WHITE PAPER

Increasing the Value of Wireless Network Assets with IDEA – Integrated Deployment Environment Architecture

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Consumer and business customers today seek wireless service that is readily accessible, benefit rich, secure and affordable. Voice, data and video services, Internet games, and mobile office access must all be provided to meet growing demand from customers. Rollout of third-generation networks has made real-time information flow of news, music, sports updates, browsing and image sharing a reality that is driving growth and change in the network. The move toward faster service will continue without end and requires that both bandwidth and network locations be increased. To do this, additional cell sites must be added and existing equipment must be upgraded or replaced in response to changing market conditions.

Managing growth and change in the wireless network isn't as simple as installing new routers or deploying new radios and media gateways. Increasing capacity and features of the network creates new challenges for both planners who design and the operations personnel who manage the network. Creating a feature-rich network and migrating to IP-based access and transport means there are more active devices to manage and more handoffs between devices and networks. Trunk media gateways, signaling media gateways, authentication servers, location register servers as well as faster, higher-density routers and multiplexers—and the cabling and connectors that tie them all together—proliferate.

Despite a selection of standards from which to choose, there is no uniformity for connectors and cable across old and new devices in the network. Implementation of GPRS and 3G provides the building blocks for broader IP-based services and has increased use of fiber cables and interfaces. A higher percent of routers and other equipment ships with fiber interfaces, too. Yet many time division multiplexing (TDM) interfaces remain in the network. Voice is still carried on TDM. Handoffs with other networks are mostly TDM while the most common interfaces for base transceiver stations (BTS) and node B sites, as well as for many signaling and router interconnections, are TDM. Twisted pair, coax and fiber will coexist in the network for many years to come.

The wireless service provider must manage this varied and constantly changing list of interfaces, as well as the general increase in number and types of cable throughout the network. Compounding the challenge is the relatively short life cycle of hardware. For example, many routers have a published end of life date of less than four years, after which time the box is not supported by the vendor and will need replacement— an event that must occur without disrupting service.

Executive Summary

IDEA is a best practices architectural approach that provides a highly functional, preconditioned infrastructure that anticipates the entire life cycle of valuable active network equipment. By recognizing today how active network elements will be installed, reconfigured, upgraded and replaced in the future, IDEA enables you to create a more reliable, less costly network that will endure multiple generations of routers, switches and other active network gear.

In addition, many wireless service providers depend upon contract labor for installation, upgrades and maintenance. Not surprisingly, craftspeople tend to have their own way to doing things. They often leave their mark and the observant person can tell when a particular vendor did a job. Walk through a mobile switching center (MSC) and every generation of network gear is easily detectable because the routing, storage and management of cabling is different. There is a tendency to get the hardware installed and forget about how it will be managed after cutover. The trouble with this approach is the next cutover takes 12 weeks instead of one week.

The issue is simple. The OEM or contractor installs the job to spec. Yet the spec often ignores how regular maintenance and operational activities will be performed. How will service provider personnel troubleshoot, isolate faults, repair, perform software upgrades and patches, add line cards, replace active equipment, reconfigure connections between devices, and maintain fibers. The new installation is truly beautiful. Yet a weak cabling infrastructure leads to degraded network performance and the risk of downtime. Once the contractor leaves, the service provider is left to manage what is left behind—which can be a high-cost, high-maintenance, and less reliable network.

The way around this is to focus design not just on the immediate installation, but also on the entire life-cycle of each network device using the field-proven methodology for preconditioning the infrastructure, ADC's Integrated Deployment Environment Architectures (IDEA[sm]).

IDEA Establishes Best Practices for Managing Network Assets

If you look at the installation instructions for your new media gateway, router, server or any other piece of active network equipment, you will notice there is no discussion of how the active equipment is to be managed within the larger framework of the building, structure, equipment room or hut. Careful instructions for power, grounding, airflow, operating temperature, proximity to RF devices and other critical considerations are covered. Yet nothing in the manual addresses the ongoing operational aspects for the equipment or how it will integrate into the complex network infrastructure. How equipment is installed today determines if, in the future, rerouting is feasible, how quickly reconfigurations can be made, or if any changes will disrupt service.

The Integrated Deployment Environment Architecture (IDEA) creates a uniform, proper infrastructure for active network elements, a best practices approach that works no matter what type of equipment is deployed. There are already many givens in your deployment. You determine appropriate flooring-load rating; power is 120AC or -48V DC; HVAC is sized to handle the anticipated amount of heat; racks are 19 inch, 23 inch or 600 mm; security doors and devices are in place; the roof doesn't leak; grounding and lightning protection are installed. Yet there are many more aspects for the deployment that may be considered table stakes—the minimum requirements to prepare everything from a rack space to an entire data center to accept equipment and create the proper environment for efficient, ongoing management during the life-cycle of each piece of network hardware. IDEA expands the minimum requirements for network deployments.

IDEA recognizes that valuable active equipment requires a highly functional deployment environment with a multi-year view on exactly how the equipment will be reconfigured, upgraded, monitored and eventually replaced. A methodology that has been in use for decades by not only the world's largest service providers but also regional and local operators, IDEA creates an installation shell that anticipates the changes that will happen in and around each active device. IDEA recognizes that equipment cables should be handled as little as possible; all available ports and slots on active equipment should be fully utilized; the network from the cell site to the handoffs with fixed line carriers should be sectionalized for fault diagnosis; routine maintenance, software upgrades and addition of line cards must be transparent to customers; cables with 10-15 years of useful service life should not be abandoned prematurely; hardware racks should be managed without touching in-service hardware; a plan is built-in for decommissioning; the ability to measure and test, critical to maintaining network performance and reliability, is incorporated.

IDEA also recognizes that the passive infrastructure will most likely remain through multiple replacements of active hardware, and should facilitate acceptance of new hardware without disrupting service or taking inordinate time to turn-up the new equipment. The benefit of passive backplanes for plugging in line cards on active equipment is well known. This was a significant architectural leap in hardware design. The same holds true for deployments designed with IDEA. Equipment installs into the preconditioned, passive "infrastructure chassis" of the building. Installation is simple and unobtrusive while practices are the same for all platforms, extending the service life of the infrastructure, maximizing the ROI on equipment, and greatly reducing operational costs of managing the network. Creating a recognizable infrastructure chassis provides a common interface for any technician and a common system for both current and future installations and reconfigurations. IDEA enables you to make the choice on how equipment transitions occur—planned, instead of painful.

In summary, IDEA acknowledges that active equipment is dependent upon full throughput over connections and cables from active equipment ports all the way through to the public network. This methodology ensures that infrastructure design accounts not just for initial installation, but also for the ongoing work of maintenance, reconfigurations and retiring of equipment. Fewer repair calls, decreased time to repair, improved service availability, improved time to revenue on new equipment, full utilization of equipment ports—by preconditioning your site, you get the operational platform you need to serve your customers.

Profile of a Site Designed with IDEA

The best practices developed under IDEA result in an infrastructure that is installed and ready for initial service turn-up, supports change during the lifetime of the equipment, and is ready to accept the next generation of equipment.

Centralized Patching Locations – Equipment cables are permanently cabled to the rear of panels in a central distribution field. Reconfigurations, rerouting service during software upgrades or equipment replacement, adding line cards, and other operations are performed using patch cords or jumpers on the front of panels in the distribution field. Circuit and jumper identification requires clear labeling and visual indication at both ends of copper and fiber cross-connects. Storage at the front of the distribution field ensures not only ease of access but also physical protection for patch cords and jumpers. When a piece of equipment is decommissioned, the cabling remains ready for the replacement equipment.

The alternative is direct connection of network elements, an approach that can work well on the first day. However, troubleshooting, reconfigurations and even simple maintenance require handling cables that are terminated directly on equipment—increasing the chance for error and service disruption. With a cross-connect architecture, deployment of a new media gateway may take a week. In a hard-wired environment, removing and deploying the new media gateway can take weeks or months.

Access for Non-intrusive Monitoring and Testing – Passive local or remote test access points at handoffs to fixed line carriers and other logical locations in the network allow bidirectional views of signals without disrupting service. This allows technicians to segment the network to isolate faults quickly, test performance before making a circuit live, and conduct proactive maintenance to detect issues such as a bad splice or connector before service degrades.

The alternative is reliance on guesswork, added man-hours and service interruptions to troubleshoot problems. This is not a formula for customer satisfaction.

End-to-End Cable Management System – Active network equipment can only perform if the cables perform. A gigabit port is of no value if attenuation from a damaged cable impedes performance or if restricted access delays fiber endface maintenance. IDEA ensures that cables on-frame and off-frame and throughout the building are deployed with proper bend radius protection, have well-defined cable routing paths, room to work on connectors and cables without affecting adjacent circuits or ports, and physical protection for equipment cables, intrafacility cable, patch cords and jumpers.

The alternative is poor use of floor space, inferior performance from active equipment, and outages. Cables stepped on and piled-up in raceways, difficult connector access, and hours to trace cables are just a few of the problems encountered. Notably, without end-to-end cable management, the time required to decommission hardware and bring new hardware online increases by tenfold.

Scenarios of IDEA at Work in the Wireless Network

IDEA is more than just a set of products. It is a design philosophy that acknowledges the burden carried by operations after cutover of network elements. IDEA works because it pays attention to seemingly minute details of best practices and highly functional products that were developed from deployment of millions of ports for service providers worldwide. Experience is the best teacher.

Managed Density

Any vendor can fashion a panel by bending metal and installing connectors provided by any number of suppliers. When highly dense routers are proposed, these vendors merely acquiesce and provide panels to support the rack density, such as a 96-port, one rack unit (RU) high fiber termination, splice and storage panel. With IDEA, this is proven to be an impossible configuration. Yes, the metal can be bent and 96 ports of fiber connectors can be crowded into one RU. Yet those who design their network using IDEA know better. They know that once the bay fills, removing individual fibers for simple maintenance will be difficult for technicians. It will result in outages on adjacent circuits. They know that adding line cards later will be impossible due to the volume of fiber cables crowding the cable managers—thereby leaving open chassis slots and requiring new floor space for growth.

IDEA encourages not just density, but managed density. There really is a limit to the number of ports that can be installed in a bay before the ability to add ports, reconfigure network elements, upgrade software and replace elements is hampered. Any action in operations will be stalled, causing a huge drain on productivity, profits and service availability.

Access for Monitoring and Testing

The value of built-in, non-intrusive monitoring is critical for testing individual segments of the network. Monitoring the signal in real time not only helps anticipate problems but also provides proof of performance on the network. For example, if a cell site seems to be functioning erratically, traffic could be rerouted to another cell site. With integrated monitor ports on the distribution field, the traffic could first be monitored to see if there is a signaling problem, avoiding the work of rerouting.

At the base of an antenna, a technician can plug-in a test set and determine if the complete signal is present, if there is a problem with the antenna, if there is a problem with the radios, or if there is a signaling problem between the antenna, node Bs, and other parts of the network. This can help determine if an entire card or the card's transmit and receive ports are bad. This monitoring capability also provides functionality during turn-up. For example, if an increase in traffic requires that a higher functioning switch be added, the switch can be installed, cabled, and tested without affecting traffic flow. Then, by using patch cords and cross-connects, the traffic can be moved over so that the original switch can be retired.

When a wireless service provider requires a new leased T1 to a base station the cable pair is routed by the local fixed line carrier and a transmission tech measures the circuit, says it works, and completes the order. The wireless service provider then hires a contractor to connect equipment to the handoff point. If there is a problem, the tech from the fixed line carrier is long gone and there is now a ten day wait to have the local fixed line carrier resolve the issue. With test access designed into the infrastructure, the wireless service provider would be able to test instantly if the leased circuit is operating correctly before the T1 service provider tech moves on to the next job.

As new companies are brought into existing networks, demarcation points are used to isolate, verify and test out communication links for proving signal integrity and establishing network maintenance responsibility. The information is used to determine signal source fault and to delegate the appropriate service provider response. Demarcation points contribute a great deal of functionality to the network and enhance the development of multi-use networks. With more collocation and leased lines, it pays to be able to sectionalize the network and isolate faults.

Flexible Raceway

Proper deployment of fiber raceway is an important IDEA design philosophy. For capital expense reasons, there is a tendency to install only the fiber bays that need to be immediately populated. However, when the raceway is installed, a downspout still needs to be positioned for each proposed bay. Any change in bay positions that occurs after the raceway's initial installation could result in the downspout being in the wrong position, exposing fiber cables to harm. With IDEA, a straight section of raceway can be run all the way down the lineup. When the equipment bays are installed, a specialized drop is affixed to the sidewall of the raceway, positioned directly over the fiber optic terminal equipment or fiber frame below. This easy solution simplifies installation, protects the integrity of fibers already in the raceway, and increases the raceway system's overall flexibility.

As more installations go beyond the recommended 2-inch fiber cable pile up in raceways, the possibility increases for attenuation caused by macro/micro bends. In applications with extremely high fiber counts, where fibers run through a raceway at an elevation of 8 to 10 feet, fiber creep can occur as the fibers are dropped to the frames. Over time, those fibers pull all the fibers in the raceway toward the downspout. Generally, only one or two fibers support all of that weight. Ultimately, those fibers can break. In order to prevent fiber creep and eventual fiber breakage, raceways with baffles or fins in the fittings that support horizontal direction changes keep cables from being pulled tight against an edge, spreading the load over a larger area so that no one fiber is carrying all the weight.

High Performance Connectors

Connector termination in fiber-optic systems refers to the physical joining of two separate fibers with the goal of 100 percent signal transfer using a mechanical connector. A connector is installed onto the end of each of the two fibers. Singlemode connectors are generally factory installed to meet optical performance and long-term reliability requirements. The junction is then made by mating the connectors to either side of an adapter. The adapter holds the connectors in place and brings the fibers into alignment.

To relay a signal from one fiber to another requires that the cores of the two fibers be joined in near perfect alignment. The measurement of insertion loss and return loss determine the junction's quality. Keeping insertion and return loss to a minimum by deploying the highest quality connectors available is an important part of reducing maintenance and upgrade expenses. Although OC192 is currently the commonly deployed network speed, OC768 will be the next generation of optical networking speed. The new systems' speed means that they are much more sensitive to reflectance interfering with the transmitter and increasing return loss.

High performance SC, FC and LX.5® connectors have been able to obtain exceptional return loss performance of less than 0.2dB when randomly inter-mated in the field and are well suited for future high-speed applications. The angle polish LX.5 was tested and found to have a minimum return loss value of 70dB. This is a tremendous improvement over flat polish connectors with a minimum return loss value of 57dB and other angle polished connectors that have a minimum return loss value of approximately 65dB.

Small-form-factor connectors with two ferrules or two fibers in the space of one SC or FC connector offer equipment manufacturers higher density options. Multi-fiber ribbon connector technology is offering exponential increases in density. The ribbon connector uses a thermoplastic type of ferrule that is typically rectangular in shape. Instead of having two fibers like small-form-factor connectors, there may be up to 12 fibers in that same space. This is a tremendous advantage for the equipment manufacturers, and the multi-fiber ribbon connectors are being incorporated into network elements. Still, there is a limit to rack or bay density, a point at which it becomes difficult to maintain and reconfigure individual fibers without affecting adjacent circuits.

Centralized Distribution

Centralized distribution brings all cables to one area for maintenance, patching, and servicing. This provides the most flexibility to add and subtract, change and reconfigure network elements. For example, assume there is a switch and mux in location A and a switch and mux in location B. These locations could be at other ends of the floor or on different floors of the building. Now, switch A needs to connect with switch B, and mux A to mux B. If these network elements were originally installed by direct cabling methods, reconfiguring these elements requires pulling up raised floor tiles, finding riser space, and abandoning existing cables. Instead, the centralized distribution field provides the ability to connect switch A to switch B using patch cords or jumpers because equipment cables remain terminated on the rear of panels in the distribution field.

One of the benefits of centralized distribution is better utilization of floor space and facilities. The better you optimize utilization, the less likely it is you will have to add on to the building or erect a new facility. Even with smaller and more compact equipment designs that make better use of rack and floor space, decentralized cabling plans that utilize direct connection rather than cross-connection require more cables over time, which in turn uses more plenum and overhead pathway space. With direct connection of network elements, new equipment usually entails new cable. Existing cables are not reused and are abandoned because the contractor is not tasked with cable recovery, cables are jammed, or long runs of overlaid cable make recovery impractical. Technicians may actually find it impossible to fill an empty rack space with new hardware because of the cable congestion, working or abandoned, at the rack or cabinet.

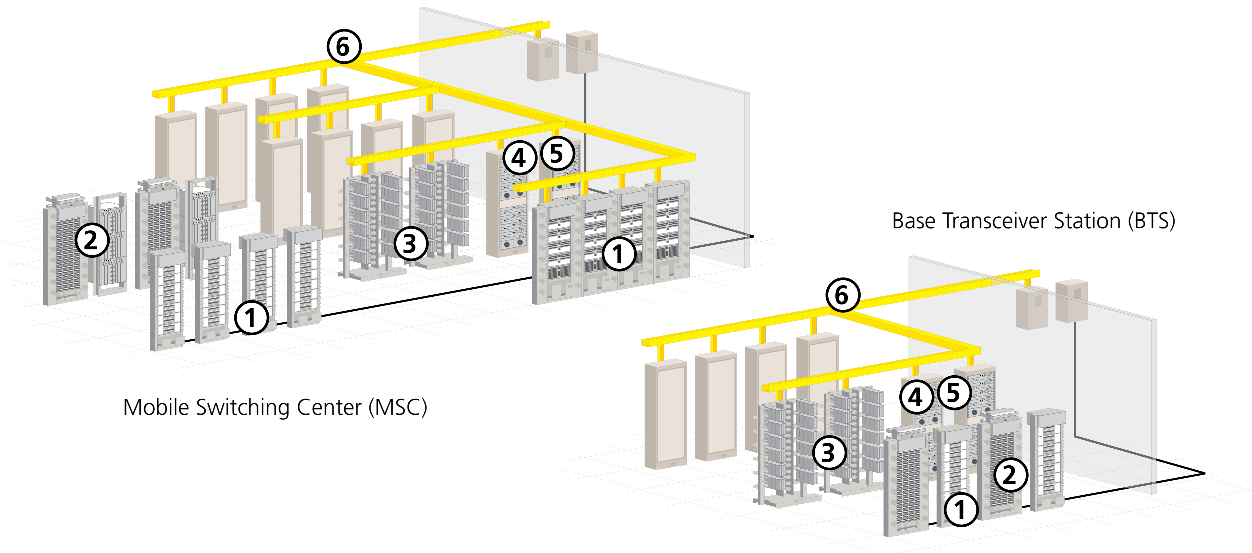
With a preconditioned, centralized distribution infrastructure, the cabling is in place throughout the facility. Adding or changing equipment requires moving patch cords and jumpers rather than laying new cable.

Conclusion

As new technologies concentrate and accelerate the delivery of revenue-generating services, the risk of and trouble created by outages, downtime and decreased performance is amplified. The selection of network connectivity elements and practices is vital to mitigating this risk. Network planners must take into account the operational efficiency of the connectivity elements and the reliability of the day-to-day operation of the network. As the systems become more complex and the network elements become more sophisticated, the probability of equipment failure increases. If there is a service outage or a software upgrade that turns out to be incompatible with the network, it is essential to stop and sectionalize the problem before an entire network outage occurs.

IDEA meets these challenges by providing an installation environment that anticipates the entire life cycle of equipment. The resulting network contains critical rerouting options, enables non-intrusive monitoring and troubleshooting, and lays the foundation for a future-proof infrastructure that accommodates change and growth without disruption of service.

Applications of IDEA in the Wireless Network



(1) Digital Signal Cross-Connect (DSX)

DSX panels provide a centralized distribution frame for managing equipment that uses twisted pair and coaxial cables. The termination, cross-connect, monitoring, testing and patch access panels and modules support signal rates from DS1/E1 to DS3/STS-1. Any network system can be connected to any other network system using jumpers in the distribution field while jack access provides testing without downtime. Reliability of active network equipment is further enhanced with PowerWorx® power distribution and protection panels mounted in distribution frames.

Applications:

- Interface between Sigtran and SS7
- Connections between TDM and trunk media gateways
- TDM to access media gateway connections

(2) Carrier Data Products (CDP)

For equipment that requires RJ45 connectivity, the CDP product platform provides a centralized distribution frame to support speeds up to 10 Gbps. Equipment cables are terminated on the rear of patch panels and circuits to the network are completed and reconfigured using patch cords on the front. The Glide Cable Management system on the side of the racks provides integrated front, rear, horizontal and vertical cable management of IFC, equipment and patch cables, even in highly dense configurations.

Applications:

- Billing server connections
- Application server connections
- Media and signaling gateway control connections

(3) Fiber Distribution Frames, Panels and Trays

Fiber frames and panels support termination, splice and storage of fiber optic cables in applications from the smallest to the highest fiber counts. These solutions include bend radius protection, connector access from front or rear, intuitive cable pathways, jumper storage and physical protection. Sliding adapter packs, angled connectors, space-saving designs support distribution of fiber optic cable between routers, gateways, multiplexers and other active equipment.

Applications:

- Termination of fiber cable from active equipment
- Inter-router connections
- Gateway to router connections

(4) CWDM Modules

CWDM modules increase capacity of existing fiber facilities without trenching and construction through coarse wavelength division multiplexing.

Applications:

- Increase bandwidth on existing optical fiber cable anywhere in the network

(5) Monitor Modules for Fiber-based Networks

Modular, plug-in modules provide non-intrusive monitoring points for testing signals on fiber cable in both directions. The modules provide demarcation points for network segmentation. Live traffic can be monitored continuously or on demand.

Applications:

- Monitor performance from fixed line carriers at handoff
- Monitor performance between MSC and BSC, or between BSC and cell sites

(6) FiberGuide® Fiber Cable Management System

The FiberGuide system protects and routes fiber optic patch cords, multifiber cable assemblies, and intrafacility fiber cable (IFC) to and from fiber splice enclosures, fiber distribution frames and fiber optic terminal devices. The system features a variety of products that enable quick installation including snap together components and the Express Exit™ fiber drop system.

Applications:

- Manage off-frame fiber in MSC
- Enable proper routing of optical fiber for bay expansions

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