

PASOLINK - Leading Mobile Backhaul Solution

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Abstract

In the long history of the wireless communications business of NEC, the demand for wireless communications has shifted significantly toward the cellular phone services since the latter half of the 90's. The associated infrastructure products have also shifted toward the commodity products and the competition in the market has recently become very severe. Even under these conditions PASOLINK business has made rapid progress by combined operations of development, production and sales, thereby making a major contribution to NEC's business achievements.

Keywords

PASOLINK, microwave communications system, cellular phone base station, backhaul network, PDH/SDH manufacturing innovation, global supply chain management (SCM), MONODZUKURI power, KANBAN system, production/sales integration

1. Introduction – What is PASOLINK –

“PASOLINK” is the brand name of NEC’s point-to-point and ultra-compact microwave communications system (Fig. 1). It is a wireless communications system providing the high speed digital communications circuits. It is indispensable in today’s cellular phones and digital data fixed line services and its scope extends over a very wide range of digital communication applications. In particular, the recent dissemination of cellular phone services has led to an increase in demand, especially from overseas, for use in high-quality, large-capacity digital communications lines interconnecting base stations. This trend has led to a rapid expansion of scale in this market.

- Definition
 - Point-to-point type, ultra-compact microwave communications system
- Applications
 - Very wide
 - Private data line for enterprises,
 - Access network for fixed equipment, etc.
 - The biggest demand is for the access circuits between wireless base stations of cellular phone systems.
- Features
 - Faster, more economic system construction than wired (optical cable) networks.

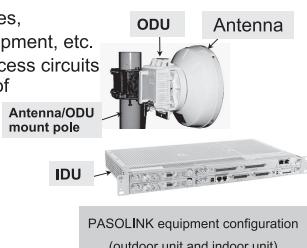


Fig. 1 What is PASOLINK.

As shown in Fig. 2, the market share of PASOLINK type microwave communications systems was in the 8th position in FY2000, but it has eventually achieved the world's top position with a share of 30.1% in FY2007 (Source: Sky Light Research survey).

1.1 History of NEC's Wireless Transmission Technology and PASOLINK

NEC has a long history of wireless transmission technology. We started R&D into microwave-based multiplex communications systems as early as 1935 and we were able to deliver a PTM (Pulse Code Time Division Modulation) wireless

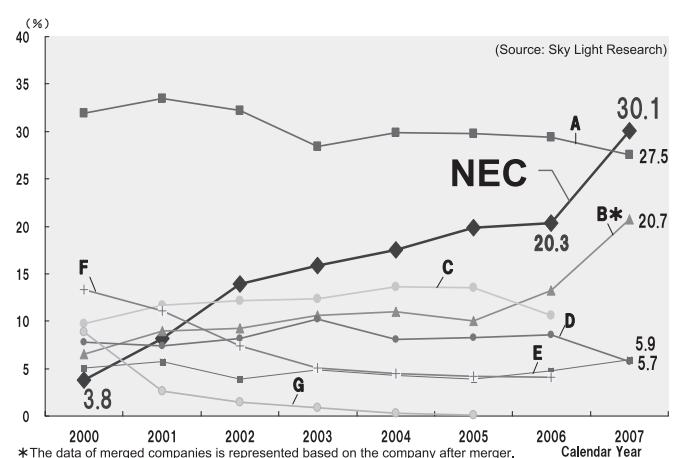


Fig. 2 Market share of PASOLINK.

microwave relay system to the Tohoku Electric Power Company in 1953. With regard to the overseas projects, we have led many worldwide projects to success following on our delivery of microwave communications system for India in 1956. In 1963, we succeeded in the practical implementation of a world-first fully solid-state microwave communications system, and it was in 1979 that we delivered a digital microwave communications system to an American telephone company affiliated to Bell.

PASOLINK was born as an enterprise oriented, private communications system in 1983, when the use of the 50GHz frequency band was licensed for simplified radio stations in Japan. We received the first overseas order for PASOLINK in 1987 from British Telecom. In the 90's, our deliveries grew in backhaul networks for cellular phone systems and for digital private network systems, mainly in Europe and in North American regions. In the 2000's, the demands from Asia, the Middle East, Russia, Latin America and Africa are increasing rapidly, by a far-reaching dissemination of cellular phone networks in these regions. As of the end of April 2008, we have achieved deliveries totaling 870,000 units in 134 countries (Fig. 3).

As seen above, PASOLINK is the fruit of more than 70 years of NEC's accomplished history of microwave communications technology.

1.2 Features of Microwave Communications Systems

The majority of the current applications of PASOLINK are in the backhaul network of cellular phones (Fig. 4).

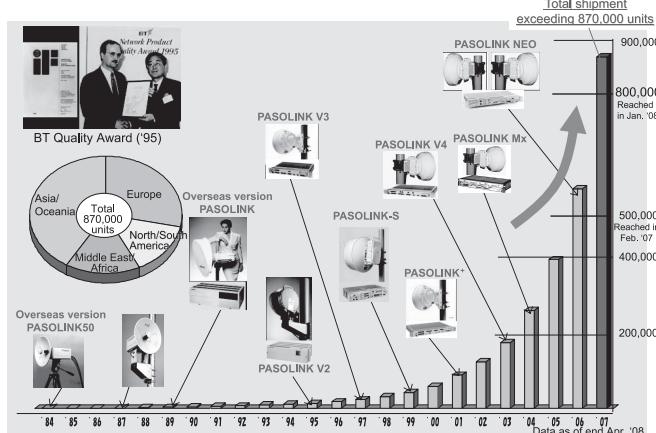


Fig. 3 History of PASOLINK menu development, supply record (accumulated).

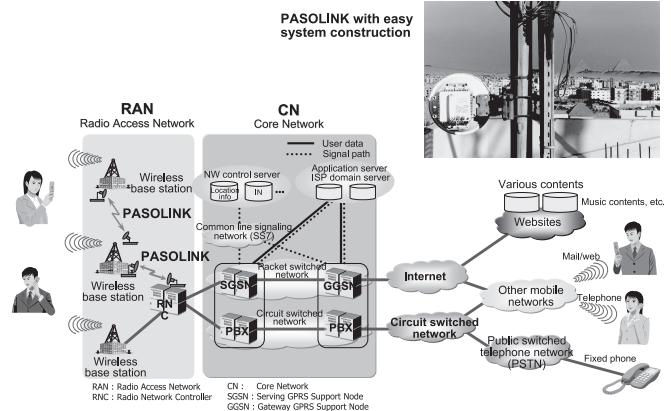


Fig. 4 PASOLINK used in cellular phone system.

The attractive features of the wireless communications systems including the microwave communications systems are independence from geographical features such as mountains and archipelagos etc., the short term system integration period at low cost, robustness against disasters, and tightness in security such as in the terrorism countermeasures that are recently increasing in importance. These features of wireless communications systems contribute to a swift and large scale network deployment in order to quickly acquire cellular phone subscribers. This factor is one of that promotes the rapid growth of the market.

1.3 Background to the World Leading Market Share

(1) Development as per Network Evolution

The backhaul networks for cellular phones are recently experiencing two major transformations. One of these is the "Swelling data volume," which is led by the introduction of new data services as represented by HSDPA (Hi-Speed Downlink Packet Access) and EVDO (Evolution Data Only) and to the application of flat rates tariff (fixed prices eliminating the upper limit of the data communication amount). The other aspect of the transformation is the "Conversion into IP networks" from the traditional TDM (Time Division Multiplexing) networks to IP networks. NEC reflected these two major trends in the development of the PASOLINK systems from a very early stage and released PASOLINK NEO in 2005 featuring full flexibility and a full IP native transport capability against the transformation in the backhaul network. PASOLINK NEO offers a single platform in consolidation with the previous products that

have been grouped into three series. These are PASOLINK V4 covering the PDH (Plesiochronous Digital Hierarchy) network of relatively small capacities, PASOLINK Mx covering PDH network with large and medium capacities, and PASOLINK+ covering SDH (Synchronous Digital Hierarchy) with larger capacities.

This unification of platforms has made it possible to cover various channel capacities and to provide various menus from TDM to IP for the base station interfaces, thereby providing very high adaptability to the evolution of networks (this will be discussed in detail in the next section). As a result, we have been able to implement products by foreseeing the requirements coming from the two transformations in the digital backhaul network of cellular phone operators. In addition, we have also been able to develop concurrent products that emphasize productivity improvements and cost reductions by keeping the actual production sites (GEN-BA) in mind.

(2) Manufacturing Innovation and the Global Supply Chain

In each process of the materials procurement, the logistics departments, and at the actual production site (NEC Wireless Networks, Ltd.), small working groups are effectively organized. These small working groups are unremittingly tackling improvement activities (KAIZEN), manufacturing innovation and MONODZUKURI (goods production) enhancements, securing a monthly production capacity of 40000 units at the peak period. This manufacturing innovation has been creating a world leading wireless products operation plant that can support a top market share. This could only be achieved by the collaboration of all related divisions including component and material suppliers. It also becomes the motive force for the creation of the Global Supply Chain (Fig. 5), thereby enabling us to construct a powerful and seamless but flexible supply chain to support our customers.

(3) Total Support System

In addition, our sales departments, regional office, distributors, system engineering department and installation companies have also built close communications channels with customers and we have attempted to distinguish ourselves throughout the network design, planning support, periodical meetings and technical seminars. We also conduct positive sales promotions and provide total customer support by creating non-hardware business such as network optimizations, network monitoring and network designs for NMS (Network Management Systems). We have thus succeeded

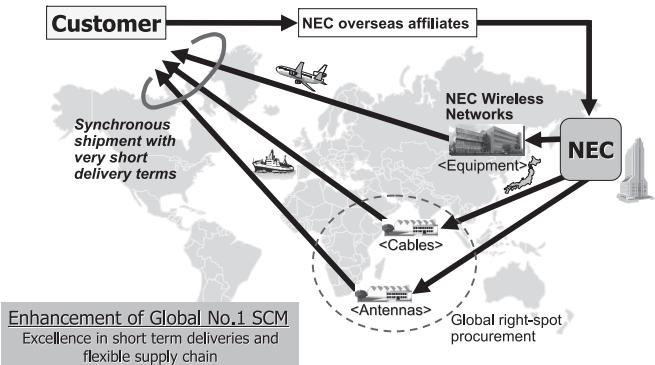


Fig. 5 Optimization of SCM.

in achieving excellent quality standards, excellent SCM and excellent CS in all aspects of hardware, software and service. Our achievement of the world's top market share is a result of the supply chain having been elaborated by strong linkage from production sites to sales sites.

2. Advantage of PASOLINK

The remarkable advantage of PASOLINK are; 1) world's top microwave technology and products in the industry; and 2) "strong MONODZUKURI power supported by SCM innovation.

2.1 Products Lineup

(1) Versatile Menus

The PASOLINK NEO Series adopts the common platform concept and compatible with various applications from small to large transmission channel capacities.

PASOLINK is composed of an out-door unit (ODU) and in-door unit (IDU). The ODU can offer a wide range of microwave frequencies selection from 5 to 52GHz so that it can be used in common for all PASOLINK families. The following variety of IDU, that defines the basic characteristics of PASOLINK, is available in order to flexibly meet with the customer requirements.

1) NEO STD (Standard)

PASOLINK NEO STD has full flexibility of its handling capacity and variety of interfaces. This equipment forms the core of the PASOLINK NEO Series. It offers an optimum balance between functionality, expandability and cost effi-

ciency. It can be used with various applications, including those for small to large channel capacity and those for various interfaces such as IP, PDH, SDH (electrical and optical interface) as well as with a mixture of them, by replacing the interface card unit.

2) NEO/c

PASOLINK NEO/c is in line with the “common platform” concept inherited from NEO series, but specially focuses on small and medium capacity transport, by targeting a small cell size or rural area coverage. As its high cost efficiency, it can contribute significantly to a reduction in the costs.

3) NEO STD Nodal

PASOLINK NEO STD Nodal gives branching functions by multi-connections of bus line cables with NEO STD equipment. The growth and dissemination of mobile networks increase the number of multi-destination branching stations (node stations). This is an advanced-function device without having drop-add-multiplexers for a large cost reduction.

4) NEO/a

PASOLINK NEO/a is a one-box type nodal device featuring a large increase in the functionality and capacity of the PASOLINK NEO STD Nodal model. It is compatible with the STM-4 Ring network and features a large-capacity cross-connection function. The modem unit as the PASOLINK NEO STD may also be applied for NEO/a equipment.

5) NEO HP (To be released in 2008)

PASOLINK NEO HP gives double sized channel capacity via single carrier operation. Recently, networks are increasing capacities following the introduction of HSDPA or application to WiMAX backhaul circuits. To deal with this trend, this model is provided with a newly designed modem unit with twice the previous transmission capacity and with the compatibility to the carrier class GbE interface targeting pure IP operation backhaul use of PASOLINK. The new modem also includes a 256QAM super-multilevel modulation capability.

Fig. 6 shows the relationship between the channel bandwidth and modulation technology of the NEO Series.

(2) Compact Size, Light Weight, Low Power Consumption

The ODU boasts the world’s smallest size and lightest weight with a volume of 3 liters, weight of 3kg and power consumption of 19W (15GHz). IDU weighs 1.8kg and boasts the industry top class performance, achieving a power consumption of 13W (NEO/c) with natural air cooling.

The ODU requires outdoor installation work, but its very

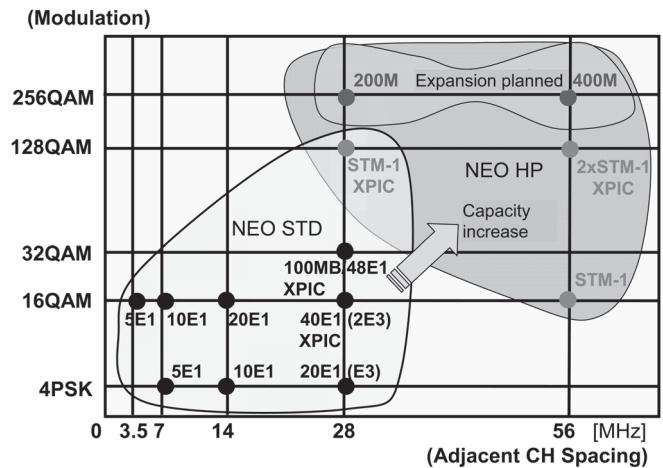


Fig. 6 Compatible transmission bands and modulation methods.



Photo PASOLINK installation.

small size permits easier installation and therefore reduces the total system integration costs (**Photo**). In addition, the 32W low power consumption (15GHz, NEO/c) of the PASOLINK series is contributing positively to global environment concerns in addition to reducing operation costs (**Fig. 7**).

(3) Quality and Reliability

PASOLINK is manufactured exclusively in NEC’s own factory in Japan. The pride of NEC, high reliability technology ensures production at the highest quality level in the world.

As a result, PASOLINK ODU can operate in a wide temperature range from -40 to +55°C and offers durability and

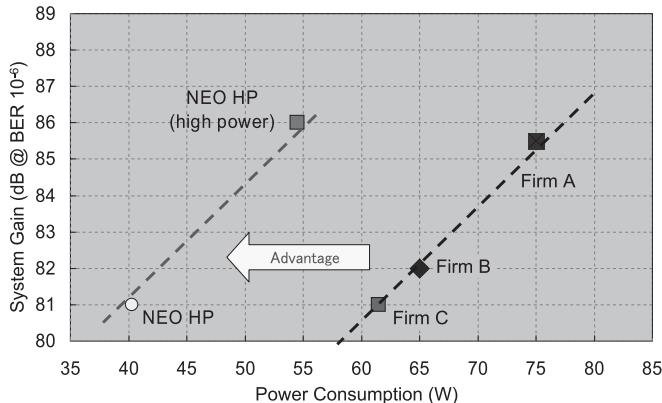


Fig. 7 System gain vs. power consumption (@ 18GHz/311Mbps transmission).

reliability withstanding severe temperature conditions such as from desert to mountain snowfall environments. PASOLINK has such a high reliability that its Mean Time between Failures (MTBF) is a 10 times better value than the industry average.

(4) Expandability

The PASOLINK NEO series IDU can accommodate various interface cards including E1, STM-1, 10Base-T/1000-Base-TX and 1000Base-SX/TX. Simply, replacing the interface card makes it possible to deal with customer needs such as transmission capacity increases or interface changes (Fig. 8).

The PASOLINK ODU is designed in common through the PASOLINK series and a simple replacement of the IDU makes it possible to extend function upgrades without any work being necessary for the reinstallation of the ODU.

2.2 SCM Innovation

One of the key elements in the promotion of PASOLINK

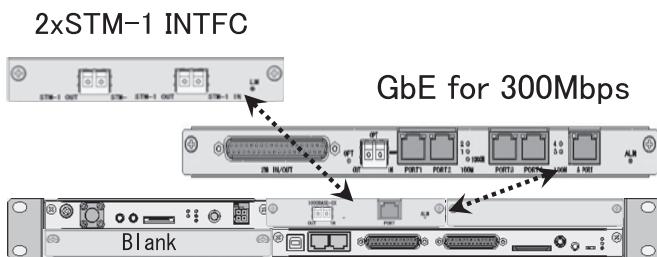


Fig. 8 Interchangeable interface card.

business is the flexibility in responding to individual customer needs that varies depending on countries and regions around the world. It is necessary to build to order from more than 1000 variations of equipment configuration menus at the same time as improving each delivery schedule.

NEC Wireless Networks Ltd., main production base in PASOLINK products, has been improving the production process under the slogan of “competitive MONODZUKURI.” It introduced the TOYOTA’s production system in 2001 in order to comprehensively improve the productivity.

Various “KAIZEN” (continuous improvement) activities include standardization of the work flow and operations eliminating wastefulness, the use of a common production line for multiple species and an independent development of inline automation equipment. This has been achieved with the participation of all of the members in the associated departments. These KAIZEN activities are also applied to support the simplicity and productivity of manufacturing from the design and development phases. Such a front loading design concept is made available by strong linkages between the design/development department and the actual site of the production line by focusing on “MONODZUKURI.”

In addition, to keep stable and constant production capacity against made-to-order production of multiple products species, NEC Wireless Networks Ltd., is focusing on the enhancement of the materials procurement that is the essential element of the constant production volume. This has been achieved by in-house manufacturing of core components and by close collaboration with parts/materials suppliers, by reducing components and numbers, and introduction of just-in-time (JIT) procurement using the “KANBAN” system.

Sales and production departments must also be in a harmony in order to maximize competitiveness by “MONODZUKURI” activities and SCM activities. These departments have been actually deploying the various systems to cope with the requirements of short delivery and variations in production volume. NEC has developed its own information system for the integrated management of order/production information (WiNDS) and for connecting the front end customers with the distributors, sales, system engineering and production divisions scattered around the world onto a single platform. With regard to the inventory information, this is consolidated into one system from the production line to distributors on a worldwide scale for accurate accounting, timely investment and proper procurement. With regard to procured items such as antennas and cables, SCM optimization has been taken by monitoring global right-spot production and the synchroniza-

tion of short term deliveries. NEC is continuously reviewing, improving and enhancing the global SCM system with flexible attention to support customer's versatile requirements.

3. Conclusion

The wireless business is achieving best practice in NEC's global business deployment and is always in the leading position in the global market, despite sometimes encountering drastic changes in business environments. When PASOLINK was first released 25 years ago, no one could have foreseen that the cellular phone services would disseminate in the world to the position that we see today.

Each time that there has been a change in the business environment, NEC has overcome the difficult situation and has managed to breakthrough with the help of its superior inherited wireless technology that has been accumulated over its long history. NEC has re-defined its business operations by unifying development, production and sales operations to deal with changes in the business environments. All of the aspects of the PASOLINK portfolio are the results of endeavors that have occupied more than 70 years and which constitute the major foundations of NEC business.

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