Hybrid Interface Solutions for next Generation Wireless Access Infrastructure

Broadband wireless communication will revolutionize every aspect of people’s lives by enabling a high-speed connection directly to the information people need, whenever and wherever they need it. New wireless technologies, such as WiMAX (Worldwide Interoperability for Microwave Access), are allowing service providers to develop new business segments and to reach new business and private customers in industrial and emerging countries. With its specialized connectivity solutions, HARTING is meeting the electrical and environmental demands of globally operating service providers and making an important contribution towards implementing the necessary outdoor infrastructure.
There’s no doubt the world is going wireless – with a higher speed and wider range than anyone could previously have imagined. The transition to wireless really started with the Internet revolution. What began as a mechanism for exchanging electronic data has meanwhile sparked worldwide demand for 24/7 data and communication solutions. The advent of Wi-Fi technology and hotspots is just the start. By offering mobile Internet access, hotspots provide users with a connection within a limited area around an access point. Although hotspots extend the previous reach of the Internet, they still tether users to a fixed location. Meanwhile, many users want mobile access. It’s this demand that will continue to fuel convergence and transform the communications industry. To that end, the telecom industries are developing new communication standards that will expand and extend the reach of wireless networks across the globe.

In anticipation of these new wireless technologies, carriers have even slowed expansion of the fiber networks. And engineers are increasingly focusing on developing products and services that will enable broadband wireless communication on a wide scale.

**BROADBAND WIRELESS TECHNOLOGIES**

Today, wireless high-speed communication comprises a number of co-existing, overlapping technologies. Wi-Fi, WiMAX, 3G and Ultra-Wideband (UWB) are used to form the global wireless infrastructure needed to deliver high-speed communication and global Internet access.

While Wi-Fi is ideal for isolated areas of connectivity, WiMAX and 3G are needed for long distance wireless applications. WiMAX and 3G are both required because their optimum platforms differ: WiMAX works best for computer platforms, such as laptops, while 3G is best for mobile devices, such as PDAs and cell phones. In contrast, UWB offers short range connectivity, which is used for the home entertainment environment or wireless USB. Accordingly, each technology is optimized for its particular application.

**WIMAX – WIRELESS TECHNOLOGY FOR THE “LAST MILE”**

WiMAX is a technology for wireless broadband transmission, based on the IEEE 802.16-2004 specification. Today, if you want broadband, you connect via existing cables, using T1, DSL or cable modems. WiMAX, an evolving standard for point-to-multipoint wireless networking, works for the “last mile” in the same way that Wi-Fi “hotspots” work for a network’s last hundred feet or so within a building.

In addition to “last mile” broadband connections, WiMAX offers diverse applications, such as in hotspots, cellular backhaul and high speed enterprise connectivity. Generally speaking, WiMAX has a range of up to 50 km.

WiMAX is being rolled out in three phases. In the first one, WiMAX technology (according to IEEE 802.16-2004) is deployed using outdoor antennas to serve known sub-

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**Overview of Broadband Wireless Technologies**
scribers at a fixed location. In the second step indoor antennas are also included, in order to enable carriers to simplify installation at user sites. Phase three, planned for 2006, is based on the IEEE 802.16e specification. Mobile network hardware certified by the WiMAX forum will then be available, enabling users to roam freely within the service area while staying connected.

**NETWORK INFRASTRUCTURE REQUIREMENTS**

The new ability to provide these broadband connections wirelessly, without laying wire or cable in the ground, greatly lowers installation and operating costs for providing these services. Consequently, WiMAX may change the economics for any place where the cost of laying or upgrading landlines with broadband capacity is prohibitively expensive, as in emerging countries. In countries such as China, India and Mexico, where there is currently an insufficient wired infrastructure, WiMAX could become an important part of the broadband backbone.

A typical point-to-multipoint broadband wireless access system is usually composed of two key elements: the base station and the end user subscriber equipment. The base station, typically realized as a 19” indoor unit, represents the actual connection to the base network. It uses outdoor antennas to send and receive high-speed data to and from the end user, and communicates with the backward network infrastructure via wireless line-of-sight radio links. This eliminates the need for extensive and expensive wired infrastructures and provides a
highly flexible and cost-effective last-mile solution. The receiver is usually directly integrated into the device on the end user side, such as a laptop.

Another key factor for the wireless network infrastructure setup is the network topology and the installation points for the base stations and devices. Today’s wireless networks are typically designed as a micro cell or pico cell structure in metropolitan areas, with multiple base stations and outdoor antennas covering an area of from just a few hundred yards to a few miles. Instead of installing complete centralized BTS and BSC technology in huge 19” rack systems in a dedicated, air-conditioned room, the future design of the network infrastructure will see the equipment increasingly decentralized and split up into a small, compact indoor unit and an active, intelligent outdoor unit. The outdoor unit with the radio receiver is packed in a robust and water-protected case, and installed in the immediate vicinity of the antenna.

Typically the indoor unit supplies the outdoor unit with wire-based data and power. The data interface is often based on industrial standards, e.g. Gigabit Ethernet based on copper or LC fiber optic. Based on these standard interfaces, cable lengths up to 100 m in copper and 2,000 m in fiber optic can be implemented, allowing the network operator to install its wireless broadband infrastructure equipment quickly and flexibly.

**HYBRID SOLUTIONS FOR TELECOM**

With the increased installation of the decentralized network infrastructure, installation time, reliability and longevity under the widest range of environmental influences will become an important success factor for system providers and network operators. HARTING is helping customers with solutions for the “best connections worldwide” wherever the network operator installs its systems. The Technology Group offers an end-to-end interface architecture that facilitates simple and secure installation.

A complete family of connectors has been developed especially for this type of application in a harsh outdoor environment. This family is based on the standard RJ45 connector in copper and the LC fiberglass connector, so that interface solutions for the future decentralized devices in the telecom infrastructure are already being offered today.

Requirements for outdoor telecom connectivity solutions:

- Based on industrial standards and interfaces such as RJ45 or LC
- Water and dust protected in IP67 and IP65
- Protected against UV sunlight
- Hybrid cabling structures with integrated data and power
- Shielded for EMC protection
- Corrosion-resistant materials
- Easy installation with cable length up to 100 m for copper and 2 km for fiber optic

Connection solutions are available for IP20 and IP65/67 protection degrees, and in metal and plastic housings. Data or hybrid cables can be used. At the device end, panel feedthroughs and couplings are available for integration. Consistent application of SMD components for both data and power at the device end keeps manufacturing costs low and permits high packing density within the assembly.

HARTING is also making use of their HARAX® rapid termination technology, which allows the user to add a connector to the cable without any special tools. The design of the Ethernet connectors allows for quick and easy ter-
mination and connection to Ethernet devices in either data-only or hybrid networks.

HYBRID INTERFACES BASED ON INDUSTRIAL STANDARDS

The RJ45 hybrid connector is an interface solution that integrates the data lines and power supply into one connector for hybrid Ethernet networks. The connector geometry nevertheless maintains a clear separation between the data and power contacts. Such hybrid cabling for telecommunication applications significantly simplifies installation, resulting in lower costs for the overall system.

Ethernet Hybrid interfaces for telecom applications are available in three versions:

EASY INSTALL RJ45

The Easy Install version of the hybrid interface is based on a RJ45 data module integrated into a newly designed Han® 3A housing that can be used for most outdoor applications. The housing is available in plastic in protection degrees IP65 and 67.

With HARAX IDC technology, the user can connect solid and flexible data wires in AWG 22 without the need for special tools. The four power contacts of the hybrid module have also been designed with HARAX rapid termination technology, allowing stranded cables of up to 1.5 mm² to be connected and loaded with up to 16 A and 48 V.

Terminated with the corresponding Category 5 hybrid cables with AWG 22 dimensions for the data wires, a maximum cabling length of 100 m can be achieved with up to six connector pairs. This interface fulfills Class D channel performance in accordance with ISO/IEC 11801:2002, supporting 100 Mbps Fast Ethernet. The panel feedthrough is compatible with standard RJ45 connectors, which means that standard patch cables can be used for service and test purposes.

GIGALINK RJ45

The Gigalink RJ45 exceeds the tough requirements of Category 6 according to TIA/EIA 568 B.2-1:2002-06, EN 50173-1:2002 and ISO/IEC 11801:2002-09. The Category 6 RJ45 data module is integrated into the standard Han® 3A housing, which can be used for a wide range of harsh outdoor applications. The housing is available in plastic and metal (protection degree IP65/67).

The two contacts of the hybrid power module are based on standard Han® D contacts, allowing stranded cables with a cross-section of up to 2.5 mm² to be connected and loaded with up to 12 A and 250 V AC. Alternatively, a power module for 48 V DC is also available.

Finger protection for the contacts on both the device and the plug side simplifies installation by allowing the use of “daisy-chain” cables with the same plug on both ends.

The Gigalink RJ45 connector fully complies with the DIN EN 60950-1 and DIN EN 60950-22 standards for safety and installation requirements in information technology. In addition to the electrical and mechanical requirements,
the hybrid Gigalink RJ45 connector can be implemented as a fully shielded metal version for optimized EMC performance in areas exposed to lightning and antenna radiation.

**GIGALINK FIBER OPTIC**

The fiber optic version combines the power supply and high speed data transmission. The IPprotected fiber optic version is the best choice wherever longer transmission distances, high data rates or EMC problems exceed the limits of a copper-based solution. The Gigalink fiber optic connector is based on the Gigalink RJ45 solution, with the sole change being the replacement of the data module.

The integration of the standard LC fiber optic connector according to IEC 61754-20 opens new fields of application for fiber connections in harsh environments. The entire system is robust and protected against vibration, and fulfils the requirements according to IP65/67. The multimode optical fibers allow transmission distances up to two kilometers, with the power wires representing the limiting factor. For transmission at the typical telecom voltage of 48 V and several amps, 2.5 mm² copper wires usually allow a range of several hundred meters, for example.

The Gigalink fiber optic connector also fully supports common telecom standards, such as DIN EN 60950-1 and DIN EN 60950-22 for information technology. Additional accessories, such as dust caps and assembled cables, complete the product range for fiber optic hybrid solutions.

**SYSTEM CABLES**

Even with a wireless infrastructure, the cabling represents a key element in a network. Mistakes during the selection and laying of
cables may lead to serious errors during base station operation, ranging from data loss to temporary disturbances depending on weather conditions and even total network failure. Especially in the outdoor environment, reliable and fully functional cables are a crucial element when planning and implementing high-performance networks that ensure a high degree of availability.

HARTING offers several Ethernet cables that have been specially designed for use in a harsh outdoor environment. Data transfer in Categories 5 and 6 to ISO/IEC 11801 is supported by means of solid, stranded, or hybrid cable. UV resistance, a high level of mechanical stability and halogen-free materials are only a few of the demands placed on the cables.

The combination of telecom cables and the robust Hybrid Ethernet connectors results in long-lasting system cables. The consistent application of a modular system for both connectors and system cables allows coverage of a wide field of applications. Customized system cables with Ethernet connectors are also available.

CONCLUSION
The world of telecommunication is changing to wireless broadband access. New technologies for broadband and radio relay networks allow network operators, business customers and private customers to access data and network services whenever and wherever they want. These new technologies are resulting in a wide range of decentralized network equipment for the infrastructure of the global network operators, and this equipment is increasingly being installed in a very wide range of outdoor environments and locations.

HARTING has developed a complete Hybrid Ethernet connectivity solution for these applications, based on standard data interfaces, such as RJ45 or LC. Connectors are available for easy field installation, Gigabit Ethernet and Fiber Optic LC, as are assembled system cables and lines. Consequently, network operators and device manufacturers can easily and securely install their equipment in a very wide range of environmental conditions.

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