Public Protection and Disaster Relief Radio-communications

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Abstract - **Public Protection and Disaster Relief (PDPR) radio-communication systems are vital to achievement of the maintenance of law and order, response to emergency situations, protection of life and property and response to disaster relief events. Expanding scope of PPDR capabilities, ranging from narrowband through wideband and broadband offers greater utility for emergency response operations around the world. The ITU Radio-communication Sector (ITU-R) Report M.2377 discusses the broad objectives and requirements of PPDR applications, including the increasing use of broadband technologies to meet those goals.**

New PPDR applications using real-time mobile video are helping detect and prevent criminal and other unlawful activities as well as supporting effective response to disaster events.

Advances in broadband technologies offer the potential of enhanced capability and capacity to facilitate the achievements of both public protection operations and responding to major emergencies and catastrophic disasters.

Keywords: Radio-communications, Emergency response operations, Broadband technologies, Harmonizing spectrum, ITU-APT, PPDR

I. INTRODUCTION

RADIO-COMMUNICATIONS are critical for saving lives and property during emergencies, major events and disasters. Public safety agencies that respond to such emergencies cannot function without the support of robust and secure wireless communications.

The International Telecommunication Union (ITU), and its members realized the importance of harmonized spectrum and standard-based technologies to meet the radio-communication needs of public safety agencies, hence the term public protection and disaster relief (PPDR) radio-communications was coined during the ITU World Radio Communications Conference 2000 (WRC-2000), in Istanbul, Turkey [1].

PPDR radio-communications are also an important tool used on an ongoing basis by first responders in their everyday work to assist people, coordinate tasks, and dispatch resources.

The ITU Radio-communication sector Report (ITU-R M.2377) discusses the broad objectives and requirements of PPDR applications, including the increasing use of broadband technologies to meet those objectives and requirements [2].

II. ROBUST, RELIABLE AND INSTANTANEOUS COMMUNICATIONS

Whether used in responding to a simple traffic accident, or a petrochemical refinery fire, the communications systems need to be robust, reliable and instantaneous. At present, most of the PPDR radio-communication networks are based on narrowband land mobile wireless technologies such as APCO-P25 or Terrestrial Trunked Radio (TETRA). These narrowband networks are built for mission critical voice communication, support instantaneous push-to-talk group and device-to-device communications but have limited data capabilities. WRC-2003 adopted Resolution 646, last revised at WRC-15 to harmonize the spectrum needed for such systems on a regional basis.

III. REAL TIME -- AN URGENT REQUIREMENT

With the explosive growth and proliferation of smart mobile phones supported by broadband with high speed internet access, video and real time social media in the hands of general public (and criminals), PPDR agencies have realized an urgent need to access broadband data, social media and mobile videos in real time. In particular, high-resolution videos from the scenes of disasters or other major events are becoming increasingly critical for real-time situational awareness and intelligence-driven decisions.

New PPDR applications using real-time mobile video are helping detect and prevent criminal and other unlawful activities as well as supporting effective response to disaster events. The fusion of artificial intelligence, mobile videos and big data technologies is enabling video content analytics that support detection, tracking, extracting and identifying people, objects and their attributes.

Such advanced PPDR applications are already supporting crime prediction and crime prevention. Mission critical integrated voice and video conversations integrated with information on the location of emergency responders, real-

time updates on public transport movements and even social media activities are helping PPDR agencies in responding to major events.

Mobile broadband PPDR networks could also enable fingerprint sensors to identify criminals or victims at the scene of an incident, saving valuable time and gathering vital intelligence in the moments that matter.

These networks can also enable live feeds from traffic cameras or drones, or the use of number-plate recognition in real time to track and intercept suspects before members of the public are put at risk.

IV. HARMONIZING SPECTRUM

Timely availability of harmonized radio frequency spectrum is important for realizing dedicated broadband PPDR networks. The ITU World Radiocommunication Conference 2015 (WRC-15) revised and updated Resolution 646 (Resolution 646, Rev. WRC-15) to harmonize spectrum needed for broadband PPDR on a global as well as regional basis. The frequency range 694-894 MHz was adopted by WRC-15 as the globally harmonized frequency range for broadband PPDR. This frequency range includes the most commonly used PPDR bands in 700 MHz (3GPP bands 14, 28 and 68) and 800 MHz (3GPP bands 5, 20 and 26).

In order to develop the new features and applications required by PPDR users such as Mission-Critical Push To Talk (MCPTT), MissionCritical Data (MC Data), Mission-Critical Video (MC-Video) and Device-to-Device (D-to-D) communications, the Third Generation Partnership Project (3GPP) has created a working group (System Architecture SA6) [2]. The applications are progressively being built into IMT (see Report ITU-R M.2291) technology, starting with long term evolution (LTE) release 13 and continue to evolve and mature in specifications of Releases 14, 15 and 16, and going into IMT-2020 [3].

V. CHALLENGES

As broadband data rapidly becomes a necessity for PPDR users, many governments around the world are faced with the challenge of how to establish broadband PPDR communications. Building new PPDR infrastructure for the coming decades requires radio spectrum resources, financial resources, infrastructure sharing of towers and sites, right-of-way rules and decisions on a governance model to be followed, as PPDR users historically belong to multiple agencies and operate under different jurisdictions. Broadband PPDR networks must meet the operational and functional requirements of PPDR agencies and be robust, secure and have the geographical coverage and capacity to provide mission-critical broadband services, such as real-time video communications and real-time data.

A number of countries have already implemented dedicated broadband PPDR networks. Others have dedicated harmonized spectrum for PPDR and a contracted service provider to build and operate the networks for them. Few have opted for commercial carriers to provide them infrastructure as a service (IAAS) against longterm contracts and operational requirements with specific quality of service norms.

VI. PUBLIC SAFETY AND THE 700 MHZ BAND

The First Responder Network Authority (FirstNet) nationwide public safety LTE (PS-LTE) network [5] in the United States, in the 700 MHz band, is the first example of a large broadband PPDR data network to supplement the country's statewide P25 narrowband mission-critical voice network that equips first responders to save lives and protect communities. A nationwide LTE network in the 700 MHz band is also being implemented in South Korea to supplement its existing TETRA mission critical voice network. Similar networks are under implementation in many countries around the world including the Emergency Services Network (ESN) in the United Kingdom, and similar networks in the Middle East and some Asian countries.

Modernizing and transforming PPDR operations to respond to evolving challenges requires substantial investments in infrastructure, work flow, systems and applications. Regardless of the approach chosen, the availability of funds to deploy, maintain and secure a PPDR capable infrastructure requires government planning for funding and securing and policy decisions in a stable regulatory environment. Mission critical intelligence and real-time data analytics and multimedia dispatch capabilities are becoming just as important as push-to-talk voice in responding to PPDR agencies communication needs.

In the coming years, LTE-advanced and 5G networks will enable enhanced mission critical applications requiring ultra reliable low latency and high mobility designed to meet the high demands of mission critical video and data by the PPDR agencies.

The ITU Radio-communication Sector (ITU-R) is also working towards defining the future role of IMT-2020 to support PPDR applications.

VII. RADIO INTERFACE STANDARDS FOR PPDR

The ITU Radio-communication sector's Recommendation M-2009-2 identifies radio interface standards applicable for PPDR operations [6] in accordance with Resolution 646 (Rev WRC 15). The broadband standards included in the Recommendation are capable of supporting users at broadband data rates taking into account the ITU definitions of 'wireless access' and 'broadband wireless access' found in ITU-R F.1399 [7]. The Recommendation addresses the standards themselves and does not deal with the frequency arrangements for PPDR

systems, for which a separate Recommendation exists, namely ITU-R M.2015 [8].

These standards are based upon common specifications developed by Standard Development Organizations (SDOs). Using this Recommendation, regulators, manufacturers and PPDR operators should be able to determine the most suitable standards for their needs.

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