What is the future of the Internet?

How can appropriate network investment and the allocation of spectrum be ensured and the increasingly complex demands for (local) cloud computing and differentiated traffic delivery be met in a future Internet? And how should issues related to privacy and security be addressed? As the Internet ecosystem rapidly evolves and fixed and mobile broadband access technologies are converging, content and application delivery via cloud-based server infrastructures operated by hypergiant firms are shaping how the majority of Internet traffic is delivered and broadening the array of content that is available. In a recently published book - [The Future of the Internet: Innovation, Integration and Sustainability](#) – which was edited by Günter Knieps and Volker Stocker, leading international experts in the field, many of them active in the ITS community, have sought to shed light on a number of highly relevant aspects related to the dynamics of the future Internet.

In her chapter, Iris Henseler-Unger discusses emerging challenges associated with the industrial Internet of Things (IoT) and the 'Industry 4.0'. In doing so, she explains not only the nature of investments in very-high capacity networks, but also how telecom providers will have to assume a new role. Through its growing pervasiveness and the widening scope of services that it encourages, the IoT is creating a complex set of demands for service delivery. Günter Knieps begins to illustrate the challenges that networks operators face. He explores how virtual networks enable to efficiently meet these demands based on the orchestrated use of traffic differentiation to deliver required Quality of Service (QoS) levels, (local) data processing and cloud computing and geo-positioning. As the IoT, however, gives rise to a broad range of use cases, the assessment of their respective business case viability is important but also not without its difficulties. To do this, Marlies van der Wee and her colleagues propose a conceptual framework that identifies a series of parameters to guide the decision on whether or not an IoT service should be deployed. Business model innovation in the broader context of 'blue oceans' in IoT is examined by Bert Sadowski and his co-authors in an empirical patent-based analysis. They examine the relationship between technological diversification and performance.

When it comes to a deeper understanding of the hierarchies and bargaining power within the current ecosystem, interconnection markets, cloud and content delivery platforms, as well as broadband access service providers must be analysed. Falk von Bornstaedt describes the evolution of interconnection and the possibilities for cooperation between different actors (i.e., CDNs and ISPs) that are typically vertically related. The analysis of interaction between Internet layers then continues in Volker Stocker, who describes how cross-layer optimizations and subsequent integration as well as a localization of traffic constitute trends that shape the current interconnection ecosystem. These can – at least in some scenarios such as the delivery of cacheable media content – reduce or eliminate the performance-relevance of interconnections. Such ecosystem evolution emphasizes the role of complementary innovation at different levels.

The many facets and role of complementary innovations are described by Johannes Bauer. Not only does he emphasize the role of institutional diversity and the periodical reassessments of existing regulations but also the need for a nuanced understanding of regulatory differences and path dependencies. He also calls for new methods to analyze the complex interaction between interdependent innovations in the evolving ICT sphere. An emerging technology that stands at the core of a vision that relies on such complementary innovations is 5G. As William Lehr explains, not only spectrum but also the softwarization and virtualization of networks and (local) cloud computing constitute essential components to efficiently meet the complex demands that arise in 5G-based networking.

When it comes to smart networks that are capable of efficiently meeting the complex and dynamically changing demands that arise, flexible and adaptive traffic management is becoming increasingly essential. Christopher Yoo and his co-author examine the tension between network neutrality regulations that constrain the entrepreneurial flexibility of network management practices with the growing need for such practices in 5G-based service provision. They argue in favor of a flexible regulatory framework that provides room for innovative traffic management strategies and thus fosters innovation. Focusing on the current regulatory framework in the EU and its stance on zero-rating and traffic shaping practices, Thomas Fetzer also emphasizes the need for entrepreneurial innovation to be possible.

The contributions in this book provide an appreciation of the complexity and diversity of the current ecosystem and the forces that drive its evolution. They also provide a more nuanced understanding of the nature and role of innovation and its integration in the current ecosystem. From a policy perspective, it becomes clear that regulations that are capable of striking the balance between preventing harmful behaviour while fostering desirable innovation must be based on a deep understanding of the complexity, diversity and evolution of the ecosystem. Path dependent and static regulations that are oriented at legacy telecom regulations need to be made more flexible to enable workable innovation systems and efficient investments in, and allocations of, network resources. This becomes particularly evident in the network neutrality debate. Network neutrality and thus non-discrimination in the Internet is not easy to define, nor for that matter is it static. Instead, it presents a moving target and should be interpreted as a dynamic and adaptive concept. What this book demonstrates is the relevance of multi-disciplinary research to understand the complex and dynamic nature of the Internet.

Dr Volker Stocker
Weizenbaum Institute for Internet Research, Berlin, Germany