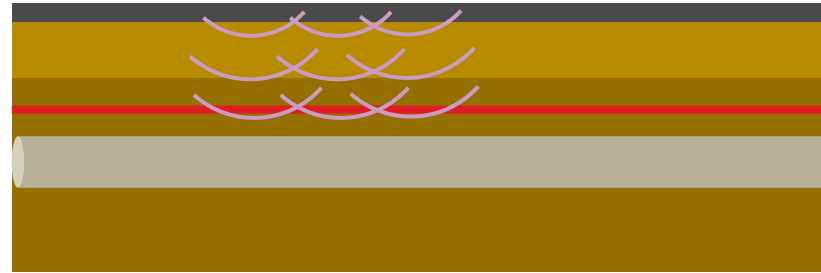


Vehicle

- The presence of a great deal of red indicates the intensity of the noise, the width of the trace suggests that the level of noise is from a loud / heavy rumbling vehicle rather than a quiet vehicle closer to the fibre.
- The speed of the vehicle can be evaluated by considering the extent of movement over the time period

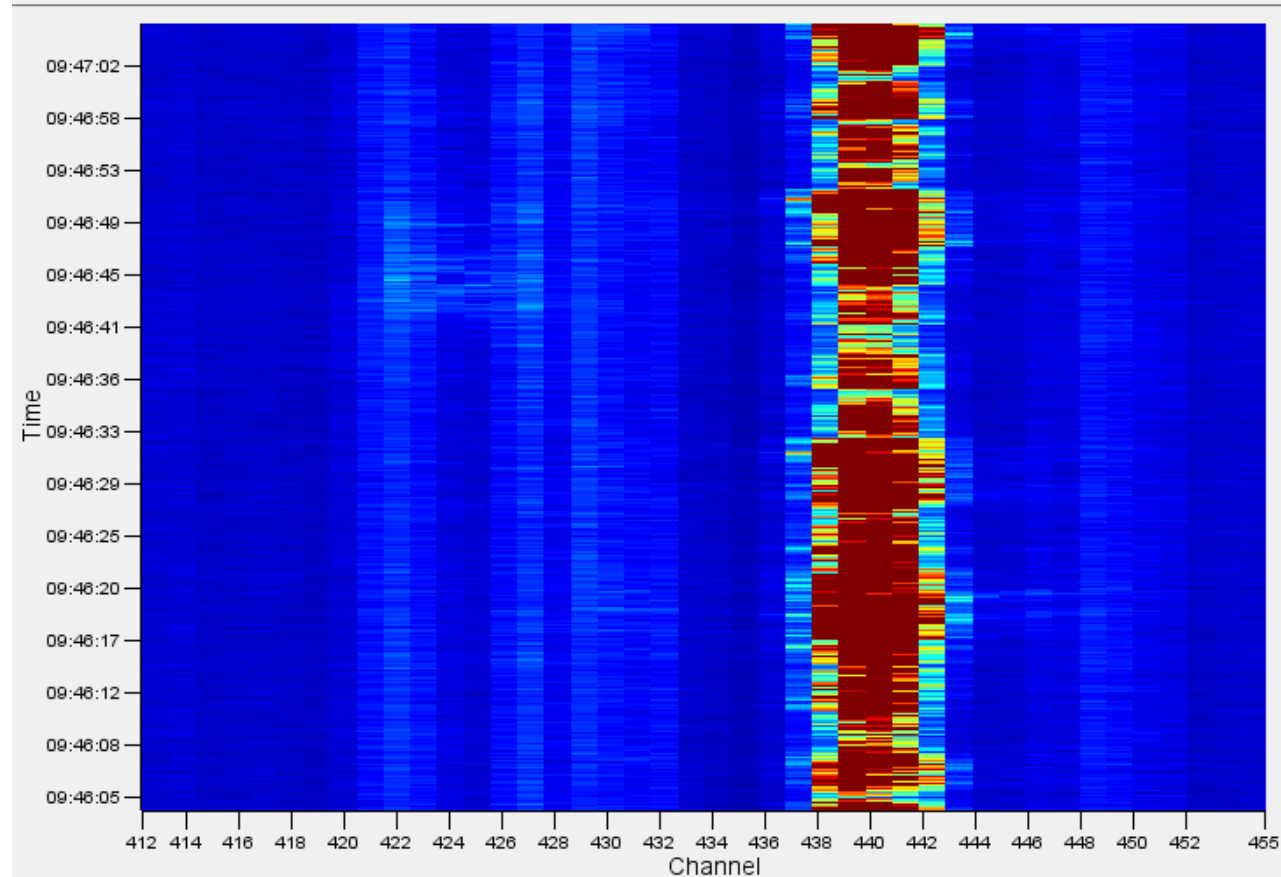
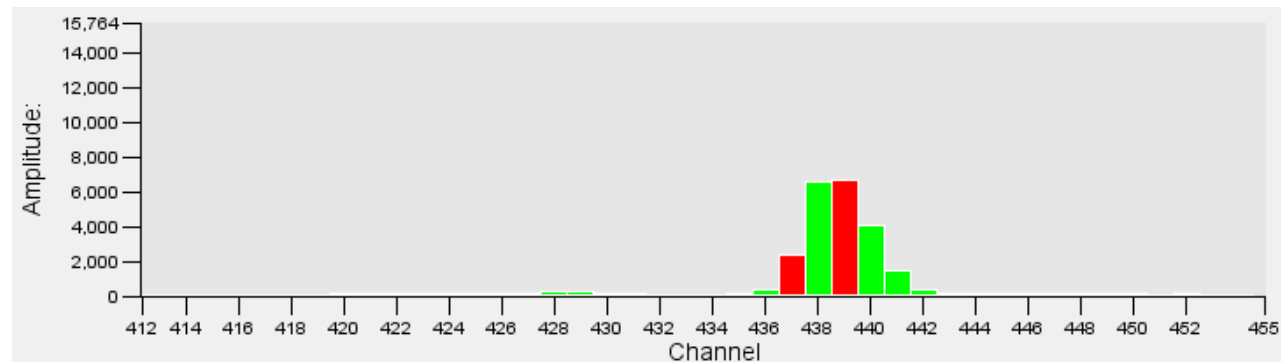


Vehicle

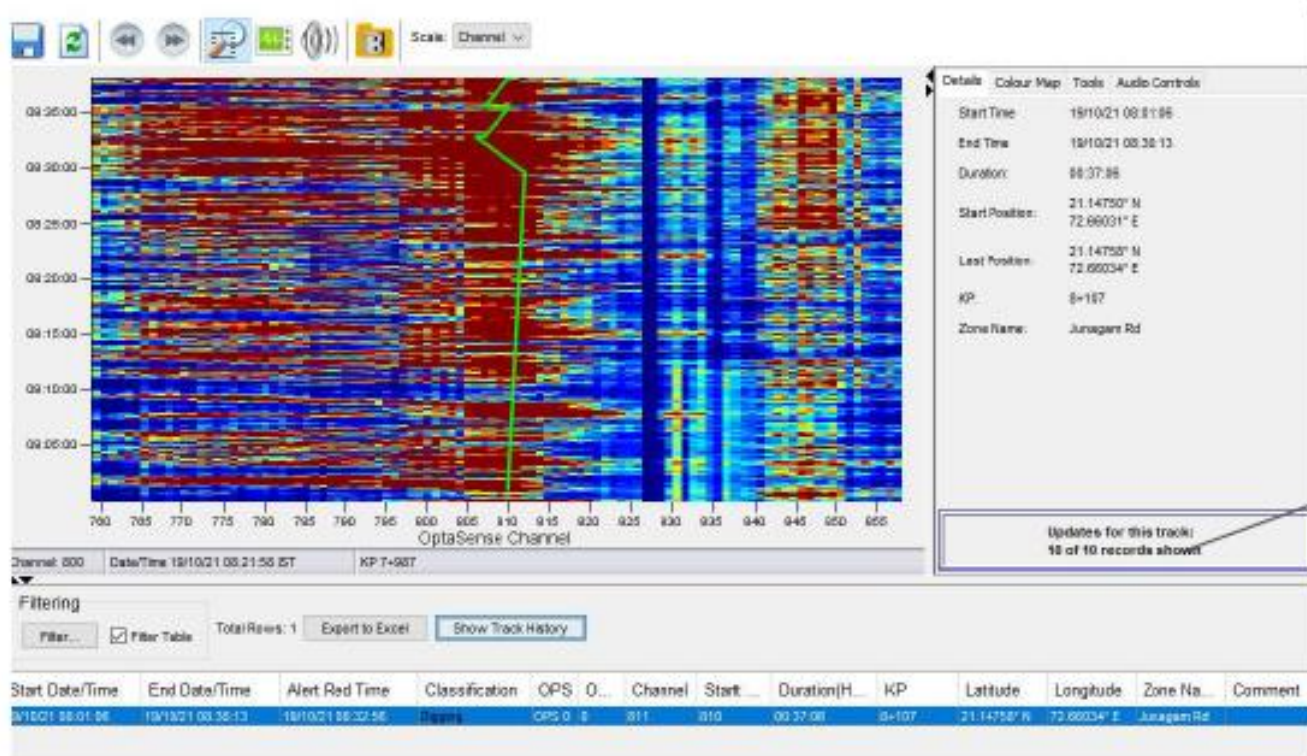


Mechanical Digging

- In essence the signature for mechanical digging comprises a superposition of a reduced form of the digging detector with some aspects of the vehicle detector.
- The mechanical digging detection algorithm uses a mixture of digging impacts and the presence of engine tones to work against both type of wheeled or hydraulic diggers.



Alerting the PST team



**Check update for this track.
NO action required if record shows
less than 10 of 10. 10 or more than
10 record required action by PST in
field**



Example of Mechanical Digging Alert

Optasense OPS 0 Alert History Waterfall (Histogram Source)

Scale: Channel

Details: Colour Map Tools Audio Controls

Start Time
End Time
Duration:
Start Position:
Last Position:
KP:
Zone Name:

Filtering
Filter... Filter Table Total Rows: 1 Export to Excel Show Track History

Start Date/Time	End Date/Time	Alert Red...	Classifi...	Ch...	Sta...	Durati...	KP	Latit...	Long...	Zone...	Com...
03/04/24 11:51:13	03/04/24 11:52:33	Mechanica	OP...	0	1256	1256	00:01:03	12+900	21.1798...	72.6738...	

30-09-2021 tes15

Live Threats List

Class	Start Date/Time	End Date/Time	Channel	<CS>	Comment
🚧	03/04/24 11:51:13	03/04/24 11:52:33	1256	12+890	
🚧	03/04/24 10:51:31	03/04/24 10:55:28	314	3+322	
🚧	03/04/24 10:36:07	03/04/24 10:43:02	181	2+150	
🚧	03/04/24 10:28:42	03/04/24 10:34:11	216	2+380	
🚧	03/04/24 10:31:33	03/04/24 10:33:48	209	2+325	
🚧	03/04/24 08:49:14	03/04/24 09:07:07	1289	12+971	
🚧	03/04/24 08:37:16	03/04/24 08:53:02	315	3+323	
🚧	03/04/24 07:45:43	03/04/24 07:48:32	315	3+323	

Class	Start Date/Time	End Date/Time	<CS>	Comment
🚧	03/04/24 11:51:07	03/04/24 11:52:13	36+580	
🚧	03/04/24 11:25:31	03/04/24 11:27:14	12+989	
🚧	03/04/24 11:07:08	03/04/24 11:26:47	8+800	
🚧	03/04/24 11:20:37	03/04/24 11:22:03	3+321	
🚧	03/04/24 11:20:14	03/04/24 11:21:48	12+880	
🚧	03/04/24 11:11:32	03/04/24 11:14:15	1+890	
🚧	03/04/24 11:07:08	03/04/24 11:13:11	8+813	
🚧	03/04/24 10:58:38	03/04/24 10:59:43	12+460	

Latitude: 21.18026° N Longitude: 72.67450° E <CS>: 12+947 OPS 0 Optical Distance (m): 12,640 Channel: 1264

Windows taskbar showing various Optasense application icons and system tray information including date (03-04-2024) and time (11:55).

Site Response to PIDS Alerts



Process Field Officer (PFO)
Informs Pipeline Surveillance
Team (PST) on receiving PIDS
Alert



PST Emergency Response
Person (ERP) responds to the
alert, mobilizes to the location,
stops any uninformed activity in
ROW and informs PST Officer



PST Officer
escalates/intervenes in case of
unauthorized excavation.
Coordinates with stake holders



- Calibration of the entire length of the fibre along with OEM as a major activity during upgradation.
- Yearly Preventive maintenance plan to simulate all different alerts using JCB/ Manual Digging.
- Periodic Check of System Diagnosis and inform OEM for any issues.
- Monsoon Profile installation before monsoon onset.



