

Introduction

Bharti Airtel (Airtel) is a global telecommunications firm headquartered in New Delhi, India. With over 403 million customers in 18 countries across Asia and Africa, the company ranks globally in the top three mobile service providers by number of subscribers. The company offers 2G, 3G, and 4G/LTE wireless services, mobile commerce, residential broadband services, and enterprise business services. In India, Airtel is the #2 mobile network operator by number of mobile subscribers with 29% of the market (Telecom Regulatory Authority of India (TRAI), November 2018).

In 2015, Airtel launched Project Leap, a major network transformation program aimed at overhauling legacy networks and adding new spectrum and fiber to expand network capacity, improve service quality, and put in place a world-class and future-ready network. As a key element of Project Leap, Airtel is in the process of deploying new scalable and adaptive optical network infrastructure. Encompassing over 100,000 nodes with extensive use of next-generation ROADMs, Airtel's network will have the world's largest photonic control plane designed specifically to handle the unique challenges of network operations in India.

This paper explores the challenges and opportunities Airtel faced as it set out to redesign and expand its optical network footprint. It also touches on some of the new coherent optical technologies and architectures used in the new network design and the resulting benefits to Airtel and its customers.

Ciena, a global leader in optical networking, services, and software and a key partner of Airtel in the design and implementation of its next-generation optical network infrastructure, is the main sponsor of this report.

The telecom environment in India—Massive growth underway

As the second-largest country in the world by population with approximately 1.35 billion inhabitants, India is an important market for telecom infrastructure investment. Today, close to 98% of India's 1.2 billion total telecom subscriptions are for wireless services (TRAI, January 2019). Recent investment in India's 4G/LTE infrastructure, and the resulting wider availability of data services, has spurred massive growth in bandwidth demand in the country. Over the past five years, over \$2.8 billion has been invested in optical networking infrastructure alone in India, primarily in support of increased capacity for mobile broadband services (IHS Markit, 1Q19 *Optical Equipment Market Tracker*).

Opportunities driving network expansion for Airtel

Although much investment has been focused on the introduction of 4G/LTE services in India, 5G services are now on the planning horizon. 5G will drive the need for even more bandwidth capacity in dense urban metro areas and in the less densely populated rural areas, which are seeing higher growth rates in mobile subscriptions. The ability to address stringent requirements for latency and reliability will also be critical for the introduction of new 5G services.

The delivery of reliable networks to keep mobile network infrastructure up and running, meet customer service level agreements, and deliver a positive customer experience is no easy feat in India. The country has a very high incidence of fiber cuts and typically sees 50 to 300 times more cuts as compared to an equivalent geographical space in the US. As such, optical networks in India must be designed and built to operate with minimal downtime even with multiple faults present in the network at any given time. Alternate routes, quick identification, and restoration of services in the event of a fiber cut are critical capabilities.