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| **Radiocommunication Study Groups** |  |
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| WORKING DOCUMENT TOWARDS A PRELIMINARY DRAFT NEWREPORT ITU-R M.[UTILITIES] |
| [Utility Communications Systems] |

# 1 Introduction

This Report describes Utility Communications Systems and how utilities support increasing communications demands for fixed and mobile voice and data systems.

# 2 Background

2.1 Utilities and Spectrum Aspects

Utilities around the world use operational communications networks to support the safe, secure and reliable delivery of essential electric, gas and water services to the public at large. Such operational communications networks facilitate utility networks and are desired to be resilient (e.g. 72 hours of back-up power at every wireless site) with low latency (e.g. 20 ms or less) to enable certain utility applications and deliver higher bandwidth applications.

Utilities may use wireless technologies, for voice, control and data communications to support the operation of their critical systems. However, as described more fully below, a wireless solution would need to support the ever-growing demand and heightened performance characteristics associated with utility system visibility, operation and management, e.g. smart grids.

The challenge for utilities is that existing spectrum provisions are limited to narrowband (e.g., channels of 25 kHz bandwidth, or less) and are subject to interference and congestion from a wide variety of other co-channel and adjacent channel operations, because the spectrum is shared with a broad class of industrial/business operations and those operations are coordinated in close geographic and spectral proximity to one another. Non-wireless alternatives may be impractical for many applications which need for wide service area coverage and low cost. For example, it is impractical to run fibre and other non-wireless technologies to millions of smart grid devices, many of which may be located in remote and otherwise inaccessible areas across the wide service area of a utility.

Some utilities are implementing additional renewable sources of energy when feasible, such as wind and solar, which are intermittent sources of energy by their nature. Suitable communications technologies can enable the management and control the flow of energy onto the distribution infrastructure. Some utilities are also implementing newer distribution automation technologies thereby enabling utilities to maintain power resilience and restore power more quickly in the aftermath of an outage and to protect critical assets against physical and cyber-attacks. These are just some of the utility applications that are creating additional demand for new wireless communications capacity and coverage. Finally, cyber security, data analytics, and workforce mobility may also affect capacity and coverage considerations.

2.2 Utility Standards and Functional Characteristics

Utilities utilize highly reliable and resilient communications in order to ensure operational safety, reliability and security of the underlying electric, gas and water services that they support.

This includes extended back-up power and diverse and redundant routing of backhaul communications networks at every wireless site. In addition, energy networks utilize extremely low latency services in order to ensure that utility teleprotection systems and synchrophasors operate to prevent faults on the grid from cascading and causing widespread outages and/or safety issues. Ensuring that these systems are secure and can be delivered in a cost-effective way is a high priority within the industry. Finally, some of the key characteristics the operational communications components of utility networks are highly ruggedized for extreme conditions within the substation environment and have traditionally used extended depreciation cycles; so that the equipment must last for an extended period of time. These are the key characteristics to maintain utility networks and their functions.

## 2.3 Bands Suitable for Utility Communication Systems

### 2.3.1 Utility Bands and Applications

Utilities operate fixed and mobile systems in various land mobile bands, and they use these systems to support various voice and data applications. Specifically, some utilities operate systems within portions of the 137-512 MHz frequency range, as well as 800/900 MHz land mobile bands. These systems support voice applications, such as routine dispatch and emergency restoration, and for data applications, such as supervisory control and data acquisition (SCADA), distribution automation (DA) and advanced metering infrastructure (AMI). Collectively, these systems comprise the field area network, and they are characterized by wide area coverage, high reliability and availability, and redundancy/resiliency.

Utilities also use license-exempt spectrum to provide additional capacity. While utilities also use microwave for point-to-point and point-to-multipoint communications that provide high capacity backhaul, access to higher capacity licensed land mobile spectrum could be better suited to offer wide area coverage, not just on a point-to-point or point-to-multipoint basis. It should be noted that licensed-exempt and fixed microwave spectrum bands are already well-understood and used by utilities and which has inherent limitations in terms of coverage and reliability.

Many of the applications considered in the Report would be fixed, but there could also be mobile applications, as well. The fixed applications could include remote terminal units and other devices that would operate across utility transmission and distribution networks; and unlike older one-way relatively slow speed devices that utilities have used in the past, these devices would enable two-way, real-time communications that would provide utilities with much better visibility and control over their entire critical infrastructure delivery networks.

Utility grid modernization represents a fundamental change in the way that utility networks currently operate; for example, dynamically responding to an isolated fault and rerouting power before it leads to a widespread and extended outage or anticipating the fault before it occurs and changing out a transformer before it fails. In addition to fixed operations for intelligent electronic devices on the grid, grid modernization also envisions mobile data applications to trucks and personnel so that they can access files with information about utility infrastructure as they are restoring power and then communicate back remotely to the utility when the work is completed, and power has been restored. Such developments could dramatically reduce the time it takes to restore power and improve the safety and efficiency of operations overall.

Grid modernization depends on the underlying communications systems, which in turn are dependent upon access to sufficient and suitable spectrum, particularly for field area networks.

### 2.3.2 Shared use of existing bands

The intent here is to make more effective use of existing land mobile service spectrum bands without disrupting incumbent operations (e.g. neither by interference nor relocation. Instead, by sharing existing bands the spectrum could facilitate more timely access to spectrum. Finally, sharing the existing bands could open up the potential for the development of shared systems that could allow existing passive network infrastructure, such as sites and active components such as fibre connectivity to be exploited thus reducing overall costs relative to operating separate networks.

Research of current uses for international electricity, gas and water utility communication systems has identified a typical common set of spectrum characteristics as shown below:

– VHF spectrum –sub 300 MHz forresilient voice communications and distributed automation for rural and remote areas.

– UHF spectrum for tele-protection, control, automation and metering

– Lightly regulated or deregulated shared spectrum for smart meters

– L-Band for more data intensive smart grid, security and point-to-multipoint applications

– Public microwave and satellite bands for access to the core fibre networks of utilities or strategic backhaul.

# 3 Related documents

There are several related documents that are being developed within the ITU, which are referenced below:

Report ITU-R [SM.2351](https://www.itu.int/pub/R-REP-SM.2351) – “Smart grid utility management systems”.

[Working document towards a preliminary draft new] Report ITU-R M.[IMT.BY.INDUSTRIES], “The use of terrestrial component of International Mobile Telecommunication (IMT) by industry sectors” (cf. Section 4.4 in [Attachment 3.13](https://www.itu.int/dms_ties/itu-r/md/15/wp5d/c/R15-WP5D-C-0875%21H03%21MSW-E.docx) to Doc. [5D/875](https://www.itu.int/md/R15-WP5D-C-0875/en)).

# 4 List of acronyms and abbreviations

# 5 General technical and operational considerations of utility applications in the Land Mobile Service

Utility systems are characterized by high reliability, high availability and low latency. Utilities typically operate their own operational communications networks in order to ensure communications reliability during extended power outages or other situations when public commercial communications networks may become affected. They also communicate in areas that commercial communications networks do not cover but where utilities may have critical assets, such as remote areas where generation or transmission infrastructure is located. Finally, utilities communicate with very low latency, depending on the type of utility application as low as 20 milliseconds or less. This is necessary in order to isolate a fault before it causes a widespread outage. Hence, utility communications networks can be characterized as highly reliable, available, and operate at low latency.

As utilities implement grid modernization more densely and deeper into their infrastructure, they are expected to need additional capacity and coverage as they shift towards two-way, real-time communications systems to provide increased control to turn systems on and turn off remotely, automatically and dynamically without the need to send out a truck and manually reclose circuits when breakers have tripped. Moreover, they will be able to automatically detect a power outage and restore power instantly by rerouting it, instead of having to attempt to triangulate a power outage based upon customer calls that a power outage has occurred and then sending a truck into the area to determine the exact location where a tree has fallen across a line or a transformer has failed. All of this automation would benefit from additional capacity and coverage.

In order to provide additional capacity and cost-effectiveness, utilities would benefit from access to wideband spectrum with channel sizes of 200 kHz or more below 2 GHz to provide favourable propagation and to avoid line of site issues, such as trees and buildings that can degrade or block services in higher frequency bands. Finally, to maintain low latency, high reliability communications would benefit from access to existing spectrum bands that are not subject to interference to avoid complex and costly operational communications networks.

# 6 Conclusions

**Attachment:** Work Plan

[To be developed]

This Report would be developed during 2018-2019.

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