

Preface I

Nokia is proud of its strong relationship with China Mobile. The author, Mr. Li Zhengmao, was inspired to think through some of the key issues that our industry faces during a visit to Finland in 2015. The results of Mr. Li's endeavors are outlined in this perceptive and insightful book.

Mr. Li summarizes the journey that the telecommunications industry has travelled, from analog, to digital, to IP, and predicts that future communication networks will combine both IT and telecommunications to become "telecommunication 4.0". The author elaborates on the key technologies that "telecommunication 4.0" will require, and reflects the demands and trends of future communications networks.

At Nokia we have risen to the challenges that "telecommunications 4.0" will bring. We also see a world where the network is growing in importance as data traffic increases, and the internet of things and the promise of 5G create new network requirements, new use cases, and new business models. The ten year work program that Bell Labs has undertaken shows what will be required, and we have worked on the technologies needed for this new world. To build on this momentum requires a scalable, responsive, programmable network with lower latency and faster speeds.

The integration of the IT world and the telcom world, as the author describes, will allow these requirements to be met. By combining new approaches and innovative technologies like Network Function Virtualization, Software-Defined Networking, and edge cloud interfaces, mobile operators will be able to re-imagine how connectivity can be used. At Nokia, we have not stopped there, we are looking further at new spectrum, and new business models, in order to ensure that the network is not merely an add-on, but an enabler—allowing operators, individuals and enterprises to make the most of the opportunities ahead of them.

At Nokia, we are inspired by the potential of these opportunities. Our vision is to expand the human possibilities of the connected world. We believe that this programmable world will have revolutionary consequences for us all, and that the network will be nothing less than the fabric of our connected lives. Nokia will continue to collaborate with China Mobile as we look to make this vision a reality. I urge you all to read Mr. Li's book, and think deeply about how you too can contribute to this important work.

Helsinki, Finland

Rajeev Suri
President and CEO, Nokia

Preface II

There are very few people who know the China's telecommunications industry better than Mr. Li Zhengmao. Mr. Li is the rare expert, who has both an academic background as well as having held a variety of senior positions in the largest telecommunications companies in China.

His engineering background and business acumen exceeds most in this highly competitive industry and he has seen tremendous change from a theoretical as well as an practical view.

The new perspectives used by the Mr. Li show his immense knowledge of the topics and sheds new light on the future of China's Telecommunications industry.

Mr. Li's description of the technology evolution and the Telecommunication 4.0 era is an early view of the industry will develop. By looking back at the history of the telecommunication industry, Mr. Li predicts future developments for Telecom Operators specifically and generally the Telecom Industry. Focusing on the future of the Telecommunication industry, the author outlines a blueprint, which will provide, in his opinion, a more open, converged and virtual path for the future.

I think that the era of Telecommunication 4.0 will impact the whole industry profoundly. It will bring more opportunities to companies in the CT/IT industry chain and trigger the restructuring of it. Internet companies and all telecom companies will continue to be interdependent on each other in order to compete in the market place. And China will accelerate the transformation of the industrial structure that drives one of the globe's greatest industries.

Mr. Li has made a great contribution to the telecommunications industry by writing this book. His thoughts and suggestions on a way forward will be studied and examined by academics and professionals alike.

USA

Craig Ehrlich
Chairman of GTI

Preface III

The emergence and development of a technology era do not merely rely on technical progress. The commercial environment and social civilization during the same period both affect technology. Therefore, practically, the Telecommunication 4.0 concept is the absolute consequence, with IT deepening into the CT industry in the current social industrial wave. For quite a long time, due to the fast development of the Internet industry, the communication industry fell into anxiety and there were doubts about whether the industry had a future. Under this circumstance, we should calm down and analyze the history, environment and general trend. The book, Telecommunication 4.0, illustrates the history of the communication technology development, explores the trends and summarizes the experience, which projects the prediction of the new systems and technologies. At the same time, the book also pays much attention to how to reverse the operation dilemma and how to reshape and form the industrial environment for the telecommunication industry. The book also highlights what is being popularized and what is happening, such as SDN and NFV, as well as the predictions for the industrial environment and commercial wave.

Telecommunication 4.0 created a new era for the development of communications networks and also offered an important opportunity for China to reshape the network system and international criterion segment. The orderly operation of human society depends on a series of rules and norms. Those who own the authority to set rules boast the capacity to improve the progress of society. Scientific research strength is the foundation to set scientific and technological criteria. However, in the past several technological revolutions during the world's modern history, China always acted as a learner and western science and technology were all along the most significant innovative origins. Therefore, western scholars have all along occupied the dominant positions in setting up scientific and technological criteria. The communication industry also faces this kind of embarrassing situation. China has more Internet users and mobile phone users than the rest of the world. But China applies communication criteria which are formulated mainly by European and American manufacturers. In order to change this situation, the Chinese communication industry strives to make headway. In recent years, in the

new revolution of communication technology, China has been narrowing the gap between itself and the most advanced levels in the world. Especially, the fourth generation of mobile communication technology (4G) of TD-LTE independently developed by China has become international criteria, marking that China has reached advanced level in the world in the field of wireless communication technology.

Compared with the success we achieved in wireless communication system, China is still learning from other countries in core technologies, though the network system we own is the most advanced and the largest in scale, with the consequence that we hardly have any words in the network-system criteria. The international criterion, no matter how advanced it is, after all, cannot meet the need of the Chinese telecommunication network. If China builds its telecommunication network in accordance with western criteria, it will certainly bring about more operation costs and a large amount of customized requirements, a situation which would embarrass the Chinese telecommunication industry all the way. Therefore, for a long time, Chinese scholars have made painstaking efforts to research and explore, resulting in an abundance of inspiring works and experience. However, the future direction of network system development is hard to predict due to the complexity of the network system as well as constant changes of technologies and commercial development. Therefore, it will never be outdated to discuss this issue. The book, *Telecommunication 4.0* deeply analyzes current condition of the telecommunication industry, with a purpose to figure out the direction of research and exploration of network technology. All of this will make great contributions to establishing the Chinese network criterion system.

Telecommunications 4.0 is already on the way, and the Chinese telecommunication industry is striding forward to the future.

Beijing, China

Houlin Zhao
Secretary-general of the International
Telecommunication Union (ITU)

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Telecommunication 4.0

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