Satellite Communications
A Canadian Perspective

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Canada has a long history in satellite systems spearheading many innovative applications and solutions both in terms of satellite communications and scientific instruments. From its debut with the Allouette program in the early 1960's analyzing radio frequency propagation from space, to the launch of the first domestic communication satellite, AnikA1, in 1972; the first Ku-band direct broadcast satellite in 1976, Hermes; the first commercial direct-to-home Ku-band service, Anik B, in the 1980s; founding partner of the COSPAS-SARSAT system in the mid 1980s; the development of key technologies that led to the launch of the first Ka -band satellite providing commercial Internet access to consumers in 2004. All of these are now considered landmarks in the history of satellite communications systems. With its rich knowledge and expertise, Canada continues to develop space technologies to bridge the digital divide providing communications means to communities and to outposts in remote and northern regions with ever increasing capacity for high speed multimedia services.

The Government of Canada has recently issued a Request For Information (RFI) to industry for the development, launch and operation of a satellite constellation in a highly inclined elliptical orbit. The program, named PCW for Polar Communications and Weather [1], will provide communications capabilities and perform meteorological observation services throughout the Arctic for the Canadian government and potential international partners. The satellites will provide communications to fixed and mobile earth terminals, maritime and aeronautical platforms in the X-band, Ka-bands (both military and commercial) as well as military UHF frequencies. PCW will complement the coverage and be interoperable with existing geostationary communications satellites which have limited reach into the Arctic especially for mobile platforms such as ships and aircraft. The weather payload on PCW will also provide meteorological data much needed for enhancing the understanding of the polar region influence on the overall global climate.

PCW communication service is intended to cover northern areas as shown in Fig. 1. The 24/7 coverage area extends from 65ºN to 90ºN latitudes (green circle in Fig. 1) with partial coverage down to 55ºN latitude. Since the potential coverage extends over Alaska, European Northern countries and into Russia, international partnerships are being discussed.

Advanced concepts using hosted payloads on satellites of opportunity are also being investigated to address the Canadian Forces military communication requirements in worldwide operations. In that regard, the Communications Research Centre Canada (CRC) is investigating new satellite communication terminal's technologies to address the multiple-bands, multiple-protocols challenges. Distributed, multi-frequency flat panel antennas and software defined radio (SDR) technology are very promising technologies to enable communications with government public safety organizations as well to consumers by linking civilian and public safety networks together in various bands through satellites.

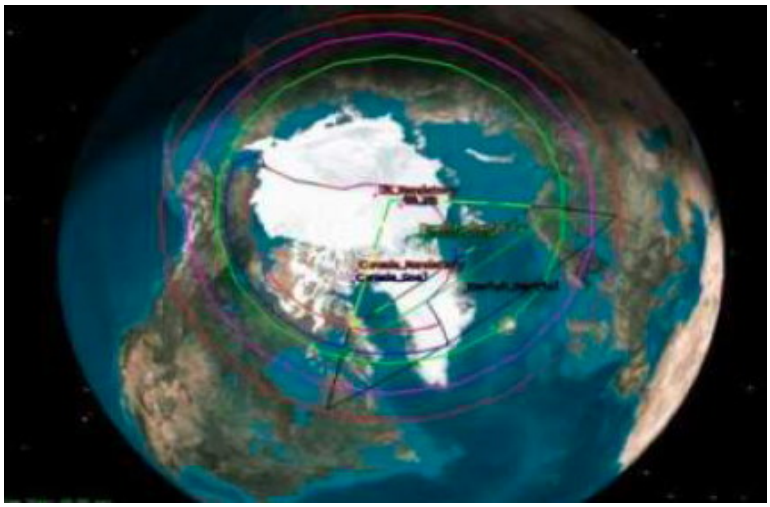

Fig.1: PCW communication coverage area [1]

What is next? The satellite community is contemplating the third generation of Ka-band satellites referred to as high throughput satellites (HTS) which will provide capacities on the order of one Terabits per second. To achieve this objective, Q/V band feeder link concepts and technologies are being developed enabling the use of the full Ka-band allocation to user terminals, albeit some regulatory impediments remain to be solved i.e., need for coordination between systems [2].

Today's mobile radio access is very different from the past when cellular technology was designed to address telephony needs when people were away from the wire line infrastructure. The current and upcoming designs of cellular systems need to provide broadband data communication to people via their smart phones, tablets and the like wherever they are (street, home, office, public areas, etc.) and whenever they need it. Some projections anticipate that an increase in capacity requirements by a factor of one thousand will occur by the end of the decade (see for instance [3]). Satellites will be an integral part of such networks, e.g., by providing backhaul services to remote/ low density population communities Long Term Evolution (LTE), WiFi or the like terrestrial access points or to mobile local area networks such as cruise ships, aircrafts, etc.. Satellites can and will play also an important role either as a direct link or as a backhaul link in the emerging field of machine-to-machine communications.

Research addressing the need for greater flexibility in satellite payloads, where capacity can be moved from one area to the other to address punctual regional requirements is being pursued [4]. It is expected that some of these concepts will start showing up in the commercial world at the beginning of the next decade.

There is a great role to be played by satellites when designed and casted properly in these upcoming broadband challenges and forthcoming new applications. R&D must continue to facilitate the introduction of new satellite concepts and technologies to serve the user's community.

[1] "Polar Communications and Weather (PCW) Project / Projet de Télécommunications et de météorologie en orbite polaire", November 1, 2013, https://buyandsell.gc.ca/procurement-data/tender-notice/PW-13-00535594

[2] PieroAngeletti, Riccardo De Gaudenzi, Emiliano Re, "Smart Gateways Concepts for High-Capacity Multi-beam Networks", AIAA ICSSC 2012 proceedings, Ottawa, Canada, Sept. 24-27, 2012.

[3] Jens Zander, "Challenge 2020: 1000 times more capacity at todays cost & energy", http://zandercom.com/wordpress/wp-content/uploads/Challenges2020_Yonsei.pdf

[4] "Proceedings of the 2nd ESA Workshop on Flexible Telecom Payloads", April 17-19, 2012, Noordwijk, The Netherlands.