SCIENCE CHINA
Information Sciences

March 2023, Vol. 66 130300:1–130300:2
https://doi.org/10.1007/s11432-023-3704-8

• EDITORIAL •
Special Topic: Spectrum, Coverage, and Enabling Technologies for Intelligent 6G

Toward ubiquitous and intelligent 6G networks: from architecture to technology*

The sixth-generation (6G) network is envisioned to support growing Internet connections with the requirements of higher transmission rate, higher reliability, lower latency, etc. While conventional methods are hard to meet such demands, the newly emerging technology, artificial intelligent (AI), is a promising way to empower the 6G communication system. In recent years, there has been a growing number of researches on intelligent 6G, including wireless technologies using full spectrum and enlarging coverage. Besides, edge learning, reconfigurable intelligent surface, and cell-free technology have been proposed as significant enabling technologies for intelligent 6G. To promote the research in this area, we have organized a special topic on spectrum, coverage, and enabling technologies for intelligent 6G in *SCIENCE CHINA Information Sciences*.

Edge learning is a typical emerging research area in the future 6G era, which proposes a stringent demand on latency, reliability, and capacity. One way to accommodate this requirement is to apply integrated sensing, computing, and communication (ISCC) technology. In the contribution entitled "Pushing AI to wireless network edge: an overview on integrated sensing, communication, and computation towards 6G," Zhu et al. provide a comprehensive overview on ISCC towards AI applications by introducing representative works on the three application scenarios, i.e., centralized edge learning, federated edge learning, and edge inference.

Full spectrum is a key technology for supporting ubiquitous connectivity and realizing Tbps-scale data rate in 6G wireless networks. In the contribution entitled "SpectrumChain: a disruptive dynamic spectrum-sharing framework for 6G," Wu et al. introduce a blockchain-based dynamic spectrum sharing (DSS) framework. By utilizing the advantages of blockchain decentralization, transparency, and traceability, the spectrum provider and requestor can fulfill spectrum sharing without any third proxy. Furthermore, the authors propose a hierarchical blockchain DSS framework to exploit wider spectrum and achieve lower latency. Currently, the research on blockchain-based DSS is in the preliminary stage, more research efforts on blockchain-based DSS should be required.

6G satellite-terrestrial integrated network (STIN) is promising for the improvement of wireless coverage. In the contribution entitled "Coverage enhancement for 6G satellite-terrestrial integrated networks: performance metrics, constellation configuration and resource allocation," Sheng et al. focus on improving the wireless coverage capability in 6G STINs, and summarize the performance metrics and critical technologies of service coverage structure. They investigate the impact of satellite constellation configuration and present a suitable network structure. Besides, intelligent resource scheduling and satellite-terrestrial collaborative computing are studied, followed by the research challenges and future directions.

Reconfigurable intelligent surface (RIS) has been recognized as an essential enabling technology for 6G networks. In the contribution entitled "Reconfiguring wireless environments via intelligent surfaces for 6G: reflection, modulation, and security," Xu et al. elaborate on two functions of RIS, i.e., reflection and modulation, as well as their benefits to wireless communication systems. In addition, the authors also propose a typical case study to exemplify the benefits of RIS for secure communications.

Cell-free massive MIMO (CF-mMIMO) is considered as a key technique to help realize extremely high spectral efficiency and ultra-reliable low-latency transmission for 6G. In the contribution "Full-spectrum cell-free RAN for 6G systems: system design and experimental results," Wang et al. propose a full-spectrum cell-free radio access network (CF-RAN) architecture to balance performance and complexity. Key transmission techniques, including channel information acquisition, transceiver design, and dynamic resource allocation, are introduced to support the full-spectrum CF-RAN. In addition, experimental

*Citation Xu W, Huang Y M, Wang W, et al. Toward ubiquitous and intelligent 6G networks: from architecture to technology. Sci China Inf Sci, 2023, 66(3): 130300, https://doi.org/10.1007/s11432-023-3704-8

results of a prototype system are presented to demonstrate the superior performance of the proposed architecture.

In addition to research on enabling technologies, there are also a growing number of theoretical researches related to intelligent 6G. In the contribution entitled "6G extreme connectivity via exploring spatiotemporal exchangeability," You reveals that the requirement of extremely low-latency communication in 6G results in a phenomenon called channel capacity collapse effect. Based on the spatiotemporal exchangeability theory of MIMO channels, spatiotemporal 2-D channel coding is discussed under rich and sparsely scattering channels. It is expected as a promising approach to enable 6G extreme connectivity.

Guest Editors:
Wei XU
Southeastern University, China
Yongming HUANG
Purple Mountain Laboratories, China
Wei WANG
Huazhong University of Science and Technology, China
Fusheng ZHU
Guangdong Communications & Networks Institute, China
Xinsheng JI
Information Engineering University, China