Proposed iPASOLINK Large-Capacity Wireless Transmission System for a Saudi Arabian Mobile Telecom Carrier

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Abstract

In Saudi Arabia the spread of smartphone and tablet use has led to a rapid increase in the volume of high-speed data communications by mobile users and this trend is becoming an important issue. There is now a need to extend current systems by adopting LTE/LTE-advanced systems with large-capacity data transmission capabilities. As a result it has become an urgent need for the mobile telecom carriers to build communications systems that feature high speed and large capacity in order to meet the needs of subscribers.

NEC has prepared a solution that introduces the latest technological advances of the iPASOLINK series in meeting this need and to increase the functionality and capacity of the mobile backhaul system that connect the base and exchange stations. This paper introduces the large-capacity wireless transmission system that was proposed by NEC and was actually implemented by a Saudi Arabian mobile telecom carrier.

Keywords

PASOLINK, LTE-Advanced, large-capacity transmission, CAPEX reduction, RTA, 1588v2 (BC)

1. Introduction

The communication traffic in Saudi Arabia has recently been increasing rapidly following the popularization of smartphones and tablets. As the real-time communications of media contents, including movies and SNS (Social Networking Services) are fairly advanced in this country, the load imposed on the 2/3G/LTE mobile telecom carriers is quite a heavy one. Therefore, additional investment in the equipment infrastructures is required. It has become an urgent matter for the mobile telecom carriers and communication service providers to renovate their networks and to build suitable systems to support the large capacity transmissions.

In this paper, we describe our proposed optimum solution that makes use of NEC's iPASOLINK Series of large-capacity wireless transmission systems. NEC has previously been supplying these systems to support the mobile telecom carriers in cope with the increasing capacity and expansion of their mobile backhaul.We also discuss the introduction of our latest technologies that are being packaged with NEC products.

2. Case Outline

In June 2014, the mobile telecom carrier started to promote the campaign at 6,000 sites throughout the kingdom and procured equipment and the services via communications infrastructure vendors. The aim of this promotion was to renovate and extend their mobile networks. NEC joined this campaign by delivering and installing the iPASOLINK series of microwave communication systems for mobile backhaul.

More than 2.5 million units of the iPASOLINK series have been shipped, a figure that includes more than 100,000 units destined for Saudi Arabia. Although we have previously been engaged in the mobile backhaul construction of only a limited area, we have succeeded in acquiring areas that have previously been in the care of competitors, with the exception of those in the Riyadh district. This means that we have succeeded in occupying almost the entire area of the kingdom (about 5,700 links). The installation work is conducted by our local subsidiaries and partners from the link design stage to the site surveys, installation work and commissioning tests. When the construction of a site completes, an ac-

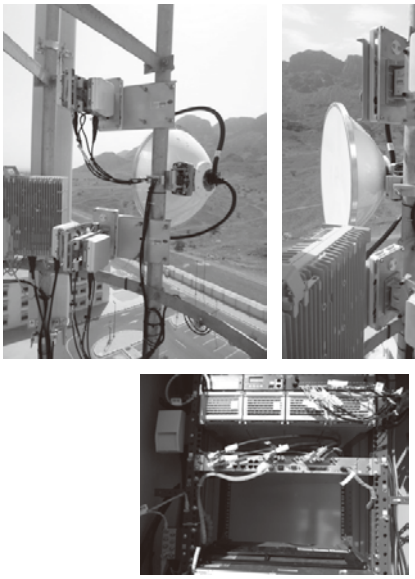

Photo PASOLINK system installation work.

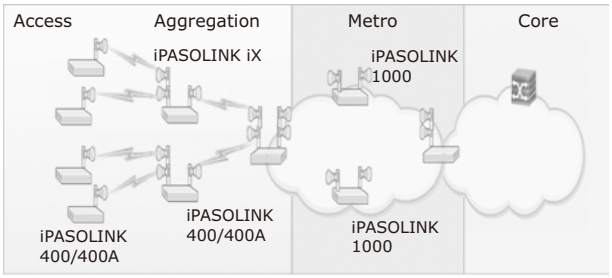

Fig. 1 Network of mobile telecom carrier (diagram).

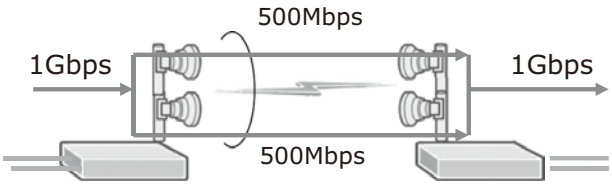

Fig. 2 Diagram of RTA transmission.

ceptance inspection is issued and signed by the telecom carrier before the services are started sequentially.

Photo shows images of iPASOLINK installation work at a typical site. Our service categories include the new installation, replacement of other manufacturer's equipment, upgrading of existing equipment and IBS (In-Building Solutions). The frequencies are from 7 to 38 GHz, and iPASOLINK of either the Split type or of the All Outdoor Radio (AOR) type is delivered as required.

3. Technologies for Large-Capacity Transmissions

The mobile telecom carrier currently uses 2G/3G/LTE system with a transmission capacity of 350 Mbps. The transmission capacity can specifically be broken down to 4 Mbps of the 2G, 21 Mbps × 2 channels × 3 sectors = 126 Mbps of the 3G and 220 Mbps of the LTE system. In addition to these, the rate of the LTE-Advanced is currently being extended to 500 Mbps, which is the reason the application of the large-capacity transmission technology that has now become indispensable for mobile backhauls.

Fig. 1 shows the network (image) of the mobile telecom carrier. We deliver many iPASOLINK systems to the districts, and they are mainly composed of iPASOLINK 1000 and iPASOLINK 400/400A. The iPASOLINK 1000 is used in up to 12 directions of the metro site, and iPASOLINK 400/400A is used in up to 4 directions of the access and aggregation sites.

As some sites do not have an indoor station facility, iPASOLINK iX AOR systems were deployed. iPASOLINK iX

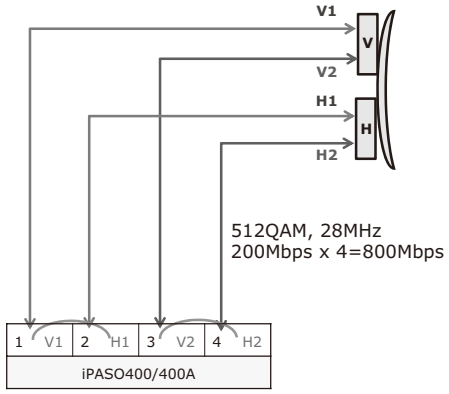

Fig. 3 4+0 iPASOLINK system configuration.

supports up to 2 directions and can meet the transmission capacity requirement of each access site by utilizing both the vertical and the horizontal polarized waves.

In the city street networks of the urban areas, we have introduced the RTA (Radio Traffic Aggregation), which bundles some wireless channels into a single virtual wireless channel for use in packet transfer. A diagram of RTA transmission network is shown in **Fig. 2**.

When the maximum transmission capacity per link is 500 Mbps, a transmission capacity of 500 Mbps × 2 = 1 Gbps can be achieved as shown in Fig. 2.

iPASOLINK VR10, which is the next-generation system being introduced sequentially, can bundle up to 8 channels, so that in the future it will be capable of dealing with the 10 GbE interface for high-speed packet transmissions.

In the actual link, 200 Mbps is achieved with a single

wireless channel, CS (Channel Spacing) of 28 MHz and modulation of 512QAM, so a transmission capacity of 4 × 200 Mbps = 800 Mbps can be secured (**Fig. 3**). Such a transmission capacity is attained by the use of both vertical and horizontal waves and the application of the RTA technology.

In addition, the ERPS (Ethernet Ring Protection Switch) is packaged in iPASOLINK. This IP packet transfer control function is for fast route switching in the case faulty detected. The ERPS is introduced in critical wireless link in order to secure the requisite high quality and reliability.

4. Proposed Optimum Solution with CAPEX Reduction

As the case introduced above was subject to compete with many vendor companies, the details of the proposal became one of the vendor selection criteria as well as of price. NEC has succeeded in reducing the CAPEX (Capital Expenditure) maximally and of effectively utilizing PASOLINK systems that had been delivered previously.

For the upgrading to the high-functionality version of iPASOLINK, we decided to use the existing ODU (Outdoor Units) and replace the IDU (Indoor Units). This procedure enables multi-directional communications and the wireless channels can be bundled for large-capacity communications.

The existing IDUs that are no longer required for the above are reused effectively in suburban sites and for sites that do not require large-capacity communications.

Implementation of transmissions using both vertically and horizontally polarized waves necessitates the use of suitable antenna for both polarized of waves. To reduce the CAPEX, we fit an adapter to each single-polarized antenna to convert it into an antenna suitable for dual polarized transmission. This procedure has eliminated the need to procure new antennas and contributes to the CAPEX reduction, particularly of the large antennas that necessitate high ocean transportation costs. **Fig. 4** shows the rear of an antenna on which an adapter is fitted.

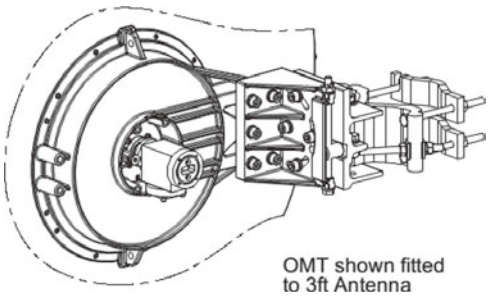

Fig. 4 Fitting an adapter to an antenna for both horizontally and vertically polarized waves.

Additionally, we also promote effective reuse of existing materials including cables and connectors whenever these are reusable.

5. Future Network Concept

The mobile telecom carrier in this case is planning an extension to the LTE-Advanced and introduction of the IEEE 1588v2 protocol featuring clock synchronization. IEEE established the IEEE 1588 precision time distribution protocol in 2002. In consideration of the advent of the age of LTE-Advanced, NEC is providing the latest iPASOLINK series products such as iPASOLINK VR10 and VR4 with IEEE 1588v2 (version 2) compatibility. For the iPASOLINK 1000, this can be migrated to iPASOLINK VR10 by modifying the main board and module. It is the flexibility of NEC's equipment designs that enables maximum use of existing equipment.

We have also developed the 4096QAM (Quadrature Amplitude Modulation) for the LTE-Advanced. This technology enables implementation of a transmission capacity of 1 Gbps or even greater.

In addition, in responding to the requests for increasing the mobile backhaul capacity, we are developing next generation system which is called LOS (Line Of Sight) MIMO (Multi-Input Multi-Output). By utilizing the MIMO technology, the transmission capacity of mobile backhaul can be increased. The configuration of the LOS MIMO system is shown in **Fig. 5**. The MIMO transmission utilizes both the vertical and horizontal polarized waves in a single frequency band. The resulting capability of reserving a 4X larger transmission capacity enables efficient frequency usage and large-capacity communications.

The mobile telecom carrier is also studying the introduction of the MIMO technology by anticipating that its high frequency utilization efficiency will reduce OPEX (Operating Expenditure).

6. Conclusion

In the above, we introduced our proposed technology for large-capacity transmissions using iPASOLINK prod-

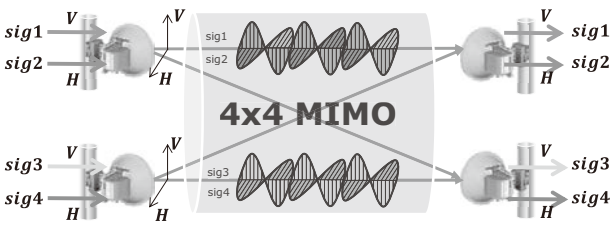

Fig. 5 4x4 MIMO transmission system.

ucts. We focused particularly on its introduction in the LTE-Advanced network of a Saudi Arabian mobile telecom carrier.

To meet the transmission capacity requirements of the LTE, the proposal adopts large-capacity wireless transmission technologies such as polarized wave transmission and RTA. At the same time maximum effective reuse of existing equipment and materials are utilized in order to reduce the CAPEX.

Next, we are considering the introduction of the 4096QAM and MIMO technologies by using iPASOLINK VR. This is to actualize wireless communications with larger capacities. This strategy is expected to contribute to increased capacity and qualitative improvements of the mobile telecom carrier networks.

* LTE is a registered trademark of the European Telecommunications Standards Institute (ETSI).
* Ethernet is a registered trademark of Fuji Xerox Co., Ltd.

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