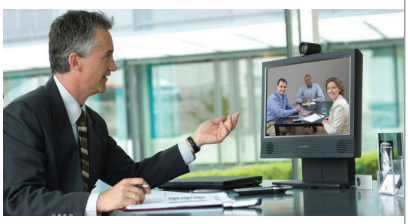

Optimizing Your Video Network: Improving the User Experience. Advantages of the TANDBERG MXP Platform

A WHITE PAPER BY

TANDBERG

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I. Executive Summary

The TANDBERG platform, the Media Experience (MXP), is the base for the broad range of TANDBERG's visual communication product families. This platform introduces an exciting array of features, and this white paper provides an overview of the MXP feature set and the rationale for its development, including considerations such as the increasing importance of open standards in the visual communications space, maintenance of higher quality video and audio transmission, greater flexibility and improved reliability.

Following this discussion is a detailed description of the key advantages of MXP features and the benefits they deliver. Enhancements include advances in the areas of hardware, audio, video, presentations, multipoint, network support, accessibility, quality of experience and security.

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II. Introduction

Overview and Rationale for Development

TANDBERG knew that to retain our technology leadership position in the visual communication industry and to drive video communication as a whole, creating a next-generation platform was a necessity. We took into account our own vision of the future of visual communication, as well as customer feedback across all industries — from small and mid-sized companies to the largest corporations and government agencies. TANDBERG saw a need for:

- Enhanced quality (in terms of image, sound, and data — total quality of experience)
- Superior reliability
- Improved integration support
- A significantly advanced platform that would support future development

Rapid advancements have been made across the spectrum of video communication technology. The TANDBERG MXP platform builds in powerful processing capability to handle these advancements and those expected to come. By creating such a robust platform ready to support new, advanced features, TANDBERG aims to accelerate development to meet customer demands and create a foundation from which new features and functionality can be easily deployed.

MXP ADVANTAGES

- Superior video quality with High Definition
- True CD-quality Audio, Stereo and Hi Fidelity Digital Natural Audio Modual (D-NAM)NAM
- Enhanced Video Quality
- Expanded Digital Interfaces
- New Control & Integration Options
- Expanded MultiSite Flexibility
- Improved Display & Screen Layouts
- Easier Use with On-Screen Menus, New Remote Control

MXP — Delivering Best Value

The TANDBERG MXP platform is designed to deliver the best value in visual communication solutions. It accomplishes this through truly state-of-the art hardware developed specifically to support the continued growth of the MXP platform through software enhancements that will provide the latest in standards-based features and functionality.

The MXP platform's ability to scale in software rather than in hardware, represents a much increased return on investment over providers who depend more heavily upon hardware-based upgrade paths. TANDBERG's MXP approach lowers total cost of ownership, while also providing unsurpassed media experience for the user. Since the MXP platform underpins the entire TANDBERG solution portfolio, including infrastructure and endpoint products, users enjoy a single familiar interface and feature set no matter what solutions they are using.

The TANDBERG MXP platform helps us meet customer expectations of quality and usability in audio, video and multimedia presentation — the full spectrum of communication.

III. Compatibility & Interoperability

TANDBERG, through the MXP platform, continues to lead the industry in developing powerful products and features (such as broadband audio, high resolution video, security) that drive deployment within an organization. Open standards are key to this ability, and the MXP feature set affords the maximum in multi-vendor interoperability, component longevity and total return on your investment. Developing the MXP platform with adherence to standards avoids the pitfalls associated with proprietary technologies, which are by nature manufacturer-specific, limiting interoperability in increasingly multi-vendor video environments and making universal connectivity expensive or impossible to achieve. Adhering to standards also enables TANDBERG to integrate with organizational tools such as those from IBM, Microsoft, Cisco and Nortel.

Using proprietary technologies runs the risk of limiting flexibility, and locking an organization into the options offered by that particular manufacturer – from endpoints through infrastructure products. In today's world of mergers, acquisitions, rogue departments, and other business realities, no business or organization can assume they will operate solely on one visual communication platform. The consequences of adopting a less flexible, proprietary standard are functional isolation, higher IT costs, organizational fragmentation and lack of cohesion throughout and between organizations. Productivity, speed to market, and dynamic collaboration suffer.

By contrast, open, standards-based technologies such as the MXP platform deliver superior investment protection through backwards compatibility and interoperability over the long term. Standards-based technologies are much more likely to benefit from developer and integrator support. TANDBERG's MXP features are designed to deliver these open standards benefits, by being highly accessible to developers, flexible, customizable, powerful, and easy to integrate and use.

Adhering to standards-based technologies protects against dead-end technology and lowered return on investment. The standards-based MXP platform therefore encourages long-term productive life spans of the products, maximizes ROI, and effortlessly supports the multi-vendor, multi-network environments in which most organizations operate.

IV. MXP Architecture

The MXP platform is based on the latest multimedia processing technologies. This affords a robust, fast and very capable processing foundation to support all system operations, from endpoints to infrastructure products, such as the TANDBERG MPS.

In the sections below, we describe specific MXP enhancements, explaining the benefits each delivers to users, IT managers, and integrators. These features are supported throughout the complete TANDBERG MXP product suite, including endpoints and infrastructure products.

MXP Audio

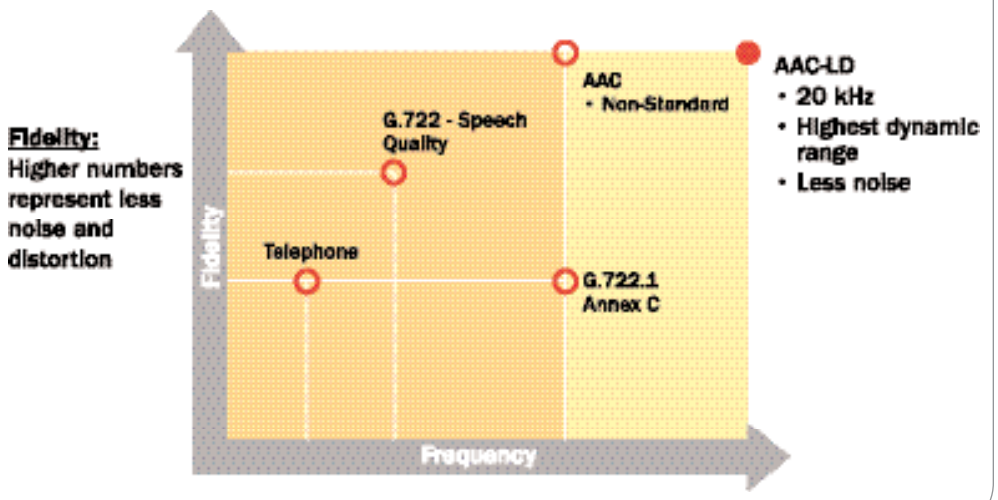
"Major benefits that the new MXP technology delivers include...Digital audio technology with true CD-quality sound and the dynamic experience of stereo...great if you're incorporating multimedia into your meeting."

The Wainhouse Research Bulletin
Vol. 5 #27, July 12, 2004

With MXP, TANDBERG builds upon its recognized industry leadership for delivering highest quality audio. TANDBERG's 20 KHz audio provides excellent fidelity, and a low signal-to-noise ratio, and brings digital audio technology with the industry's finest **CD-quality** and **stereo sound** to the visual communication experience.

The MXP technology supports the MPEG4 AAC-LD standard ratified for use under H.320 and H.323 by the International Telecommunication Union (ITU) — an open standards organization that encourages interoperability, development and support.

High Quality Audio: How does it compare?



In addition, significant advances are delivered by TANDBERG's **echo cancellation** design. Each microphone input has its own separate adaptive echo canceller, so what goes into one microphone is independent of what goes into another microphone. This is a key difference setting TANDBERG apart, giving greater flexibility in design and implementation.

Each TANDBERG microphone input is processed independently, plus, the TANDBERG 6000 also has echo cancellation on line level inputs, independent of the microphone inputs. This allows individual definition, easier handling of different feeds, and accommodation of room areas with varying acoustic properties.

S/PDIF (Sony Philips Digital Interface) digital outputs are on many MXP products, affording highest quality digital output. The key benefit to the integrator and user is a standard interface for stereo audio.

VCR ducking provides audio flexibility during presentations, reducing the audible volume level of your tape, DVD or other audio media during participant conversations, allowing conversation prominence. When participants' conversation abates, VCR ducking ramps up the gain automatically to normal presentation volume.

Additional Enhancements:

- Individual gain setting for all audio inputs and outputs
- On-screen meters of audio levels
- Standard XLR connections for microphones
- Stereo input (RCA L/R)
- Stereo output (S/P DIF and RCA L/R)
- Digital Audio Sound System (D-NAM)
- High Quality Stereo Speakers (optional on some systems)

MXP Video

The MXP platform delivers a variety of enhancements to the implementation and quality of video in visual communications. In addition, the MXP platform now delivers native widescreen formats including HD, w228p, w448p and w576p. Existing 4:3 displays also have increased resolution choices with 448p/400p resolutions now supported. To assist users to sustain highest quality video even on low bandwidth calls, the TANDBERG MXP platform **supports H.264 video,** the latest video compression algorithm, in all call configurations (point-to-point, multipoint, dual stream, and encryption). This also conveys advantages across the entire bandwidth range, enhancing video quality at bandwidths up to 2Mbps as well.

The MXP video subsystem interface builds on the previous TANDBERG 6000 interface, affording additional flexibility, customization, and full control over how the system is configured.

MXP provides **increased VGA input,** plus **DVI-I** for both digital and analog input/output options, giving easy backwards compatibility with both VGA and DVI standards. The **digital video interface** provides participants with exceptionally high quality images, as well as native support for HD imagery.

This MXP video functionality allows great flexibility in deciding what images will be displayed where, and when. Users can push any video source or any menu to any output: this would enable a presenter to view menu options on a small control monitor, previewing and adjusting images before the rest of the participants see them, in order to reduce distraction and increase presentation impact and flow.

Virtual Monitor Support

Embedded into the TANDBERG MXP codecs is a powerful **video router** that delivers robust video image control. The 6000 MXP codec has four video outputs — two video (Composite or S-Video), two digital DVI-I outputs — and each output is independent of the other. Each output supports multiple screen layouts; full screen with picture-in-

picture (PIP), quad split, 5+1 (one lager image and five smaller), 3+1, (one larger image and three smaller) and side-by-side (two equally sized). Since each of the outputs supports all image formats, there is a very large array of possible display combinations.

TANDBERG's control interface is of specific benefit to integrators, enabling them to build any sort of image that is required, for even the most sophisticated configurations (such as video walls with picture-in-picture, etc.). The MXP control interface affords the ability to route the transmit main source, the transmit secondary source, and any of the receive sources to any output and also to any display, using any of the various supported formats. This highly flexible, customizable video router feature set is a unique feature of the MXP platform, setting it apart from its peers.

Illustration of Virtual Monitor Support

Monitor 1
Video

Monitor 2
Video

Monitor 3
XGA

The DVI-I allows for several key improvements. First, users no longer have to manually change and set their PC resolution and display settings when sending presentations, increasing ease of use and reliability. This is because all MXP systems except the 150 have increased the PC input by supporting up to **SXGA (1280 x 1024).** TANDBERG implemented the EDID standard, so that the codec and PC automatically negotiate the optimum resolution between the laptop and the MXP system.

The MXP also includes **improved power management** functionality through EISA Power Management, which automatically puts the monitors in sleep mode when entering its power save mode. This is particularly important for plasma monitors in order to avoid the burn-in of images and subsequent persistent ghost images. This power management feature saves the step of having to program this function into the system, making integrators' jobs easier. In addition, the MXP PC output now optimizes **HD** and other wide video formats as well as **NTSC/PAL** video on VGA (via the XGA output) for excellent image quality.

MXP Presentations

TANDBERG's latest technology brings advanced display features that allow integrators and users to fully leverage digital displays and projectors. Dual Stream **(H.239/DuoVideo)** is supported with any video source, for sessions combining participants and content. With the MXP's **improved display features,** a broad selection of screen layouts is available, and the preferred layout of participants and rich media on a single monitor can be selected with the touch of a button.

The MXP platform also supports these multiple display styles on wide screen **(16:9 aspect ratio)** monitors without distortion, an enhancement that sets MXP endpoints apart.

The MXP platform allows users to maintain both PAL/NTSC and widescreen images in their native formats, to avoid the problems of translating images and instead retain highest image quality, especially for high resolution images with a **digital video interface** that provides for accurate plasma and LCD imaging. The MXP units can run all presentation images through the DVI-I output, so that, for example, if one participant is sending a PC image, it does not need to be translated to an NTSC image, which would decrease the display quality of that image.

MXP MultiSite

TANDBERG MXP technology delivers greatly enhanced features in the embedded MCU (MultiSite environment). Users can enjoy extremely high image quality (even at lower bandwidths) and rich media sharing while maintaining face-to-face communication. Call security is maintained, even when collaborating among multiple sites, thanks to MXP's support of a variety of protocols, including H.264, AES and dual streams.

TANDBERG MXP affords users the **highest number of participants** for internal MCU calls – up to a maximum of six video and five audio participants for the 6000 MXP system (6+5). The ability to bring in multiple audio-only participants is a significant advancement by TANDBERG.

Each of the expanded number of participants can link to the call at the highest possible quality for their own system, without degrading the experience of the other participants. TANDBERG has accomplished this by adding two new features critical to call reliability — embedding both **rate matching** and **transcoding** into the MultiSite features.

Previously found only on stand-alone bridges or available solely as costly options, transcoding and rate matching dramatically improve the overall call experience. Transcoding allows different video and audio protocols to combine within same conference. Rate matching allows different systems to join the same conference at different speeds. These features allow people to connect — so that users with older systems can participate right along with those with the newest systems, across all manner of networks, allowing the best quality possible for each participant, with no "drag down" to the lowest common denominator.

Illustration of MultiSite Layouts


Voice Switched


CP4


5+1

MXP Integration

Seamless video system integration is a hallmark of the MXP platform. For example, the generic codec provides interfaces for every conceivable configuration requirement, necessitating fewer external components. Each unit supports multiple network types, as well as most universal audio and video connectors, making TANDBERG codecs ideal for integration.

For example, interfacing a TANDBERG MXP solution with existing multimedia systems — such as projection, audio conference or audio reinforcement systems — is made easy with the MXP systems. Integrating content in a rich media conferencing room and enabling content to be pushed both locally and over video can be accomplished with ease, as MXP codecs support multiple media interfaces in various formats — even from multiple sources simultaneously.

MXP Network Support

Key advances in the network area provide higher quality call transmissions, easier configuration, and simplified usage. As a pioneer in the area of network fault tolerance, TANDBERG developed standards-based **downspeeding technology** in the mid-90s to improve call reliability on ISDN-based networks. TANDBERG has implemented this technology on IP to maximize overall performance. In addition, TANDBERG has developed IPLR (intelligent packet loss recovery) which helps to adapt for packet loss in packet networks, improving video when operating in a lossy network environment — that is, if video calls across networks experience packet losses, the audio, video and data transmissions will remain more stable and call terminations will be dramatically reduced. This radical improvement works with any vendor's equipment, both on the sending and receiving side. TANDBERG has also implemented a standards-based mechanism for audio packet loss recovery.

To provide maximum configuration flexibility, the MXP platform accommodates a variety of **network types.** For example, the 6000 MXP supports IP, two flavors of ISDN (BRI and PRI) and serial (V.35/RS449/RS530) interfaces directly on the units. **Maximum speed** is 4 Mbps point-to-point and 6 Mbps in MultiSite.

TANDBERG continues to improve the user experience by eliminating the cumbersome process of manually switching from internal to external IP address settings. **AutoNAT** (Network Address Translation) ensure that TANDBERG's MXP codecs automatically adapt, knowing when users are calling within their private network or outside to a public network — no user input is required.

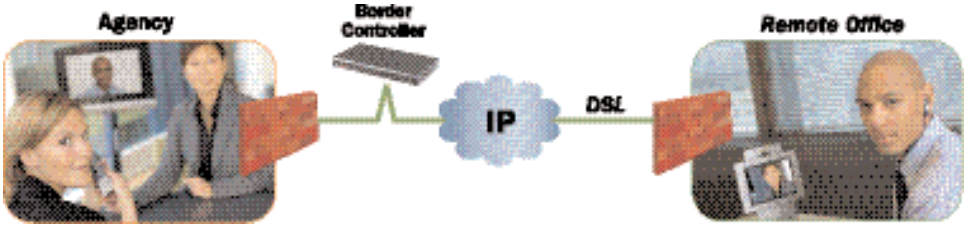
Firewalls & Accessibility

IP-based video solutions offer the promise of fast, efficient, cost effective organizational communications. However, firewalls, network protocols and disparate dialing schemes have presented significant hurdles to more widespread adoption of video over IP solutions, both within and between enterprises.

TANDBERG Expressway is an H460.18 and H460.19 standards-based solution that allows seamless traversal of firewalls, allowing users to communicate with video across public networks and still maintain network security. In addition, TANDBERG Expressway overcomes the challenge presented by disparate dialing schemes, providing a simple, protocol-independent dialing plan that is easy to implement and use.

All TANDBERG MXP products are Expressway-enabled, thereby providing integrated support for secure, IP-based video communications as well as easy dialing across different network protocols.

Secure Firewall Traversal



Quality of Experience

Even first time users of TANDBERG MXP-based systems will find them easy to set up, as well as simple to initiate and manage a conference. Straightforward, icon-based interfaces make usage intuitive, even when adding multimedia presentations and additional participants (multipoint conference calling). On-screen menus and an easy to use remote control make navigating processes and options fast and efficient.

On-screen symbols and descriptions make using the MXP systems virtually effortless.

The new streamlined MXP remote features auto system wake-up and large, easy-to-read keys.

Security

The TANDBERG MXP platform affords both content and access security. **Content security** is ensured by AES/DES encryption, which encrypts all audio, video and data that are sent at maximum, government-approved security levels. This is accomplished automatically — complete with key exchanges, automatic secure keys, and unique one-time (non-reused) keys. TANDBERG was first to bring AES to visual communications. Again, TANDBERG is committed to open standards by implementing ITU approved encryption mechanism on both H.320 & H.323 networks. Access security is provided by H.235 authentication which requires the MXP system to 'log in' to the video network and receive a customized call policy set up by the video network administrator. The MXP platform now supports IEEE 802.1x network authentication to ensure that TANDBERG solutions can connect to a network secured through IEEE 802.1x.

MXP systems also provide **access security** to ensure that the device itself is secure. For example, systems can turn off various protocols such as HTTP, FTP and SNMP if they are not being used. What's more, the system will notify administrators of failed log-ins, reporting the source IP address, what protocol was used, and the time of day the failed attempt was made — all through the management system. Additionally, MXP systems supports protocols like HTTPS, MD-5 challenge and others for encrypted management.

V. Summary

The TANDBERG MXP platform delivers the optimal user experience and best value — that is, the highest performance, best quality, and rock-solid reliability for any organization's mission-critical needs. The MXP platform was designed with powerful capability built in to accommodate tomorrow's technology advances — thereby "future-proofing" your investment in a visual communication solution.

For clients wishing to gain the greatest return on their investment, the TANDBERG MXP-based product line delivers feature sets that break new ground in this industry, in an architectural environment of open standards to ensure maximum interoperability. The MXP support of open standards helps to encourage continued development, and ensures maximum investment protection.

The MXP platform is both more reliable and secure, providing an ideal visual communication solution where extremely sensitive, real-time requirements make highest quality communications imperative.

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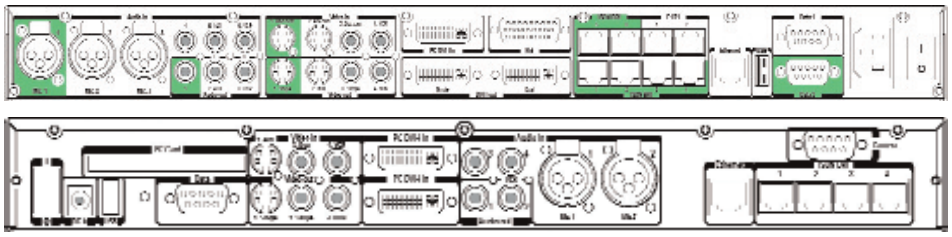
Addendum A

CODEC Connectivity Illustration



Top Illustration: Rear Panel, TANDBERG 6000 MXP; Bottom: Rear Panel, TANDBERG 3000 MXP

Product Specification Matrix

Feature	3000 MXP	6000 MXP
Bandwidth	384k V.35/512K ISDN/2M IP	2M V.35/2M ISDN/4M IP
Multisite Bandwidth	2.3 M	6 M
Sites In Multisite	4 Video + 3 Audio	6 Video + 5 Audio
Network Interface	10/100 Ethernet, 4 BRI, V.35/RS-366*, Wireless	10/100 Ethernet, 6 BRI, 2 PRI, V.35/RS-366
XGA Input	1 x SXGA In (DVI-I)	1 x SXGA In (DVI-I)
XGA Output	1 x XGA Out (DVI-I)	2 x XGA Out (DVI-I)
Video In	1 x S-Video, 2 RCA Composite, 1 x DB-9 (main camera)	2 x S-Video, 2 x RCA Composite
Video Out	1 x S- Video, 2 x RCA Composite	2 x S- Video, 2 x RCA Composite
Audio Input	2 x XLR, 2 RCA Line Level	3 x XLR, 3 x RCA Line Level
Echo Cancellers	2 separate (for XLR inputs)	4 separate (for XLR in and 1 line level)
Control	1 x RS-232, Telnet, XML	1 x RS-232, Telnet, XML
Power	12V DC or 110/220 AC Auto Sensing Power with adapter	110/220 AC Auto Sensing Power

** V.35 is optional and replaces 4BRI*