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|  | Title: The cheapest way for network connectivity  |  |
| 1 | Introduction* Trade-offs among capacity, coverage, and quality in wireless network planning

When the wireless network is designed, there are some trade-offs between capacity including throughput/bandwidth, coverage, and quality-of-service (QoS). The spectral efficiency is also important for cellular network planning to optimize the overall construction cost of wireless network. When designing nation-wide network, the optical networks may be used to connect the geographical distances of each cellular wireless network. An optimal harmony between optical wireline network and cellular wireless network is required to configure a large-scale distributed network.In terms of quality-of-service of wireless transmission channel, there are trade-offs between error/loss, delay/latency, and throughput, etc. In situations of high error or high interference situations data packets can be transmitted hundreds to thousands of kilometres if they are encoded with long error correction algorithm. If data should be transmitted with very low latency of less than 10 ms, a large spectral bandwidth or multiple transmission channels are needed, even at short distances. * Advance of wireless technologies in terms of spectral efficiency and coverage

The spectral efficiency of recent 5G wireless technology is at least 2 times higher than that of the conventional 3G/4G technologies. By adopting more than 16x16 MIMO technology, the frequency bandwidth gain will be continuously increasing. Until now, the coverage of 3G/4G/5G wireless technology is designed for up to 5 km. The wireless coverage of IoT applications can be extended up to 10 Km. If lower frequency bandwidth less than 1 GHz is allocated, the coverage of wireless network can be easily increased. For example, if the latest wireless technologies are applied to existing AM/FM frequency bandwidth, current internet applications can cover hundreds to thousands of kilometres with the speeds of several Mbits/sec. Low-frequency wireless networks are efficient in rural or non-congested area. One interesting fact is that the latest wireless technology like OFDMA, when equipped with a variety of antennas, can be applied simultaneously to complex urban areas in large cities above 1 GHz, as well as rural area below 1 GHz. It means that the spectrum frequency allocation is a matter of coverage and bandwidth demands, it is not a matter which wireless technologies is selected. The lower frequency bandwidths of less than 1 GHz can be used to build the low-cost wireless networks, especially in areas where the optical wireline networks are difficult to construct. It notes that HF/VHF/UHF bandwidth mainly for broadcasting and communications should be reviewed whether the existing old applications should be maintained or not. In fact, the 2G frequency bandwidth used in the last 10 years is no longer in use. * Emerging demands on client/server and machine applications

Currently, network traffic mainly comes from client/server web applications such as SNS (social network services) including social media like Youtube. Recent network applications are expanding to include energy, transport, logistics and military applications. There are emerging demands for machine-to-machine and human-to-machine communications which are categorized as non-telco applications. Here, it notes that digital communication technologies can be used regardless of applications such as broadcasting (radio or TV), communication (mobile phones), client/server web and machine-to-machine (M2M) applications. * Problems of broadcasting and communication-oriented frequency allocation

Until now, the policy of frequency bandwidth allocation has mainly focused on AM/FM radio, broadcast TV and telecommunication. During last three decade, frequency spectrum has been allocated primarily for cellular wireless applications like 2G/3G/4G-LTE. Therefore, it is necessary to reconsider the current broadcasting and communication-oriented frequency allocation policy. It should be able to encourage the future demands of network applications. One interesting fact is that recent 5G applications are trying to include non-telco applications like industrial, agriculture, health/medical, transport and environment, etc.  |  |
| 2 | ProposalsWith considerations of future market demands and advances in wireless technologies, it is time to reconsider the existing frequency spectrum allocation policy. It notes that the frequency bandwidth allocation policy so far has been oriented from the perspectives of broadcasting and telecommunication. Most network operators are reluctant to deploy wireless networks with unlicensed frequency bandwidth since the widespread use of unlicensed frequencies is less benefit to the carriers. Only public organizations or science/research institutions are trying to be interest of usage of unlicensed frequency spectrum. Moreover, wireless network required in energy, transport, and environmental applications are invisibly forced to use licensed frequency bandwidth of carriers. Therefore, this contribution proposes to develop the analysis table of wireless technology in terms of frequency spectrum and applications. If ITU including governments get some consensus of rearrangement of the frequency spectrum, new emerging markets for very low-cost network connectivity could be accelerated. Also, it can maximize the frequency efficiency as a public resource used by people around the world. Future advances in wireless communication technologies will create new global market where anyone in the world can use the network in the cheapest way. |  |