Wireless Big Data

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Abstract Wireless and big data are hot research topics in the communication and information community. Wireless technology has grown tremendously reaching across the globe and touching almost everyone on the planet. Big data refers to large data that is generated in complex systems and is growing rapidly and expanding in all science and engineering. Wireless big data integrates the traditionally separate two areas. This paper provides a brief introduction to wireless big data.

Keywords wireless big data, mobile big data

Introduction

The masssive growth in mobile networks, cloud computing, and social networking has ushered in the so-called big data era. Large data volumes are generated on daily basis at unprecedented rate from heterogeneous sources such as social networks, healthcare, government, marketing, and financial institutions. Data that originate from wireless devices and networks (such smart phones, cellular networks, sensor networks, vehicle networks, etc.) constitutes an important source of big data. Thus, wireless networks play an important role in big data generation and processing.

Big Data Characteristics

Big data refers to massive amount of data that are so large that traditional processing tools cannot cope. It is produced by emails, online transactions, medical records, etc.

Big data is characterized by the 5Vs: volume, velocity, variety, veracity, and value.

- *Volume:* This refers to data sets of extreme size (e.g. exabytes, zettabytes) which are beyond the capability of the commonly used software tools.
- *Velocity*: Data are generated and processed in a fast way to extract useful, relevant information. Big data could be analyzed in real time and it has movement and velocity.
- *Variety*: This refers to the fact that big data originate from heterogeneous sources and is in different formats (e.g., videos, text, logs).
- *Veracity*: This suggests that the data is available from a reputable and trustworthy origin..
- *Value*: This refers to the process of discovering hidden values from large datasets.

Big data involves situation where the data is too big, too fast, or does not fit the regular database architecture. It may require different strategies and tools for profiling, measurement, assessment, and processing.

The process of examining big data is often referred to big data analytics. It is an emerging field since massive computing capabilities have been made available by e-infrastructures. Analytics include statistical models and other methods that are aimed at creating empirical predictions. Data-driven organizations use analytics to guide decisions at all levels [1].

Wireless Big Data Features

Big data in the 5th generation (5G) wireless communication system is complex and challenging [2]. A framework for wireless big data is shown in Figure 1 [3]. As evident from the figure, the framework consists of four layers: data, transmission, network, and application layers. In the data layer, wireless big data exhibits spatial-temporal dimensions. It is a high-volume, high-velocity, and high-variety information that requires special information processing tools. It is distinguished by its unique multi-dimensional, personalized, multi-sensory, and real-time features as illustrated in Figure 2 [4]. In the transmission layer, wireless channels are responsible for conveying the information sent from the transmitter to the receiver. Wireless communications show unique advantages over wired communication, such as cost efficiency and flexibility. Wireless network virtualization ensures big data transmission in a wireless network environment. In the network layer, transmission optimization through big data could be implemented. The network layer is perhaps the most investigated area in wireless big data. Potential applications of wireless big data include smart grids, Internet of Things (IoT), mobile computing, and unmanned aerial vehicle (UAV).
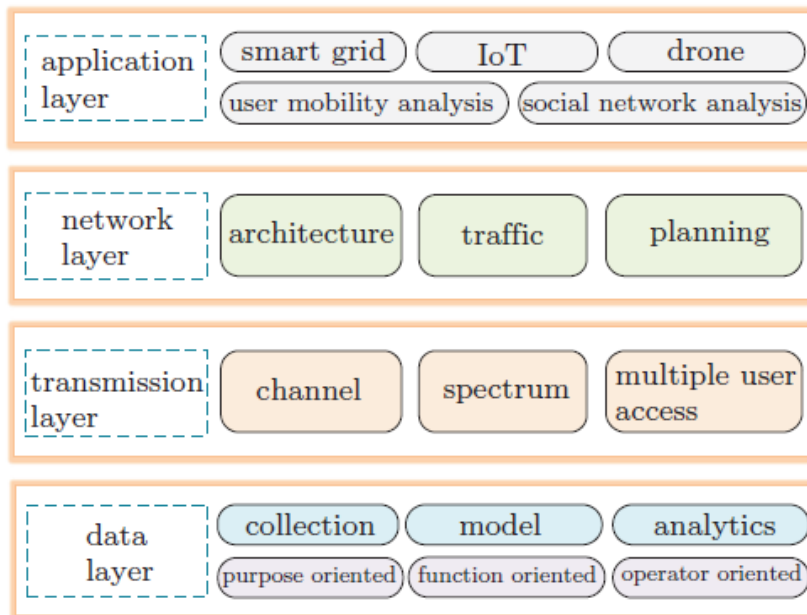

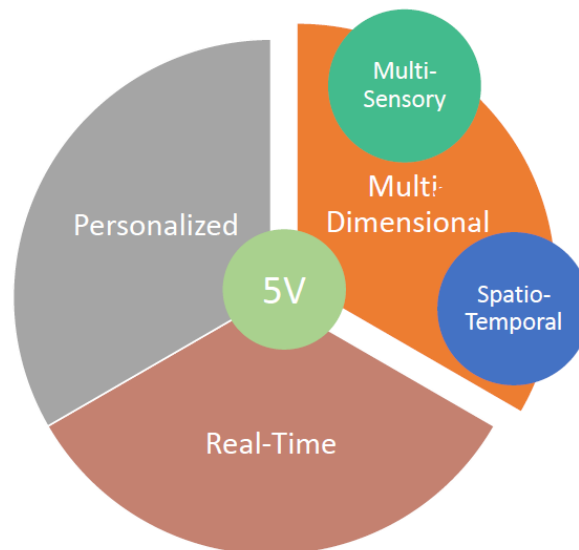*Figure 1: A framework for wireless big data [3]*

Figure 2: Unique features of wireless big data [4].

Applications

Wireless big data has received a lot of attention in various applications. It finds applications in smart grid networks, network security and privacy, mobile cloud computing, resource optimization, network visualization, and social media.

- *Smart Gird*: The smart grid is emerging as a promising technology meant to cope with the energy efficiency problem and integrate renewable energy in the grid. The data produced in smart grids exhibits the 5Vs characteristics of big data. Research and development on smart grids are conducted by utility companies, university communities, and standards bodies [5]. The smart grid can be divided into three major domains: the home area network (HAN), neighborhood area network (NAN), and wide area network (WAN). Wireless technologies for HANs include Zigbee, WiFi, and cellular networks [6].
- *Internet of Things* (IoT): This is another possible application of wireless big data. Among smart cities constructed based on IoT, big data may come from home, industry, government, etc. Due to the variety of objects involved, this application is endlessly evolving.
- *Wireless Body Area Network* (WBAN): This is used for monitoring pervasive health care. It generates a very high volume of heterogeneous unstructured data (text, video, and images). Processing clinical data involves intensive computing. Harnessing big data for WBAN application is reliable and cost effective. It reduces the processing of the heterogeneous clinical data [7].

Challenges

There are a number of challenges that need to be addressed before such real-time wireless big data applications become feasible. Processing a large scale of data is a great challenge. Big data is a problem for many organizations because current data processing technologies cannot process big data effectively.

Other challenges facing wireless big data include safety, privacy, and security. This is of major concern due to the variety and heterogeneity of data, increased attack, and grave consequences of breaches. Privacy concern arises continue from the users who out- source their private data into the cloud storage. This concern has become serious with the development of big data analytics, which require personal information [8].

Some of the major obstacles of wireless big data signal include processing and network design with respect to the scale of problem size and the complex problem structures. In spite of these obstacles wireless big data is not only promising but also inevitable in view of the persistent data volume explosion [9].

Conclusion

The evolution of the wireless communication has radically changed the nature and socialization of human communications. This technology is expected to meet the emerging wireless big data transport, which significantly challenges the current network management and control architecture. Dealing with spatial big data will be a major challenge for many future wireless networking applications [10]. The technologies relating to wireless big data (such as 5G, cloud computing, network virtualization, software-defined networking, etc.) require multi-disciplinary and joint efforts from governments, industries, and academics.

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