# Taggle Systems

## Comments on *Beyond 2020—A spectrum management strategy to address the growth in mobile broadband capacity*

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## Introduction

This document is a response to the Request for Comments on the discussion paper "***Beyond 2020—A spectrum management strategy to address the growth in mobile broadband capacity***" issued by Bridget Kerans on 1 October 2015. Our comments describe alternative methods of spectrum valuation, specifically spectrum to be used in low-power wide area remote sensing applications.

Taggle Systems have proven that, with the right radio technology and spectrum, water utility companies can use remote reading of water meters to extract considerable savings in operational expenses. The key requirement for radio technology to achieve these savings is that the cost per unit is low since the savings rely on the management of large numbers of meters where the average benefit of the remote reading is small. Low cost remote water meter reading requires a long-life, small battery. This means a transmit power under 100 mW, but with an urban range more than 2km to reduce network infrastructure costs. This means that spectrum for this purpose must have extremely low interference potential. A bandwidth of 5MHz would achieve economies of scale and allow networks to monitor large numbers of remote sites, to increase the utility of the network beyond water meters.

## Background

Taggle Systems was formed in 2007 to develop a new radio system that would allow cost-effective, battery-powered remote monitoring in Australia. Taggle developed a new integrated circuit radio transmitter and ultra-sensitive receiver that are now used across the country. These new radio networks are managed by Taggle and enable tens of millions of dollars of value to be achieved by Taggle's clients. This value is mostly though operational savings achieved by analyzing large volumes of data from networks that currently monitor about 100,000 sites.

To make a business case Taggle's clients require that the individual cost of monitoring each site be kept to a few dollars per year. Taggle's clients are mostly water utilities who use hourly water use data to reduce water consumption by alerting consumers about leaks and high usage, manage their networks by monitoring the water balance within the network, and improve efficiency of meter reading for billing. The water industry has provided strong positive feedback to water utilities adopting Taggle technology through a number of prestigious awards for innovation, cost saving and customer service. The cost savings are extremely sensitive to the cost per site of the data collection network.

In the body of this submission we will discuss Taggle's experience in achieving measureable financial benefit from its current network, and some aspects of public benefit that may not have a direct dollar value. We will comment on the spectrum requirements that enable low-cost, long life, battery-powered remote monitoring.

## Benefits of Low Power, Wide Area Networks

### Direct Financial Benefits

The LPWAN acronym is now widely accepted for radio networks that allow very low-cost remote monitoring. Taggle Systems developed one of the first commercially viable LPWAN solutions in the world.

Mackay Regional Council has reported potential savings of $100 million over 10 years due largely to deferred capital works because of reduced water usage. The reduction in water usage was enabled by improved monitoring using the Taggle automatic meter reading device.

Taggle enabled water meters provide large financial benefits for other clients in Goldenfields Water County Council and Grampians-Wimmera Water.

Based on an average of $10 per device per annum and a mature market of 5 devices per household, the extremely coarse value of these radio networks is $500 million per annum within Australia. To realize this value with only Taggle radio technology, given appropriate radio spectrum, would require an up-front investment of the order of $50 million to $100 million. The investment potential of this market has prompted increasing interest in LPWAN around the world. The market potential has fostered significant investment in this "hard" technology by venture funds, and Taggle in particular has had no difficulty in fundraising, and has extended capabilities in this technology development thread leading back to the early days of Australian radiophysics innovation.

## Indirect Benefits

A LPWAN network can be used to provide a large range of cost-effective monitoring solutions including wildlife, rainfall, temperature, humidity, soil moisture, water depth, water overflow, wind speed/direction, open/shut alerts. Much of this monitoring has direct financial benefits but there is also widespread public benefit, in providing large datasets for reliable management of agronomy, parks, pests and protected species. A Taggle network proposed for Cassowary Coast Regional Council in Queensland, being built for water meters, can also be used to monitor cassowaries crossing roads to provide driver alerts. Another network constructed to monitor water meters in southern NSW is also being used to alert land management authorities when wild dog traps are activated. An extensive network of rainfall meters in Mackay is used to provide early flood and sewer overflow warning. The same network has been used by farmers to convey information about wind speed and direction, to help farmers manage spray drift into riparian areas that discharge to the Great Barrier Reef. Rainfall, temperature and humidity meters in western Victoria provide data for agronomic models and advice to farmers.

The current deployments of Taggle networks provide sufficient data to enable reliable prediction of their costs, benefits and spectrum requirements across Australia. For only 5 MHz of spectrum in the 900MHz band a properly configured LPWAN network could monitor approximately five devices per household in urban Australia and 50 devices in rural areas.

## Technical Requirements for Utility Spectrum

### Network management cost

Network construction and maintenance must be amortized over the devices to be monitored. Management costs per device must be a few cents per annum. Efficient management allows connection and data delivery from large numbers of devices in regional networks.

Characteristics of efficient network management include:

1. Low client engagement costs. This means few clients with large numbers of devices per client.
2. Low costs for network infrastructure. Remote monitoring clients often control distributed real estate for radio towers.
3. Low levels of Electromagnetic Radiation from network equipment. Radio towers with zero or very low levels of radiation can be sited close to other radio equipment with no interference consequences, and close to population.
4. Low cost of regulation. The spectrum must be self-regulated or have low-cost oversight provided.

### Device cost

This discussion assumes network devices that are battery powered, with no effective access to external power supplies. The devices must work for many years (10 years is a common requirement) providing real-time data for a few dollars each per year. These power requirements require total transmit power to be less than 1000 joules per year. Most transmissions need to be less than 15 dBm EIRP to achieve more than 10 years of battery life from single AA batteries. Delivering this power profile enables projects with large numbers of sensors.

### Network capacity

The third strand of allowing low-cost long-life remote sensor networks is that these networks must be able to handle thousands of devices for each deployment of network infrastructure. The value of a network is only realized when several devices are connected for each household.

## Conclusion

Taggle Systems have proven that it is possible to design radio networks that allow large numbers of very low power transmitters to be managed for a few cents each per year. These networks deliver large benefits but require spectrum that allows low power transmitters to be detected over several kilometers in urban environments. This means that the average channel power from active devices must be similar to the thermal noise at the receivers.

Taggle requests the development of new spectrum in the 600MHz to 1000MHz region that is specifically designed to address the needs of public utilities and public interest groups. Using our large and growing base of clients we have concluded that 5MHz of spectrum would be sufficient to provide for future needs. Taggle is in a position to manage this spectrum on behalf of Australian utilities with the aim of promoting efficient spectrum utilisation and new technology development.

Allowing such a spectrum would enable millions of dollars of real benefit for Australian utilities and cost-effective monitoring for environment management.