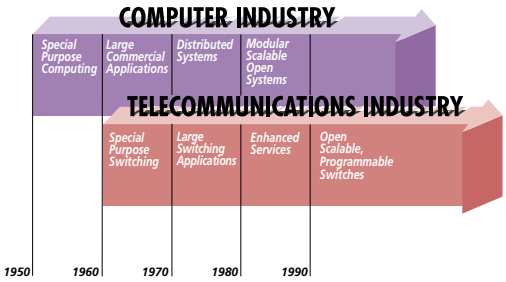
EXCEL SWITCHING

Empowering Creativity in Telecom



The major change in the computer industry from traditional large, special purpose systems to today's open, distributed computing environments is being replayed in the telecommunications industry at an accelerated pace.

Deregulation opened the market. We're opening the infrastructure.

The telecommunications industry is undergoing an explosive evolution -- in services, in geographic reach, in impact on every element in the network from the individual subscriber to the infrastructure. Globalization and liberalization are fueling widespread demand for:

- Network integration and routing
- Multiple, distinctive enhanced services
- Multimedia integration

Carriers, system integrators and developers have unprecedented opportunities to prosper in these emerging markets, but they also face critical challenges from increased competition:

- How to be first to market with new services
- How to compete and win on price and service offering
- How to gain market share via expanded services and broader coverage
- How to future-proof service platforms to support change and growth
- How to safeguard and leverage your service investment

The answer lies in open, scalable, high performance, programmable switching platforms. Open, because today's switches must be able to adapt to tomorrow's network and media technologies. Scalable, because switches must be able to expand in both size and scope as the market grows. High performance, because switching platforms must be tailored, transformed and driven to meet a wide range of differentiated services addressing current requirements and future trends. Companies that want to be part of the next wave in the telecommunications revolution need to select a switch platform that meets these design criteria.

ONE Architecture™

An open, distributed switching environment positioned for the future.

Criteria for Open Switching: A Design Vision

Excel Switching Corporation established a design vision for a new kind of switching architecture - one that is neither tied to a particular type of service, nor to a preconceived notion about its networks, user populations, or performance criteria. Excel capitalizes on innovative technology and open design techniques to offer robust products that are distributed in architecture, scalable in implementation, and truly programmable to meet unique market needs. These are the hallmarks of Excel's ONE Architecture family.

Open Architecture

At the foundation of ONE Architecture is the Expandable Switching System, EXS™. EXS is designed to support the highest levels of integration with external resources, from the host application to media support to worldwide network integration. Excel's commitment to open architecture is illustrated in our product design:

Open Programmability means the ability to offer distinctive, competitive, unique services on a single, scalable platform to meet changing market demands. It makes switch software not just configurable, but truly programmable, to address your unique requirements. Excel delivers this powerful and unique capability via a patented technology called the Programmable Protocol Language (PPL). PPL enables developers to program or customize virtually every aspect of the EXS system, including: call processing and call flow, network protocols, common channel signaling services, media resources, and system management and operation functions.

Open Connectivity enables you to connect unrelated resources into a single logical system. With open connectivity, external voice resources such as interactive voice response, voice recognition, and voice over Internet devices can be integrated into the switch environment. Open connectivity also applies to the system's ability to adapt to worldwide network protocols and standards.

Open Design means the ability to operate with any host system, application language or operating system. It also means the ability to write applications independently of the network protocol, and to receive switch information in a consistent and unified format. Excel's Application Programming Interface (API) defines a rich set of standard messages that establish communications between the host system and the switch.

Midrange EXS configurations support over 2000 ports and provide high reliability.

Open Technology employs a modular approach to enable the use and reuse of technology where it makes sense, and to upgrade to new technologies without redesign. Daughter card processor implementations permit new chip technologies to be introduced without re-engineering the underlying board; and daughter cards can be used for multiple boards. This minimizes design costs, and preserves the investment in technology.

Configurable and Scalable

Excel's EXS family of programmable switches addresses a wide variety of configuration needs in a single logical switch. The system's scalability enables customers to configure their switching resources according to today's needs, knowing that the system can be expanded, where needed and when needed, to address changes in service requirements or growth of the subscriber population. The benefit to the service provider is that you can match your system investment to your revenue stream, improving your return on investment and overall profitability.

Product Line Scalability

The EXS consists of a family of products designed to address a variety of configuration needs. The EXS is Excel's response to true expandability and scalability, including configurations from 100 ports up to and exceeding 30,000 non-blocking ports in a single logical system. This enables service providers to deploy switching resources most cost-effectively, by purchasing only those resources needed to support initial market needs, while ensuring that the system can be expanded to meet growth in the subscriber population or expansion of service offerings.

Entry-level or distributed EXS configurations support 1000 ports in a PC-sized footprint.

Common API

Since the EXS family uses a common API, developers can implement services on one EXS platform and deploy them on the platform that fits the customer requirements. Likewise, a service may be deployed on one switching platform, and, as requirements evolve, the system may be expanded without requiring changes to the software, and without interrupting service.

Configurable Chassis Design

Because the Excel chassis supports a universal card-slot architecture, Excel switches can be configured to address the specific requirements of the customer's application. Except for the matrix CPU and power cards, any card slot can be used for any line or service resource, offering the most flexible configuration environment possible.

Product Line Reliability

The EXS family is built for central office deployment, and as such, reliability is a key requirement for these environments. The EXS internal bus is redundant by design, and the system backbone can be configured for redundancy. Similarly, power supplies and fan trays provide redundancy and backup. All resource cards, as well as the host interconnection, can be configured for redundancy. Even line cards can be configured with "N+1" redundancy, a cost-effective approach to reliability with the network. All cards are hot insertable and removable, so that the system can undergo maintenance or expansion without interruption to service.

High Performance Distributed Multi-Processor Design

The EXS uses a microprocessor technology to distribute processing across every resource in the system. A distributed processing architecture enables each intelligent card to share in the workload, off-loading matrix CPU processing, eliminating overhead on the matrix ports and substantially increasing overall throughput. This is demonstrated in a benchmark conducted by Excel, using an ISDN Feature Group D call model, which illustrates the capacity to support well over 100,000 busy hour call completions (BHCC) on a single EXS shelf, and over 1.2M BHCC on a 15,000-plus port EXS system.

Distributed processors combine with field programmable gate array (FPGA) technology to optimize space utilization, enabling Excel to design very densely populated boards, achieving high performance in a compact chassis.

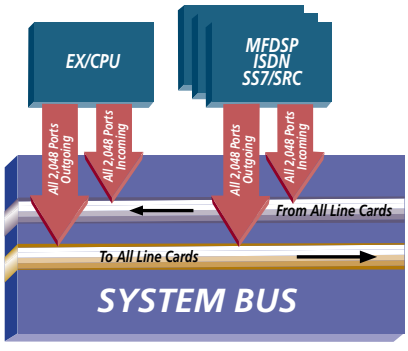
Excel's multi-processor design has many benefits: high performance, better resource utilization, faster time to market, and investment protection via technology re-use.

Selective Space Switching Architecture

One of the most profound capabilities of the EXS design is the ability to distribute telephony operations across all service resources, enabling the system to separate the physical network from logical signaling operations. This results in the achievement of three major design advantages:

- Because service resources use their own timeslot interchange, they do not consume matrix ports, thereby maximizing the number of ports available for network signaling.
- Common Channel Signaling Engines (SS7, ISDN, DPNSS/DASS2) are not tied to network interface cards (T1, E1), resulting in maximum configuration flexibility.
- The independence of resource cards from the network interface cards results in modular, cost-effective, and more flexible expansion of every resource in the system.

Selective Space Switching Architecture



Since processing is distributed across all resources, Excel switches maximize network port capacity and system performance.

The EXS offers unprecedented expandibility and system scalability, plus the ability to connect voice processing resources directly into the switching network.

Service Resources are designed with their own intelligence and a dedicated timeslot interchange on the resource card. While the matrix CPU uses its timeslot interchange to connect calls, other resources can access those ports via their own timeslot interchange, without requiring additional matrix CPU ports. For example, a DSP can attach a DTMF receiver to one or many ports without using any additional matrix CPU ports. Excel's Selective Space Switching technology means that all service resources have access to all ports in the switch directly.

The result is higher performance and optimization of matrix CPU capacity, while maximizing network port capacity.

Excel Switching Platforms

EXS: The Standard in Programmable Switching

The Expandable Switching System (EXS) marks a point of departure in the switching industry. Based on a compact, densely populated design, the EXS delivers 100 to over 30,000 non-blocking ports in a single, scalable switching platform. The EXS takes advantage of Excel's design criteria for open, distributed, programmable, scalable, high performance switching. It uses a distributed multiprocessor architecture consisting of state-of-the-art processor chips operating in companion mode.

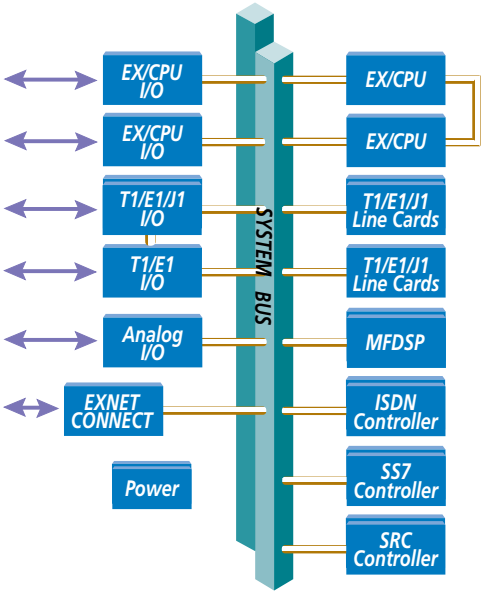
The EXS addresses a primary requirement for CO switching environments: a fully redundant architecture to achieve a level of reliability that is not only required in this industry, but expected. The EXS is based on a dual bus and system backbone internal architecture, uses dual power supplies and fan tray support, and is designed for optional redundancy at the card level. The Matrix CPU card, all service resources, and the host interface cards can be configured redundantly for reliability. Even line cards can be configured for reliability with "N+1" redundancy. And all cards are hot insertable and removable to support maintenance and expansion without interruption.

Each shelf consists of either an EXS 1000 or EXS 2000 configuration. The EXS 1000 is designed to support Central Office (CO) environments, distributed switching, wireless local loop, and in-building wireless applications. It supports 1,024 non-blocking ports in a very compact chassis – the size of a commercial PC. The EXS 2000 supports CO environments for a variety of wireline and wireless infrastructure requirements as well as a host of enhanced service platforms including operator services, debit card, unified messaging and call center operations. It supports up to 2,048 non-blocking ports, and is also compact – four shelves can be supported in a single rack.

EXS systems can be configured to support over 30,000 non-blocking ports, consisting of a combination of Excel switching nodes, connected together over a dual counter-rotating network called EXNET. The first two slots of each shelf are reserved for the matrix CPU card(s) and the last two for power supplies. The remaining slots can be configured as needed to support the following resources:

- Multi-Function DSP cards
- T1, E1 and the Japanese variant J1 protocol cards
- ISDN PRI common channel signaling
- DPNSS and DASS2 common channel signaling
- SS7 common channel signaling
- Subrate Switching Controller
- EXNET Controller, for the EXS backbone
- EXNET Connect for media resources

EXS Architecture



With an open design, all services have access to all resources using a consistant common message interface.

EXS: Advanced Expandability and Connectivity

The EXS is expandable to a capacity of over 30,000 non-blocking ports. This technology was conceived to fulfill a rising need for a switch that can support continuous expansion both in services and in capacity, in order to address the explosive growth in the telecommunications industry. The EXS is an enabling architecture, supporting an integrated switching environment comprised of the following types of services:

- EXS switching shelves
- Voice Resources and Multi-Media devices
- A 1.2 Gbps backbone to support non-blocking access among switching shelves and media resources

Switching Expandability beyond Today

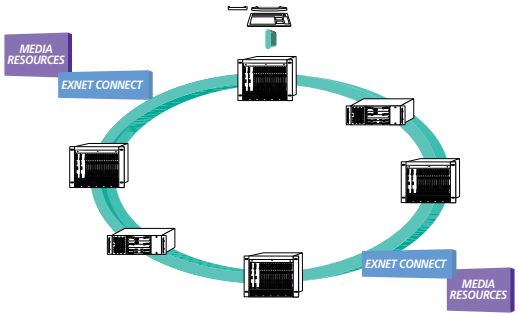
The EXS uses EXNET, a redundant, counter-rotating ring operating at 1.2 gigabits per second, onto which various switching shelves and media devices can be configured. The ring connects into Excel switches via the EXNET Controller, which can be configured for redundancy. Nodes can be added into the network by inserting an EXNET Controller and I/O card; this can be done while the system is in service for seamless expansion.

EXNET Connect

Direct Connectivity to External Resources

The EXS is designed to integrate external voice and media resources, such as interactive voice response, voice recognition, voice mail, and voice over the Internet.

EXS Architecture



Every system resource is accessible to all other resources in an EXS system, and high reliability can be achieved via a dual bus architure and optional redundancy of every major component.

Operating as a node in an EXS network, EXNET Connect can integrate a wide variety of industry standard voice resources into the switching fabric, off-loading host processing overhead, improving performance, improving network capacity and resulting in a consistent user interface. Once operating on the EXNET ring, all switching nodes, thus all ports, have access to all resources connected into the EXS system. To add service and media resources, the EXNET Connect card is installed into the media device, and connects both to the appropriate industry-standard bus and to the EXNET ring.

Configuration Flexibility

EXS networks offer outstanding configuration flexibility. They can be used strictly to provide incremental switching capacity, using one or more switching shelves. They can be used to connect voice resources to the switching environment, giving switching bandwidth to the service resource and eliminating the need for T1 or E1 connection between the switch and the resource, effectively increasing port capacity. Or they can be a combination of both. Another configuration alternative is to construct a private resource network with a single node interface to a switching network.

Line and Service Resources

Line Cards

Each T1 and/or E1 line card supports up to 16 spans, and J1 line cards support up to four spans. The system will support up to 64 spans per EXS shelf, giving a total port capacity of 2,048 E1 ports, 1,536 T1 ports, or 768 J1 ports - or a combination thereof. An Analog card supports up to eight analog channels.

Common Channel Signaling Cards

The SS7, ISDN and DPNSS/DASS2 cards use a centralized packet engine design to allow the dynamic allocation of switching resources. They take advantage of the selective space switching technology with unrestricted direct access to all ports. The ISDN PRI and the DPNSS/DASS2 cards support up to 32 D channels. The SS7 card can be configured for up to 16 links.

MFDSP Card

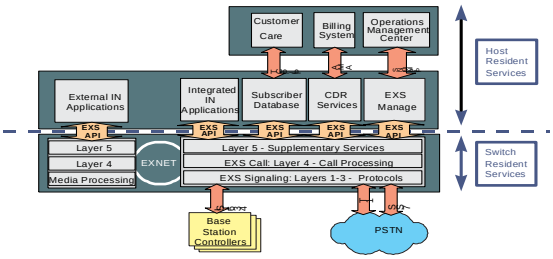
Excel's modular design is extended to the Multi-Function DSP card which, unlike special-purpose DSP technologies, can be used to support multiple features. These include: tone reception and generation, voice recorded announcements, conferencing services, interactive voice response (IVR), Intelligent Network mid-point trigger features, and other similar services. The card is designed using SIMM technology for high density, and supports a combination of DSP and VRA components, including up to eight C31 DSP chips or 200 minutes of Voice Recorded Announcements (VRA).

SRC Card

The Subrate Switch Controller (SRC) enables Excel line cards to support sub-rate transmission speeds, frequently required by wireless service providers. This results in switching at rates of up to 8 calls per DS0, improving the efficiency of digital switching resources, and effectively increasing port capacity of a single shelf to over 16,000 connections.

RBI Card

The RBI enables Excel switches to connect to external voice resources. The RBI consists of a card residing in the Excel switch connected via cable to a card residing in a PC chassis supporting industry standard voice processing resource buses, such as MVIP and PEB. The RBI product offers a low-cost, high bandwidth subsystem interconnect for co-resident voice processing resources. Since voice processing resources usually connect via network channels, network port capacity can be maximized by off-loading voice resources to the RBI.



EXS software provides a sophisticated, API driven, programmable suite of facilities to manage switching and media resources.

True Programmability

Programmability is synonymous with the name Excel. It is provided through the EXS Software, Excel's open programming software environment. EXS Software begins with a rich application programming interface (API), and extends throughout the system architecture to provide an intelligent, distributed software architecture that doesn't place limits on the programmability of the switch.

The benefits of open programmability go beyond programming power. The customer, not the switch supplier, controls the development of new features on the switch: services can be differentiated on a per customer basis; time to market for new services can be significantly reduced; costs can be reduced by supporting any combination of network routing, media support and enhanced services on a single system; system performance can be improved by moving more of the switch-centric call control functions to the switch; and new services can easily be customized to adapt to new business opportunities. With a truly open programming environment, developers can:

- Bring new applications to market quickly
- Customize network T1/E1, SS7, ISDN signaling protocols
- Use common management tools to expedite development
- Support multiple services on one or more host systems
- Integrate media resource processing in the switching fabric
- Improve system performance by moving call processing to the switch, reducing host overhead and increasing total throughput

EXS Software Environment

EXS API	Rich, Distributed Application Programming Interface
EXS Signaling	Based on Excel's PPL technology, extends programmability to line and service resources
EXS Tools	Software support tools that enhance program development and software maintenance
EXS Call Control	Also based on PPL, brings programmability to the Call Control level, enabling multi-applications and integrated Call Control and APIs
EXS Resource	Integrates multi-media resources into the switching environment via industry-std. media APIs
EXS Manage	Unified OAM&P environment

The EXS Software is based on Excel's patented Programmable Protocol Language™ (PPL) technology. It includes the following software modules:

- EXS API, a rich programming environment
- EXS Tools, to support fast delivery of new services
- EXS Signaling, to support worldwide protocol variants
- EXS Resource, media processing on the switch
- EXS CallControl, programmability of all switch resources
- EXS Manage, operations and network management

Software Reliability

Excel's switch software is based on a real-time multi-tasking operating system which takes advantage of the distributed multiprocessor architecture of Excel switches. Where appropriate, the system software supports fault tolerance with fault monitoring, fault isolation and automatic switchover.

EXS API

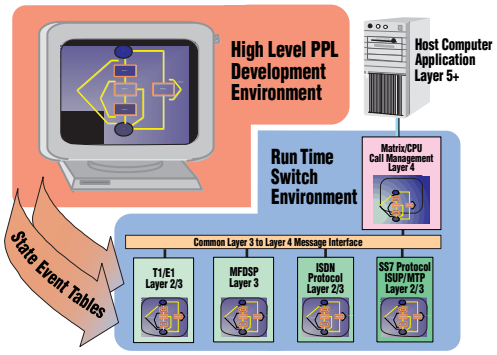
The EXS API is the primary interface that developers use when implementing services. It is designed to address four functions: configuration control, call control, alarms and maintenance, and service resource control. The EXS API consists of a rich message set that places no limitations on the messages or the contents that can be programmed, giving control to host developers and providing the most open programming environment possible.

Programmable Protocol Language (PPL) Technology

The Programmable Protocol Language (PPL) is a patented software technology that gives developers unparalleled power to deploy customized services and features within today's accelerated time-to-market constraints. The PPL consists of two parts: a development environment and a run-time environment. The development environment features a Windows-based graphical user interface (GUI) development tool called the PPL Tool. The program is used to create or modify state event tables.

PPL-based software can be implemented much more quickly than traditional software environments. Since PPL modifies event tables but does not change the underlying software, PPL-based software can be executed without recompiling the system software and without time-consuming regression testing.

Once the tables have been developed, they can be downloaded to the switch using Excel's host to switch message-based API. Once downloaded to the switch, the software is verified and distributed to the appropriate resource. The run-time environment executes on various line and service resource cards in the switch in real-time.



PPL provides high-level protocol development that speeds and enhances the implementation of switch-based services.

Each service card with PPL capability has a common interpreter or engine. The PPL engine processes events and executes software accessing a function library for each resource or channel it is controlling. The PPL engine has an audit capability that can be enabled on a per channel basis to facilitate debug sessions on PPL-enabled resources.

The PPL achieves important design goals:

Increased performance: PPL can be used to off-load host processing by building more functionality in the switch.

Optimized implementation: Because PPL is composed of two environments, each one can be optimized for its function. The PPL tool optimizes ease of development, while the run-time environment is optimized for real-time performance.

Ease of use: The PPL uses a visual, graphical user interface and is self-documenting.

No Software Re-Compiles: PPL modifies downloadable tables, not the system software, thus does not require recompilation, and eliminates the need for regression testing.

Dynamic Protocol Selection: The PPL facilitates the local storage and invocation of protocol variants which are applied on a per component basis. The result is unprecedented flexibility.

PPL Software Library

Excel maintains a library of custom-developed PPL modules addressing a wide variety of custom PPL-driven services that operate on our line cards and service resources. These are available to our customers as individual product modules.

Empowering the Creativity of Telecom

Switching architectures of the future must be able to address the requirements that ONE Architecture is designed to support today. If the global telecommunications market can respond to the anticipated growth in services and geographic reach, only an open, distributed, scalable, reliable and programmable technology will be capable of such far-reaching change. Only ONE Architecture.

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