Chapter 12
Next Generation Networks: A New Digital Divide?

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ABSTRACT

At present there is no one definition of the term 'International Digital Divide'. It is often defined in different ways, but nevertheless, factors that influence its definition include access to telecommunication lines, the ratio of internet hosts to GDP, and the level of development of the human capital base. The lack of a clear definition will have knock-on effects in the loan documentation of aid agencies involved in infrastructure development and capacity building. However, a clear definition of the divide could help to focus and better target the necessary investment to help address the inequalities the divide attempts to capture, particularly with the rollout of NGNs. This paper attempts to (a) provide a brief overview on the rise and structure of the internet and evolution to Next Generation Networks, (b) set out basic indicators of the Digital Divide and clarify the significance of these linkages, and (c) to review various definitions of the Digital Divide available in current literature so as to arrive at one new overriding definition.

1.1 INTRODUCTION

In the context of this paper, an international digital network is a network that provides connectivity to the backbone internet, the global infrastructure of links connecting Internet Backbone Providers (IBPs). As such when reviewing the international Digital Divide, we first need to understand how the internet developed in the first instance. The Author will not discuss the underlying development in technology or of the management of the *domain name system* currently administered by the Internet Corporation for Assigned Names and Numbers (ICANN), but will focus instead on the main technological milestones that allowed the infrastructure of the internet to develop. In section

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1.2, the Author looks first at the emergence of the internet in the United States and the development of the two protocols that helped facilitate its growth, the *Transmission Control Protocol* (TCP) and the *Internet Protocol* (IP). Also, the Author looks briefly at other technologies that have helped to accelerate the development of the internet, such as the advent of Local Area Networks and fibre optic cable, and the migration of existing networks to NGNs. Section 1.3 discusses the linkages to the Digital Divide and in the concluding section 1.4, definitions of the international digital divide.

1.2 A Brief Overview of the Evolution of the Infrastructure of the Internet

The present day internet can be described as a "network of networks", but the catalyst for its early development was the desire of the academic community to enable computers to interoperate with each other. In 1965, the U.S. Defense Department's Advanced Research Project Agency (ARPA) funded the first computer network, the forerunner to ARPANET (the first wide area network). By the late 1960s ARPA was using a variety of electronic, computer and communications technologies, and a decade later, when computer networking was beginning to really take-off, the use of Local Area Networks (LANs) began to proliferate. A fundamental idea of ARPA's research was a new approach to interconnecting LANs and Wide Area Networks (WANs) that became known as the "internetwork", later abbreviated to the "internet". ARAPNET continued to grow steadily through the 1970s to include international connections to Norway and the UK, trans-Pacific connections to Hawaii, and domestic network of some 15-20 sites across the United States. In the early 1980s, the Personal Computer (PC) allowed intelligence in the network to move to local distributed networks (LANs), whereas up until this point, networks consisted mainly of dumb terminals directly connected to centralised mainframe computers on a time-share basis. Easy access to computers meant that there was a need to "scale-up" communications between these LANs (now consisting of intelligent terminals). One of the problems in achieving scalability was that much of the software used at the time by hardware vendors was proprietary and which prevented the portability of information technology between different hardware platforms. Cromer (1995) argues that this problem was overcome eventually through the development of UNIX as the first open source software, and also the development of *Open Systems Interconnection* (OSI) standards in 1984. The OSI standards set in place a common set of layers that designers could now build networks around and which would allow different hardware and software protocols to interoperate. Particularly important was the innovative Internet Protocol (IP) software, which provides basic communications, and the Transmission Control Protocol (TCP) software, which provides additional features that internet applications require (note however that both TCP and IP were invented in the early 1970s before the OSI standard was produced in 1984: TCP was invented by Vinton Cerf and Robert Kahn in the early 1970s and IP was established by 1978). Both IP and TCP work together to send data reliably across the internet: IP provides a set of rules as to how to present packets of information, allowing an interconnected set of networks to operate like a single large network. The current version of IP is IPv4, sometimes referred to as the "thin layer" due to the limited level of functionality that it provides, is limited in terms of *addressing availability* and also in its ability (or lack-off) to facilitate real-time applications. Every PC on a network is allocated an IP address (similar to a telephone number). As Cromer (1995) argues these addresses can be both dynamic (changing), or fixed depending on the type of network used. The Internet Engineering Task Force is working on a new version of IP (IPv6) that will