INNOVATION STRATEGY CLOSE-OUT REPORTS

PROJECT TITLE	Sigfox Trial
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BRIEF OVERVIEW OF PROJECT & EXPECTED BENEFITS

What is Sigfox?

Sigfox operates in the licence exempt 870 MHz range (Sigfox uses 868.0MHz to 868.6MHz for uplink, downlink 869.4MHz to. 869.65 MHz) and is primarily a one-way communication facility from remote sensor to base station. The remote sensor sends back information either by exception or periodically. The payload for these devices is 12 bytes. Sigfox uses various techniques to increase the likelihood that messages are successfully sent, e.g. re-transmit, transmit message multiple times on multiple frequencies, frequency hopping. However, this in turn reduces the ability to have increased capacity.

Band	Frequency	Power [dBm]	Duty cycle
F	863.0-865.0	14	0.1%
G	865.0-868.6	14	1.0%
H	868.7-869.2	14	0.1%
K	869.4-869.65	27	10%

Figure 1: Duty Cycle Limitations

+14dBm (25mW) is the typical device transmit power limit for the 863 – 870 MHz range (although Sigfox downlink in a +27dBm (500mW) range), and the Duty Cycle is typically limited to 10% for each device. This limit in power reduces the propagation distance for a device, however increases the ability to reuse the frequency and in conjunction with the low Duty Cycle enables the remote device to last a long time working off a battery. These limits are set by ComReg in line with EU standards.

These limitations mean that only 8 messages per sliding hour can be reported per remote sensor. Sigfox technology is ideally suited for applications which report back information by exception or on a non-frequent basis.

Sigfox is primarily an uplink centric application. The end device sends a message periodically and/or event based (e.g. movement of a GPS tracker, threshold in temperature exceeded etc.). The end device listens for a very brief time just after it has transmitted to the base station only. This limits the technology's capability to be communicated with out of sequence. This also limits devices capabilities of receiving software upgrades.

Sigfox, like other licence exempt technologies, has the benefit of not necessarily suffering direct interference as it has numerous ways to prevent interference/ensure message is sent. Therefore, there is no need to carry out intra-network interference criteria for frequency reuse. The issue with this is that it is not possible to design the network to prevent interference issues, and as a result the availability and probability of messages being successfully sent are not at the high levels experienced by ESB Networks for various other wireless communications systems (e.g. point to point links, SCADA with availability of 99.99%+).

Sigfox in Ireland is currently backhauled using Mobile Network Operator's (MNO's) data networks. As a result, Sigfox base stations can only be deployed in locations with coverage from MNO's networks'

and is also reliant on availability of the MNO networks. Sigfox devices do have a much greater sensitivity, which allows these devices to effectively communicate with base stations even if the signal was much lower than the required minimum mobile phone signal for effective communications.

There are numerous manufacturers of Sigfox devices. All Sigfox devices report back information to the Sigfox head-end. Depending on the application/device, the information reported back may be unintelligible to an observer. Most Sigfox manufacturers have their own head-end and some have apps as well. This allows further observations of the messages reporting back and the performance of the device. Some manufactures facilitate email and SMS notification of an event or significant event (e.g. report on exception). It is possible to develop a front end which hosts all devices and allows set up (e.g. reporting conditions e.g. deadbands, thresholds), email and phone details for sending of messages from devices).

Scope

The objective of this trial was to validate the performance of Sigfox technology for a variety of applications and services in a variety of locations. Testing took place in a number of locations in Cork, Dublin and Portlaoise for the following;

Sigfox devices were used;

- To monitor Switch Mode Power Supplies at a 110kV station in the south of the country. There was no alternative telecommunications solution available at this location. It was possible to have text and email alerts sent to specific personnel. This deployment was successful and increased efficiency and organisational awareness of assets (increasing reliability).

- GPS devices used in numerous vehicles to verify functionality. A low-cost option for GPS tracking of assets. Option exists to set up Geo-fencing for specific assets, so notifications are sent/received if they are moved from a specific area.

- Fluid filled cable monitor: A dry contact sensor Sigfox device was deployed and tested for fluid filled cable monitoring. This worked extremely well and provided a cost-efficient solution for the application and can be used elsewhere.

Other devices were purchased and will be tested in time (Leak Monitors, PIR).

RESULTS

Sigfox has widescale coverage as experienced through the trial. ESB Networks had a third party set up a dedicated front-end web Graphical User Interface (GUI) which allowed for efficient management and review of the data sent from remote devices. This GUI also allowed for the setting up of email and text alerts to specific staff when specific Sigfox devices were communicating useful information from Assets. The Sigfox technology performed extremely well in trial mode and offered an effective telecommunications service from a number of locations (including a rural 110kV station). The trial concluded that Sigfox has potential to deliver on ESB Networks' requirements for certain telecommunications services of the business.

LEARNINGS

This technology can functionally be used by the company for a wide range of tasks throughout the country and should be considered along with other low power technologies for deployment for suitable services.

BENEFITS REALISED/VALIDATED

Low power technology can enable the deployment of a high volume of lower cost sensors to get useful information from assets and from locations of specific interest. These devices generally do not require power (they are battery powered) which makes their deployment simplistic and flexible. The key benefit of such low power technology is that it permits the collection of data for a wide variety of use cases in a highly scalable and cost-effective manner. Owing to the restrictions on the technologies, it is only suitable for certain non-critical services. Main potential benefits to the organisation are;

- Operational Efficiencies: Reducing amount of time and effort of staff carrying out checks/tests.
- Asset optimisation: Get information on assets/devices which is not feasible otherwise. Protects equipment and improves reliability of supply. This allows for asset optimisation, pre-empts faults/issues with equipment, expedites fault resolution.

NEXT STEPS – BAU, TRANSFER OF OWNERSHIP

ESB Networks should conduct an analysis on all available low power technologies and evaluate which of the available services (or combination thereof) has the best capability of meeting the business requirements.

FINAL TIMELINES (REASONS FOR ANY DELAYS IF THEY OCCURRED)

No delays.

FINAL COSTS

- €12k for equipment
- €1.7k for web interface.
- €46k time.

  Total €60k

Figure 1 - Fluid Filled Cable Monitor Utilising Sigfox

2017-03-14 12:29:20	1.6	0000	2e0a1100		2250	-118.00	33.57	868.1975	1	
					13A4	-134.00	17.16	868.1970	1	
					23FC	-110.00	41.15	868.1967	1	
2017-03-14 12:28:57	1.8	0000	2c0a1001		23FC	-118.00	33.27	868.2108	2	
					2250	-123.00	27.93	868.2116	2	
2017-03-14 12:27:59	2.2	0000	2a0a1100		2250	-120.00	31.55	868.1819	2	
					23FC	-107.00	44.21	868.1822	3	
2017-03-14 12:27:38	1.5	0000	280a1001		23FC	-114.00	36.90	868.2114	2	
					13A4	-134.00	17.29	868.2117	2	
2017-03-14 12:26:58	2	0000	260a1100		13A4	-130.00	21.37	868.1939	3	
					23FC	-100.00	50.71	868.1936	3	
2017-03-14 12:26:07	1.4	0000	240a0101		23FC	-104.00	47.09	868.1809	3	
					2255	-123.00	27.64	868.1817	1	
2017-03-14 12:24:55	1.5	0000	220a0101		2250	-120.00	30.89	868.1988	1	
					23FC	-105.00	46.47	868.1980	2	

Figure 2 - Raw Data From Fluid Filled Cable Monitor

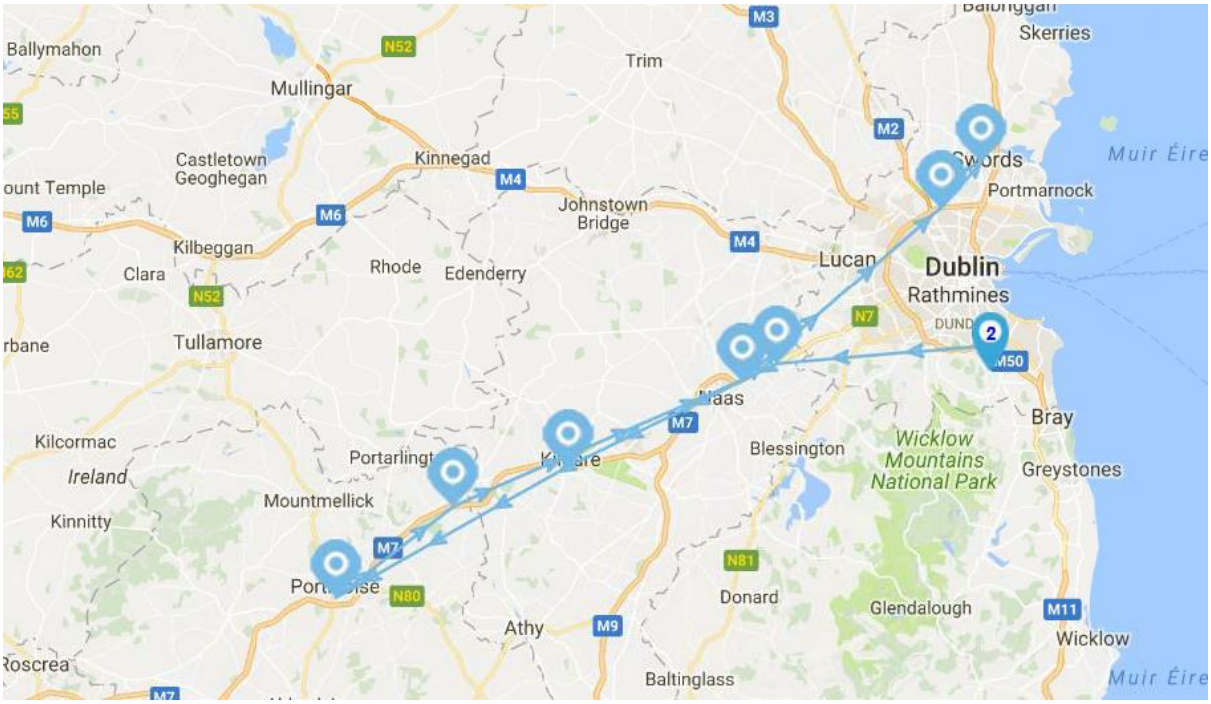

Figure 3 - Sigfox GPS Tracker Data

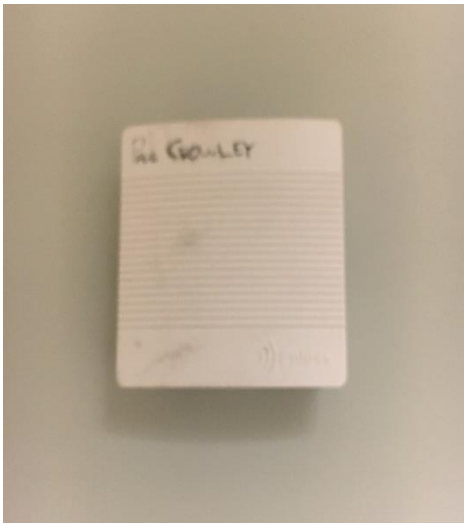

Figure 4 - Temperature Monitors

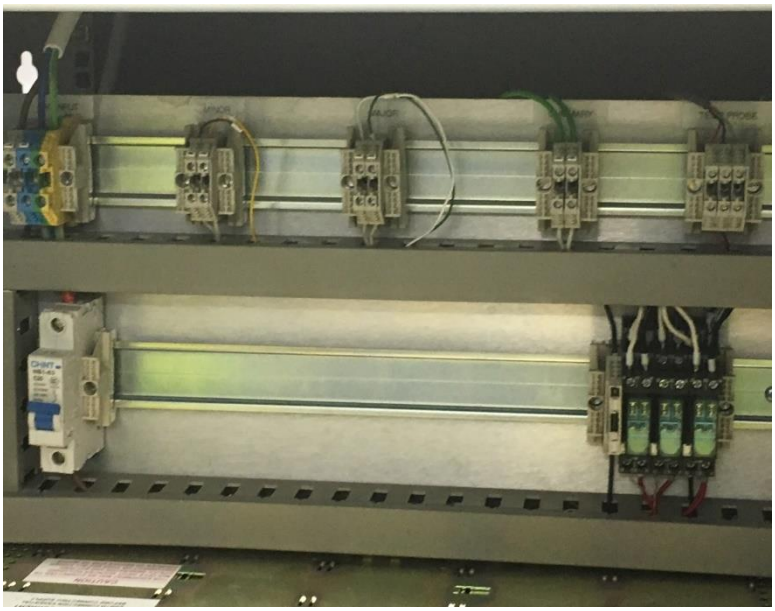

Figure 5 - SMPS Status Monitoring