МУЛЬТИМЕДИЙНАЯ ДИЧЬ В ВАШИХ СЕТЯХ И КАК С НЕЙ ЖИТЬ

Виктор Шопин

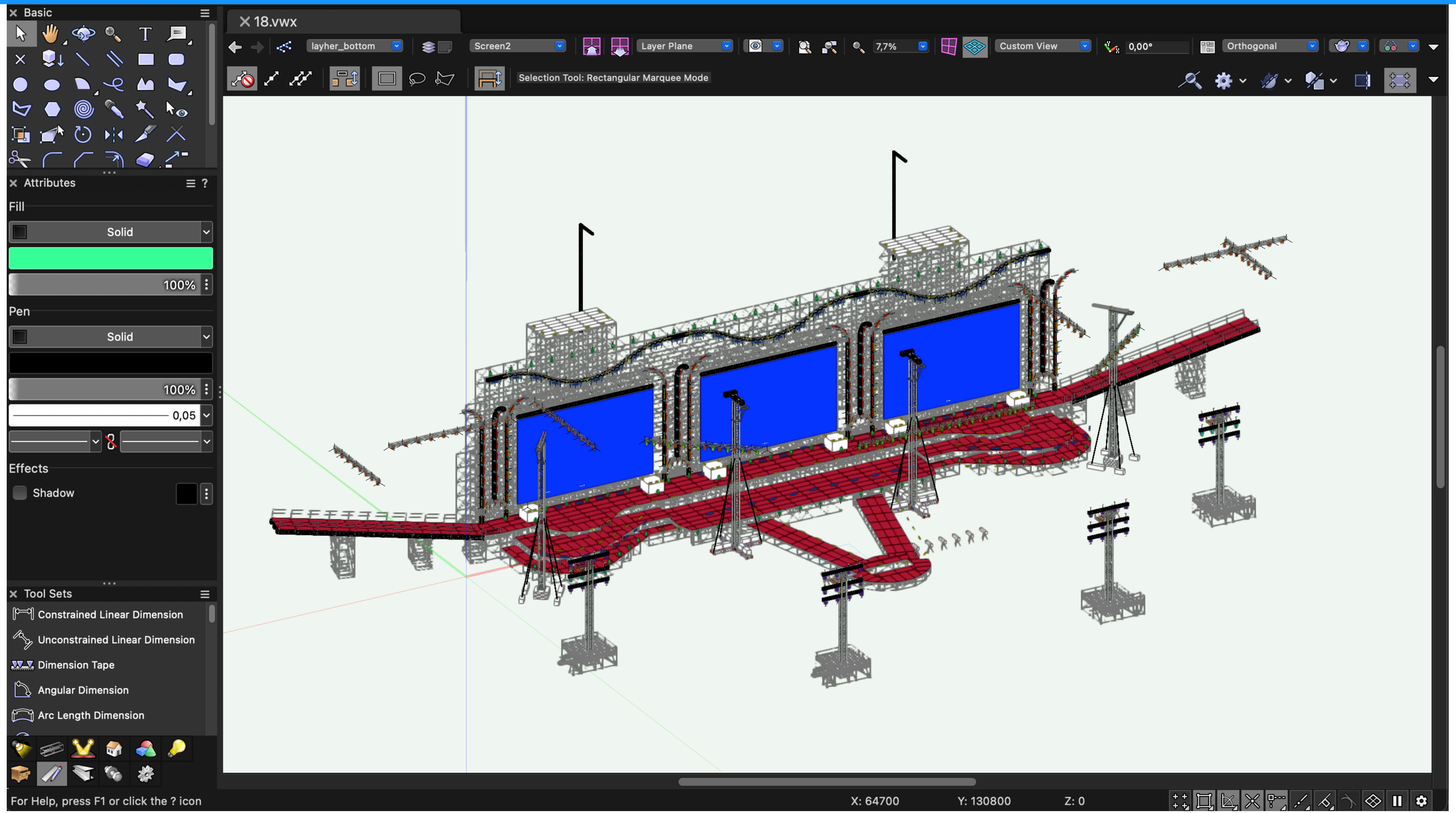
Архитектор систем визуализации и управления комплексными объектами и шоу-программами

Инженер технической поддержки видеоцеха исторической сцены Большого Театра

Руководитель центра дополнительного образования **PRAKTIKUM.SCHOOL**

Основатель и директор производственной компании IRON OPTICS

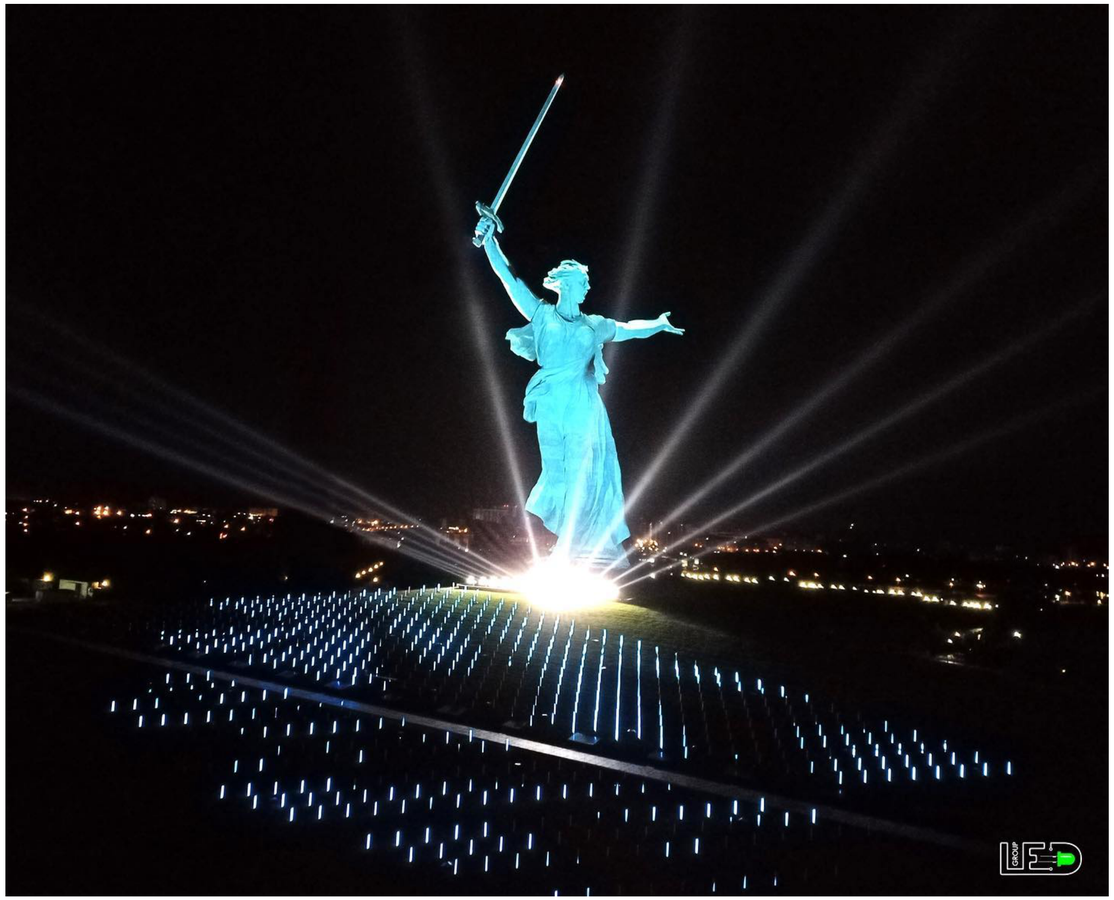
МУЛЬТИМЕДИЙНАЯ ДИЧЬ В ВАШИХ СЕТЯХ И КАК С НЕЙ ЖИТЬ



Художник по свету - Марина Ларикова

МУЛЬТИМЕДИЙНАЯ ДИЧЬ В ВАШИХ СЕТЯХ И КАК С НЕЙ ЖИТЬ

Художник по свету - Марина Ларикова



Торжественное празднование 75-й годовщины Победы в Великой Отечественной войне (24.06.2020)

Сеть передачи данных со скоростью 10 Гбит/с, оптическая трасса с сегментом 500 м

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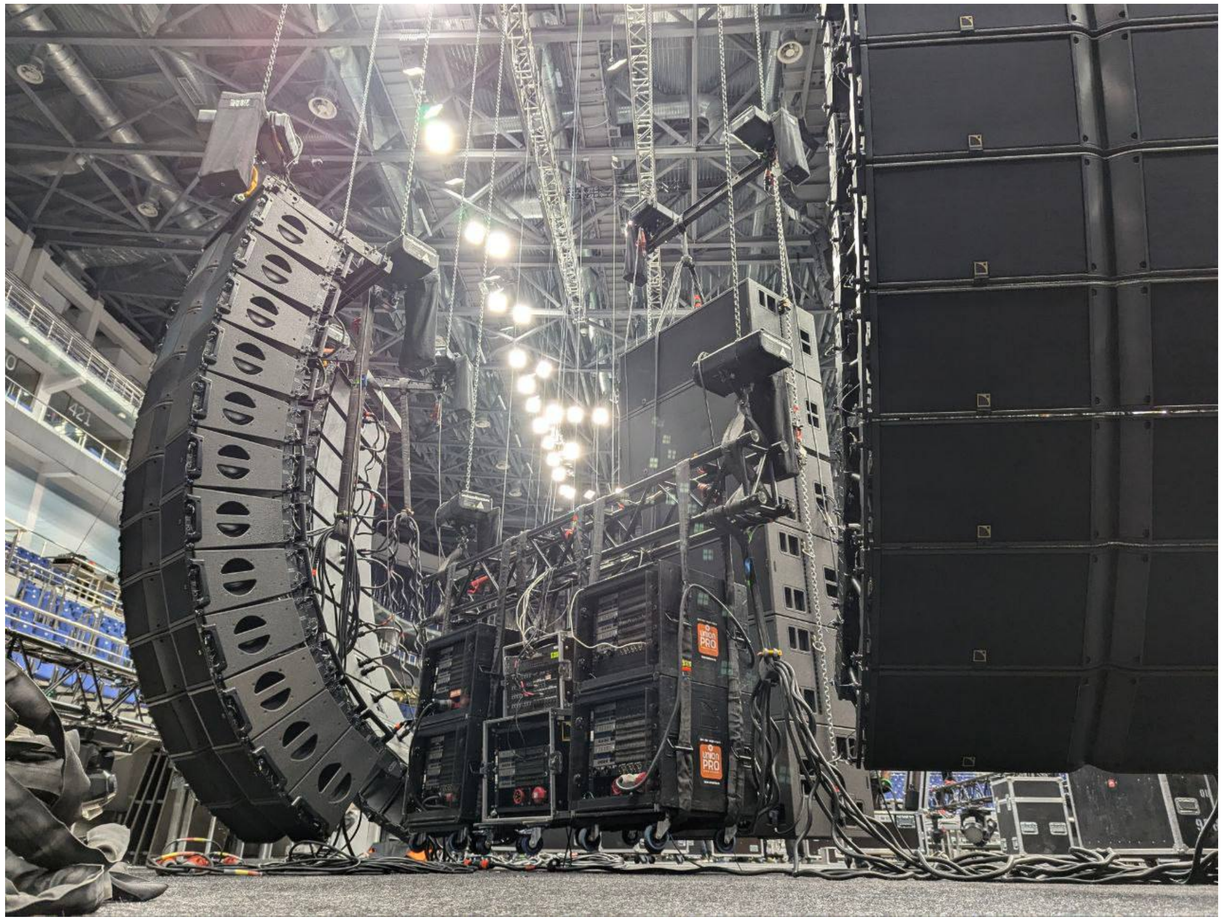
Полина Гагарина в Лужниках. 29.06.2024

Полина Гагарина туровое шоу

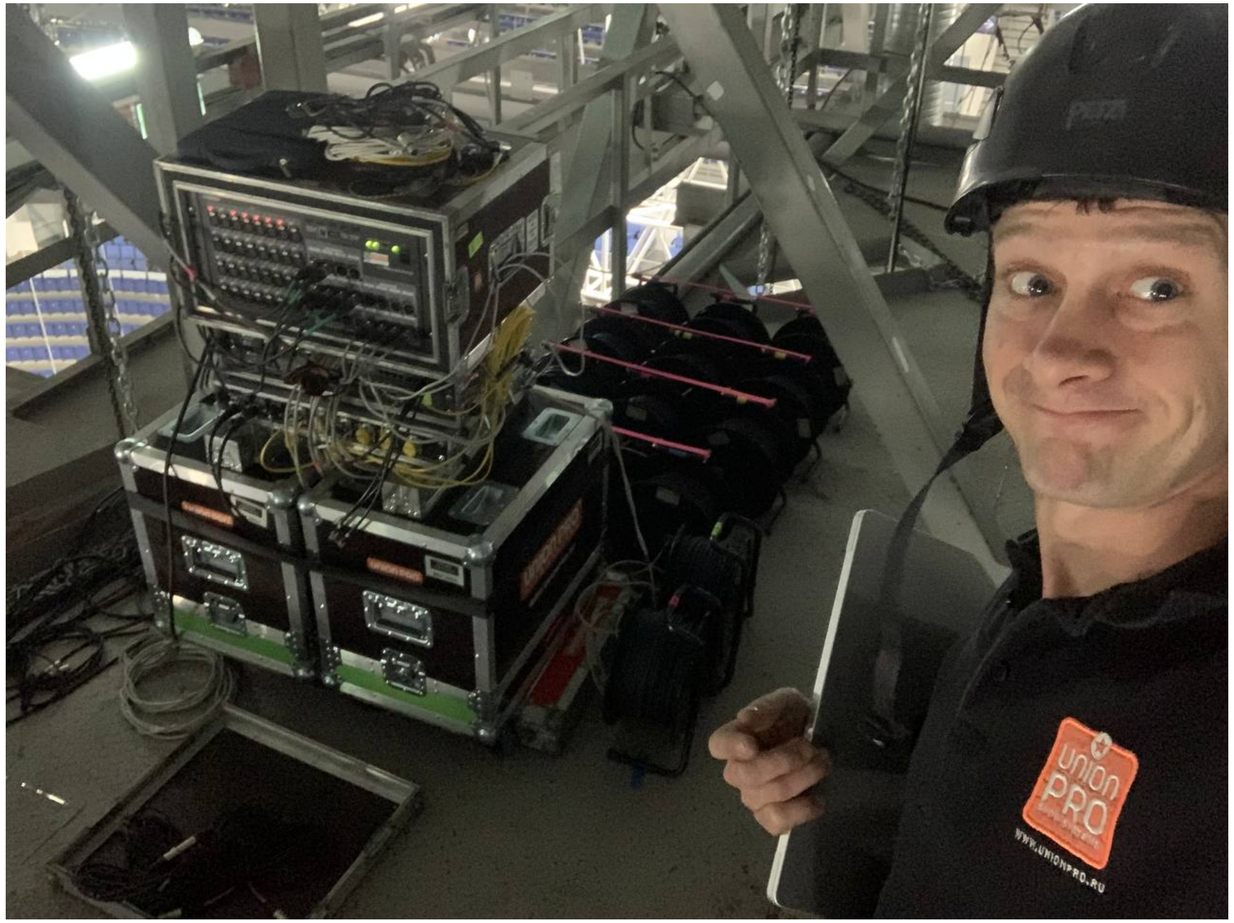
Rental company - RentSound
Video engineer - Alexey Pavlenko
Lighting designer - Maxim Ponomarev



Шоу тысячи музыкантов в ЦСКА-Арене 29.06.2024

Системный инженер проекта - Михаил Провозин

Реализация проекта - компания UNION PRO



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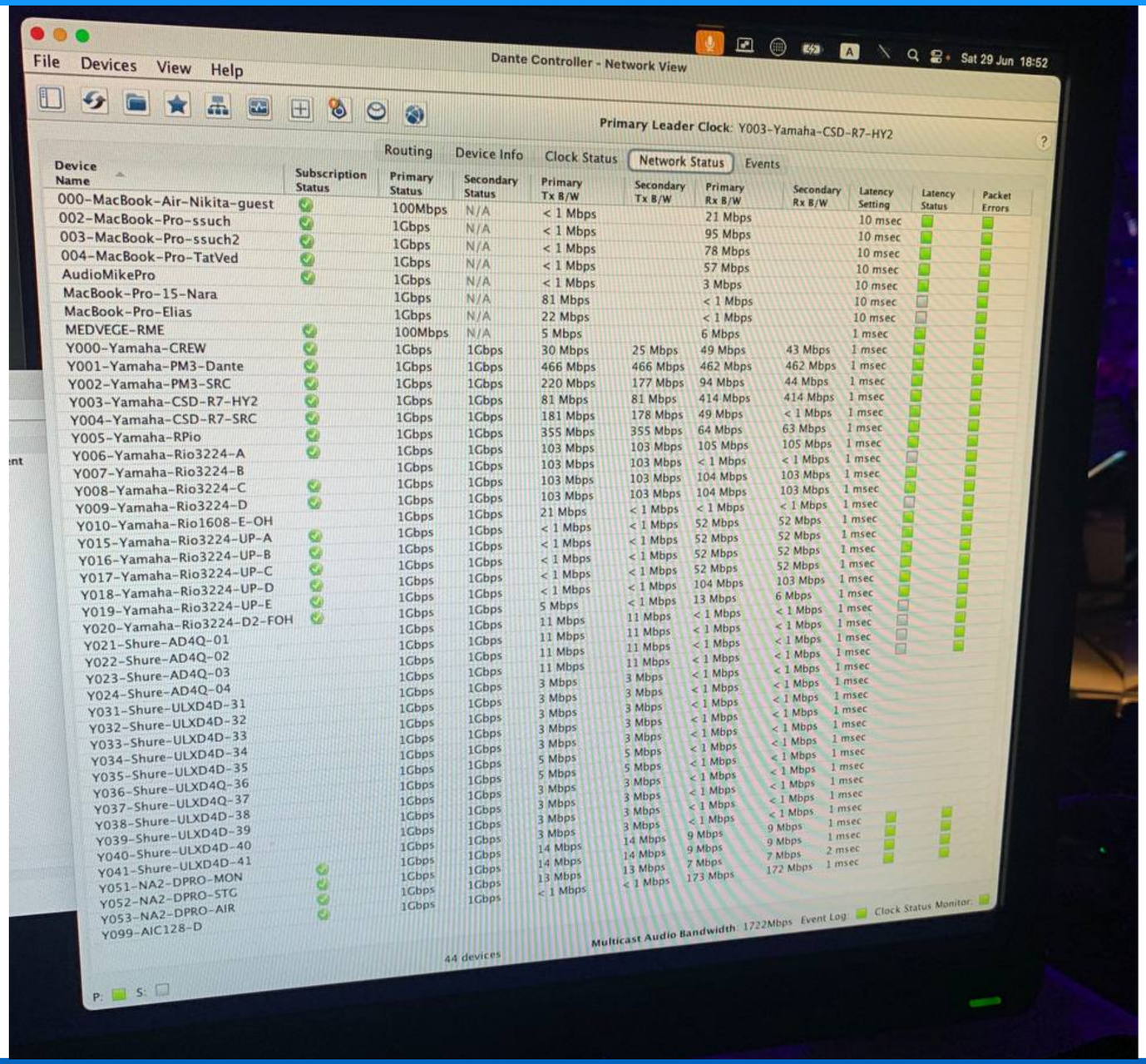


1,7 Гбит/с несжатых аудиоданных в режиме MULTICAST

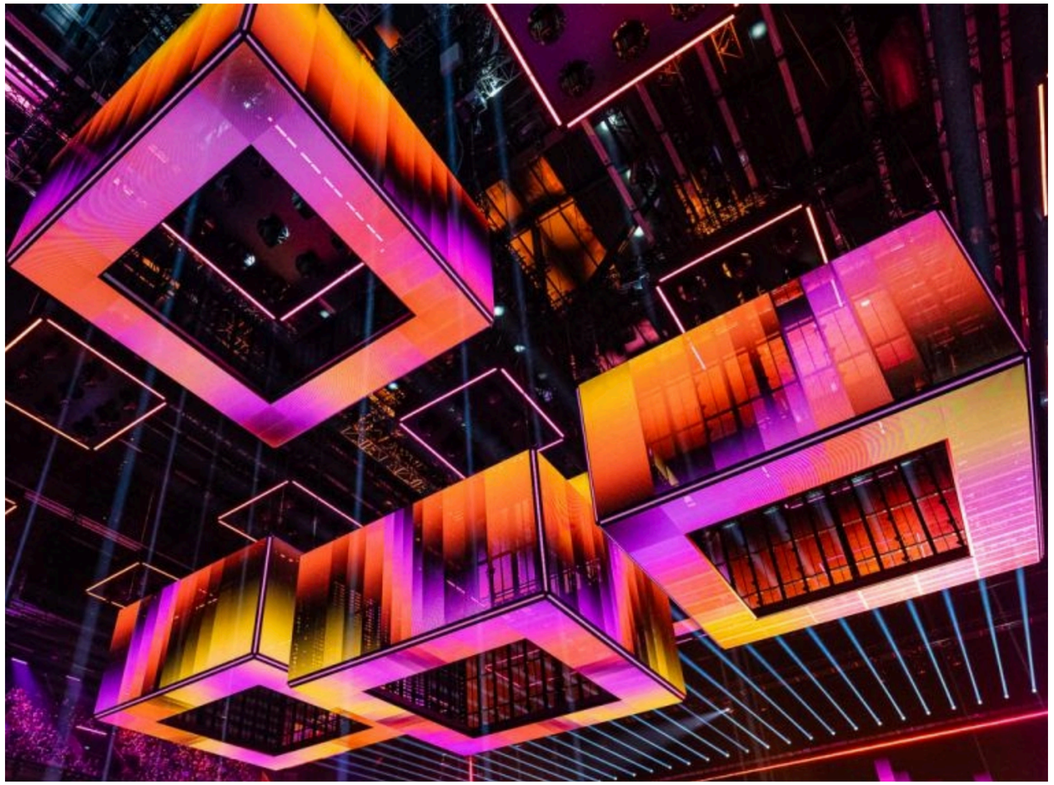
Переход в IP

NEWS

Disguise enables the first large-scale live broadcast running full ST 2110 for Eurovision Song Contest 2024

Live Events | Music | Hardware | Software | Workflows

Share



Переход в IP

Emil Højmark
Jeff Putz 203.000 parameters - 1 session with PUs for All 250.000 parameters.
19 desks - 96x 8port nodes. 44 Luminex switches..
760 universes +680 universes pixelmapped from video merging into the MA session - 350+IP adresses on the LX network.
And MA is indeed supporting on site.

2 д. **Нравится** **Ответить** **Поделиться** Отредактировано 5

Jeff Putz
Emil Højmark that's nuts! I've watched some of the YouTube vids for prior years, and I love how epic the rigs are year after year. Is all of that on one network, or is physically segmented for some reason?

2 д. **Нравится** **Ответить** **Поделиться**

Emil Højmark
all departments networks are fully separated - Video is running ST2110 for everything, transporting more than 2,3TB/Sec of content.

In regards to LX, its one big network. 10GB Trunk connecting FOH with the 2 main Data worlds - and then 1GB Trunks to the 2 other Distro locations. on top of this, 48 universes sACN to and from the Follow-Me system.
really a huge but cool system!

2,3 ТЕРАБАЙТ данных в секунду для 1 концерта

Переход в IP

SMPTE
MEDIA
TECHNOLOGY
SUMMIT
PUTTING THEORY INTO PRACTICE
SESSION
Eurovision 2024 Case Study: Transition to ST 2110
Presenter: Jeremy Hochman, Co-Founder & CEO - Megapixel
Presenter: Scott Blair, VP Product & Project Management - Megapixel

Переход в IP, бюджетное железо

Blackmagic 2110 IP Converter

NEW

Blackmagic 2110 IP Mini IP to HDMI

Monitor 2110 IP video and audio on any HDMI monitor or TV. Compact design connects and powers from 10G Ethernet and supports HD and Ultra HD standards to 2160p60. Also includes DC power supply.

$295

Buy Now

NEW

Blackmagic 2110 IP Mini IP to HDMI SFP

Monitor 2110 IP video and audio on any HDMI monitor or TV. Compact design connects using 10G Ethernet SFP optical module and supports HD and Ultra HD standards to 2160p60. Includes DC power supply.

$295

Buy Now

NEW

Blackmagic 2110 IP Mini BiDirect 12G

Convert broadcast cameras with SDI connections to 2110 IP video systems. Connects and powers from 10G Ethernet and supports all HD and Ultra HD standards to 2160p60. Includes 5 pin XLR talkback.

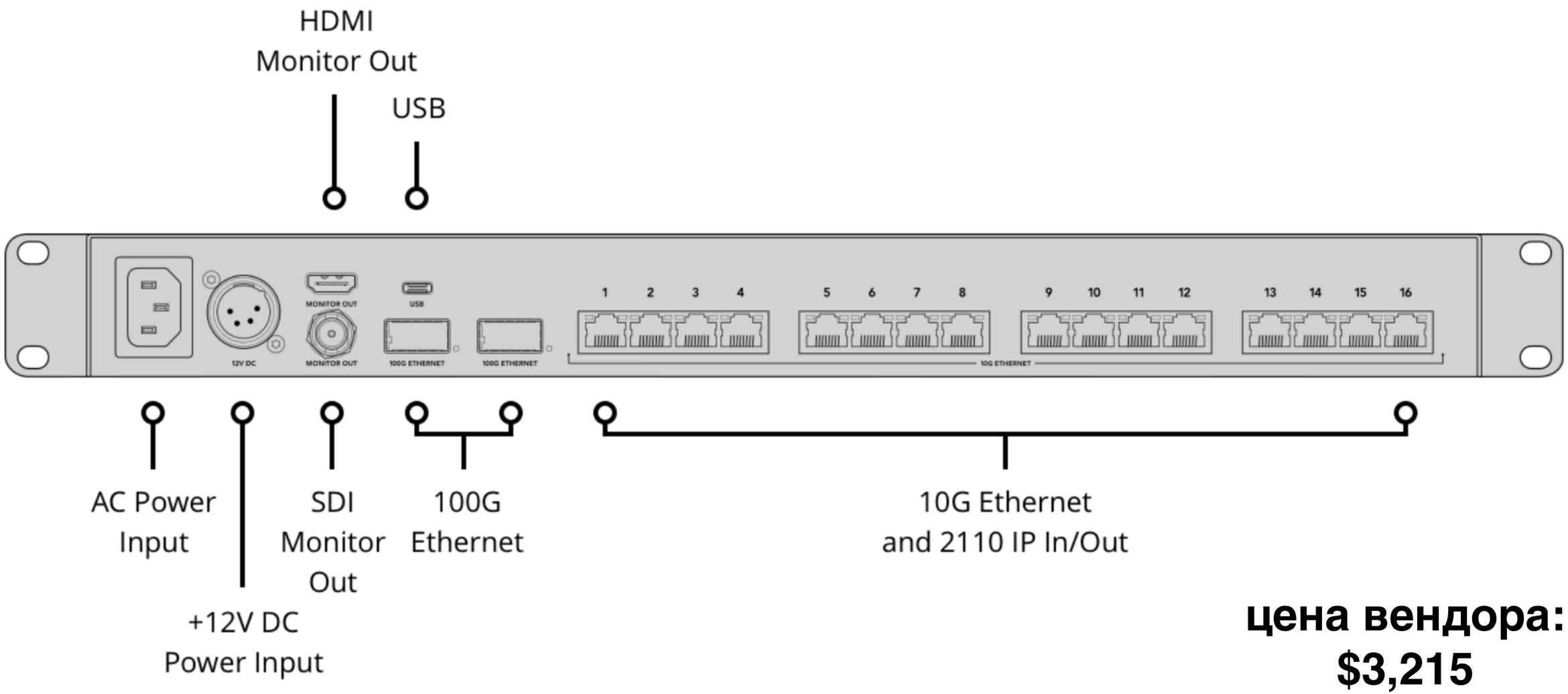
$365

Buy Now

Переход в IP, бюджетное железо

Идеология plug’n'play - сетевых настроек на коммутаторе НЕТ

Переход в IP, бюджетное железо



цена вендора:
$3,215

Технологии шоу-индустрии и мультимедиа

РЕАЛЬНОЕ ВРЕМЯ

UDP - это наше ВСЁ!

Технологии шоу-индустрии и мультимедиа

Несжатое потоковое аудио
Несжатое потоковое видео
Контрольные сети

Технологии шоу-индустрии и мультимедиа

Классические IP-сети
Датацентровые топологии

Оптика
DWDM
...

Используется всё, что решает задачу

АУДИО-ВИДЕО по IP

CobraNet
EtherSound

RAVENNA
AVB
DANTE
AES67
…

?

SMPTE ST 2022-4
SMPTE ST 2022-6

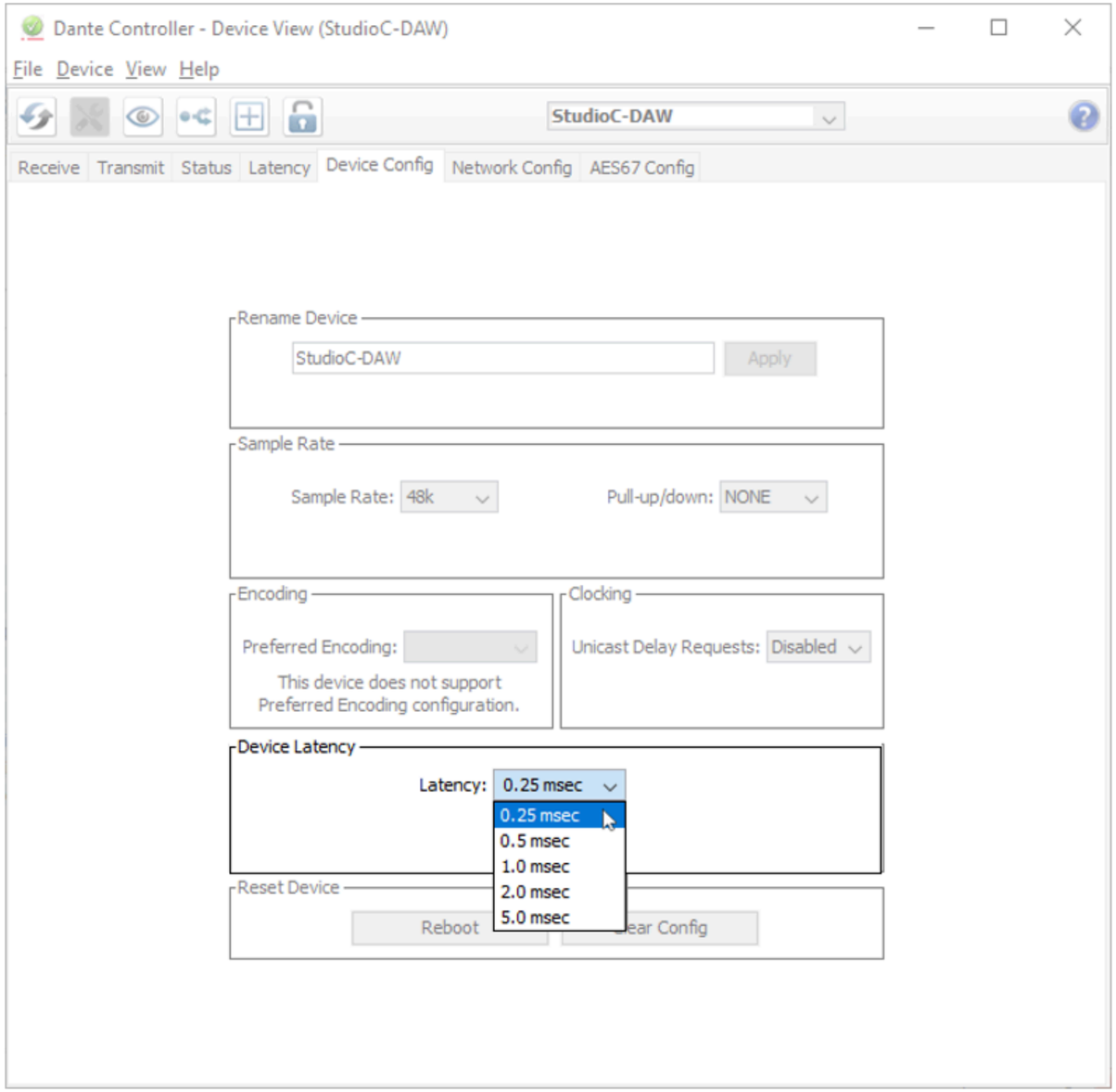
NDI
DANTE AV

SMPTE ST-2110
…

Для работы сетей для АВ-индустрии нужно учитывать и знать

Время (допустимые задержки)
Полосу пропускания
Спецификацию протоколов и методы передачи данных (unicast, multicast, broadcast)

Нужны ли специфические функции от сетевого железа и сетевых интерфейсов (ptpv2, gptp и тд) ?


Dante Controller - Device View (StudioC-DAW)
File Device View Help
StudioC-DAW
Receive Transmit Status Latency Device Config Network Config AES67 Config
Rename Device
StudioC-DAW
Apply
Sample Rate
Sample Rate: 48k
Pull-up/down: NONE
Encoding
Preferred Encoding:
This device does not support Preferred Encoding configuration.
Clocking
Unicast Delay Requests: Disabled
Device Latency
Latency: 0.25 msec
0.25 msec
0.5 msec
1.0 msec
2.0 msec
5.0 msec
Reset Device
Reboot

Сигналы часто имеют фиксированную полосу и не меняются во времени

BROADCAST - это тоже про ДАННЫЕ

1 Гбит/с BROADCAST - это часто не шторм, а просто так ОНО иногда работает в штатном режиме

Спецификации

Audinate

Dante Information for Network Administrators

Dante AV-over-IP is based on common IT standards, enabling Dante to run alongside data traffic on networks comprised of readily available conventional switches and cabling.

Addressing Dante Devices

Dante devices use DHCP for addressing when available or will auto-assign an IP address in the 169.254.0.0/16 range on the primary network and 172.31.0.0/16 on the secondary network if DHCP is not available. Dante devices continue to look for a DHCP server even after auto-assigning an IP address. Most Dante devices support static IP addressing.

Audio Transport and Expected Bandwidth:

The majority of audio used in professional settings is PCM (uncompressed), sampled at 48 kHz and a bit depth (word length) of 24 bits. Dante audio is unicast by default but can be set to use multicast for cases of one-to-many distribution.

- Dante packages audio into flows to save on network overhead.
- Unicast Audio flows contain up to 4 channels. The samples-per-channel can vary between 4 and 64, depending on the latency setting of the device. Bandwidth usage is about 6 Mbps per typical unicast audio flow.
- Bandwidth for multicast flows is dependent on the number of audio channels used. Bandwidth is about 1.5 Mbps per channel.
- Dante audio cannot be sent over Wi-Fi.

Address	Port	Usage	Type
Device IP	UDP 14336-14591	Unicast Audio/Video	Unicast
239.255.0.0/16	UDP 4321	Multicast Audio/Video	Multicast

Основы аудио: оценка полосы пропускания

- **Общее правило: удвоение частоты дискретизации уменьшает количество доступных каналов вдвое**

  (для сохранения одинаковой полосы пропускания)

512 каналов x 48 кГц x 24 бит ≈ 590 Мбит/сек (содержимое)
≈ 768 Мбит/ сек (общий объем)

÷2 x2

256 каналов x 96 кГц x 24 бит ≈ 590 Мбит/ сек (содержимое)
≈ 768 Мбит/ сек (общий объем)

÷4 x4

128 каналов x 192 кГц x 24 бит ≈ 590 Мбит/ сек (содержимое)
≈ 768 Мбит/ сек (общий объем)

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	Разрешение & частота кадров	Цветовая субдискретизация	Несжатые данные	Сжатые кодеком данные	
				Максимум	Типично
VIDEO	4Kp60	4:2:2	8.49 Гбит/сек	≈ 600 Мбит/с	≈ 540 Мбит/с
	4Kp30		4.25 Гбит/ сек	≈ 400 Мбит/с	≈ 270 Мбит/с
	1080p30		1.00 Гбит/ сек	≈ 150 Мбит/с	≈ 68 Мбит/с

Предполагаемый объем данных при передаче с использованием протокола Dante AV хорошо освещенного контента, закодированным кодеком в режиме Ultra Low Latency

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Типовая требуемая полоса передачи для протокола NDI High Bandwidth

1 x stream of SD video = 20 Mbps	1 x stream of 1080p50/59.94 video = 125Mbps
1 x stream of 720p50/59.94 video = 90Mbps	1 x stream of UHDp30 video = 200Mbps
1 x stream of 1080i50/59.94 video = 100Mbps	1 x stream of UHDp60 video = 250Mbps

ALLEN & HEATH gigaACE, DX, SLink

A CASE FOR PROPRIETARY AUDIO-OVER-ETHERNET PROTOCOLS

What Standard?

In other whitepapers we have examined the complex world of Audio-over-IP protocols with a specific focus on de-facto industry standards like Dante and open standards like AES67.

There are a variety of other protocols in use in the pro audio industry, often part of a closed ecosystem to link devices within the same brand or product family. Of these, Audio-over-IP protocols make use of Layer 3 Ethernet, but several others stop at Layer 2 of the OSI model - most notoriously CobraNet and EtherSound, but also Roland's REAC and SoundGrid by Waves Audio.

In this white paper, we will discuss what advantages proprietary Layer 2 protocols can offer, and why Audio-over-IP is not necessarily the best solution for every audio connection.

ter. In the course of a decade several alternatives to multicore audio cabling appeared, offering lower cost, less sensitivity to electrical noise and crosstalk, easier routing, and crucially the ability to interconnect digital audio devices without multiple AD and DA conversions.

Engineers were quick to realise that Ethernet offered an ideal platform for audio transport in larger environments. Patching and distribution of analogue audio can be both costly and ineffective. The advent of Audio-over-Ethernet meant audio could be dynamically routed from any source to any number of destinations, with instant reconfiguration, no rewiring, and using existing network infrastructure. Cost, availability and reliability of network hardware were key to Ethernet's acceptance in the pro audio industry - Cat cables are inexpensive, easy to terminate, and ubiquitous.

100Mbps Ethernet provides the raw band-

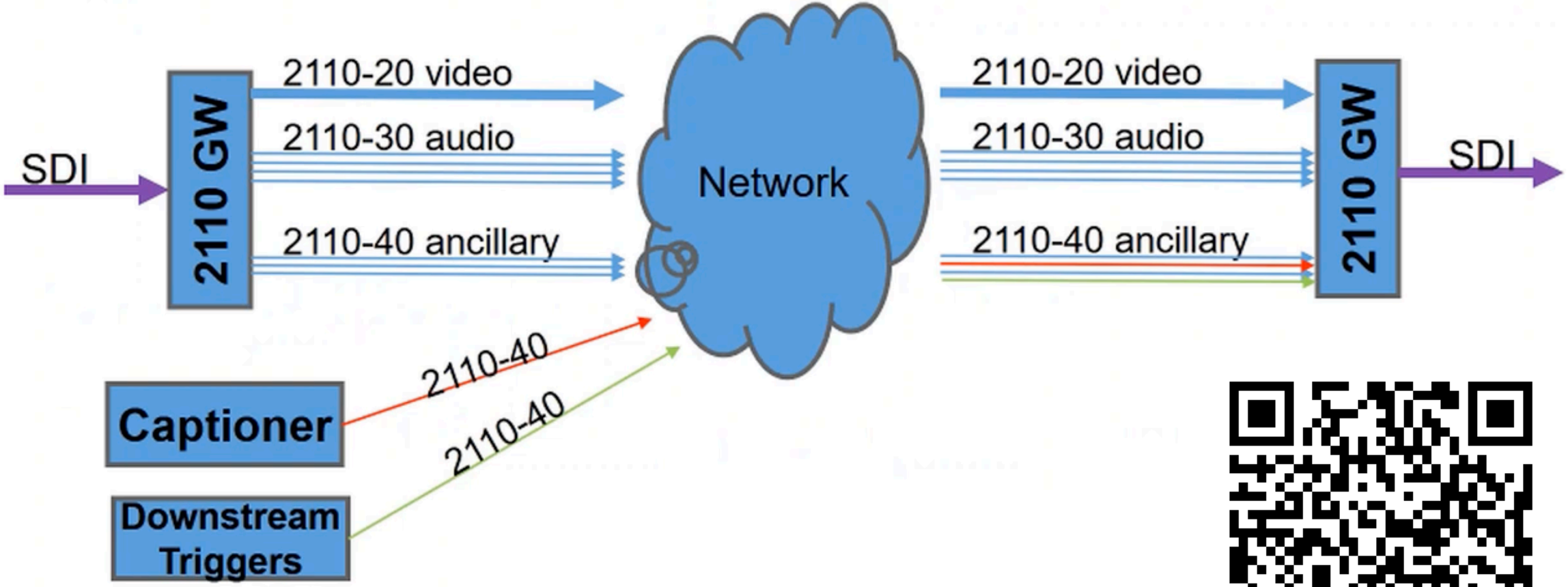
General rules

The switch or media converter must support the protocol bitrate. This is 1000BASE-T (Gigabit Ethernet) for gigaACE, 100BASE-TX (Fast Ethernet) for ACE, dSNAKE and DX. Link speed negotiation on auto-switch devices can cause issues and should be disabled.

Layer 3 & 4 protocols including Spanning Tree, Tagged Egress Packets, and Broadcast Storm Protection can cause interruption to audio data or audible clicks. Smart / managed switches may allow turning off Layer 3 or 4 functions, but as a general rule, use Layer 2 devices where possible.

No other network device should be plugged into a switch carrying ACE, gigaACE, dSNAKE or DX audio, unless a dedicated VLAN is set up.

VANC Data Routing – Just Like Audio?



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SMPTE ST-2110 и часть других протоколов это

ТОЛЬКО MULTICAST

How Much Bandwidth was Saved ?

Scan Format	2022-6 (Gb/s)	2110-20 (Gb/s)	difference
2160p @ 59.94	12282.2	10279.6	-16.3%
1080p @ 59.94	3070.7	2570.1	-16.3%
1080i @ 29.97	1535.4	1285.0	-16.3%
720p @ 59.94	1535.4	1142.5	-25.6%
2160p @ 50	12294.8	8754.9	
1080p @ 50	3074.1	2143.9	
1080i @ 25	1537.4	1071.9	
720p @ 50	1537.4	953.0	

THE NEXT CENTURY

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SOFTLAB-NSK

forward@softlab.tv +7 383 363-04-62

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О НАС | ПРОДУКТЫ | КАК КУПИТЬ | ПОДДЕРЖКА | ЗАГРУЗКИ

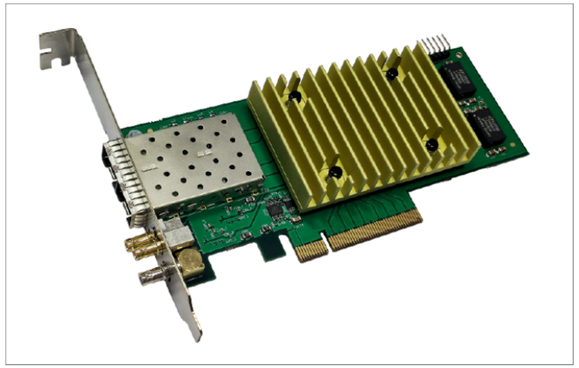
Главная » Продукты » Оборудование » Платы ввода-вывода серии FDExt » Плата FD2110

ПЛАТА FD2110

2 X 25G ETHERNET. 2 X SDI/ASI

Многоканальная PCI-Express плата ввода-вывода с поддержкой SMPTE ST 2110 IP и SDI/ASI:

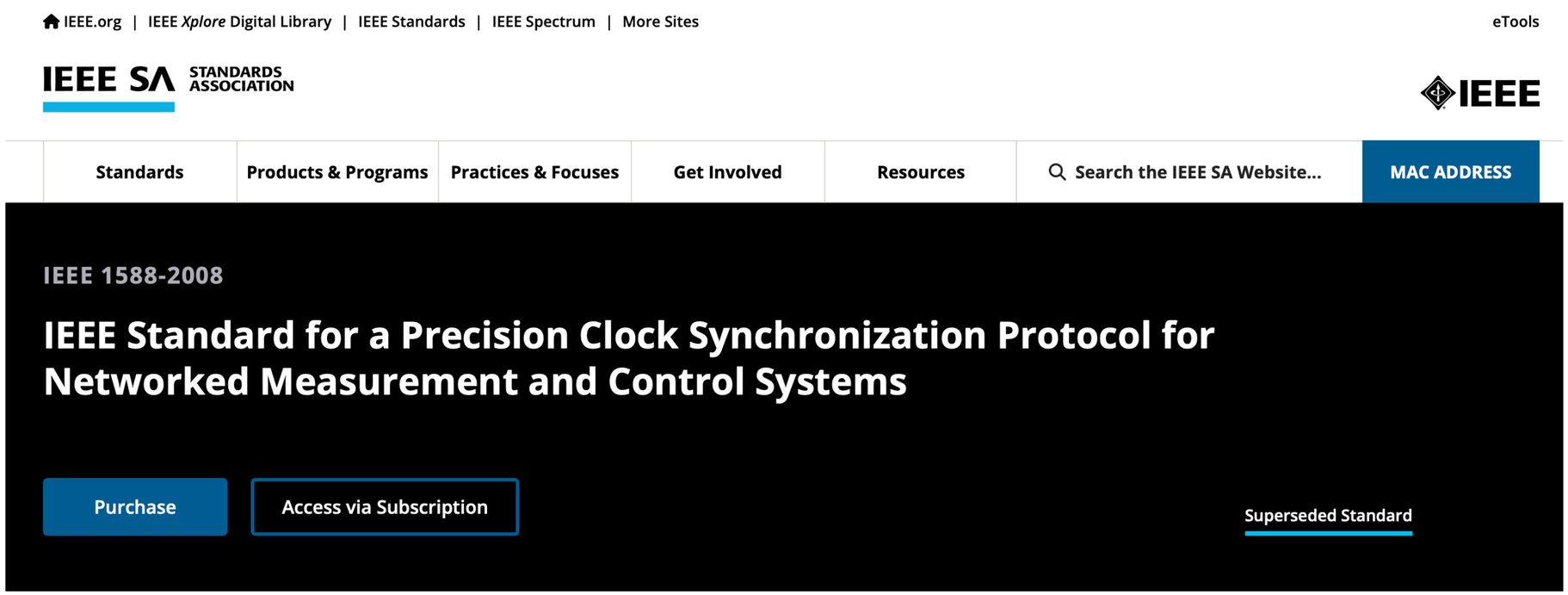
- 2 порта SFP28 25G/10G Ethernet – для передачи аудиовидеоданных через IP-сеть по стандарту SMPTE ST 2110;
- 2 разъема HD-BNC – настраиваемые SDI входы/выходы SD/3G/6G/12G-SDI;
- 1 разъем HD-BNC – вход/выход синхронизации Black burst/Tri-level sync.



ПРОТОКОЛЫ

SMPTE ST-2110, AVB, MILAN и т.д. требуют поддержки на железе допфункций для возможности синхронизации устройств

IEEE-1588-2008 он же ptp



Протоколы типа AVB требуют наличие поддержки gPTP и других функций на сетевом железе

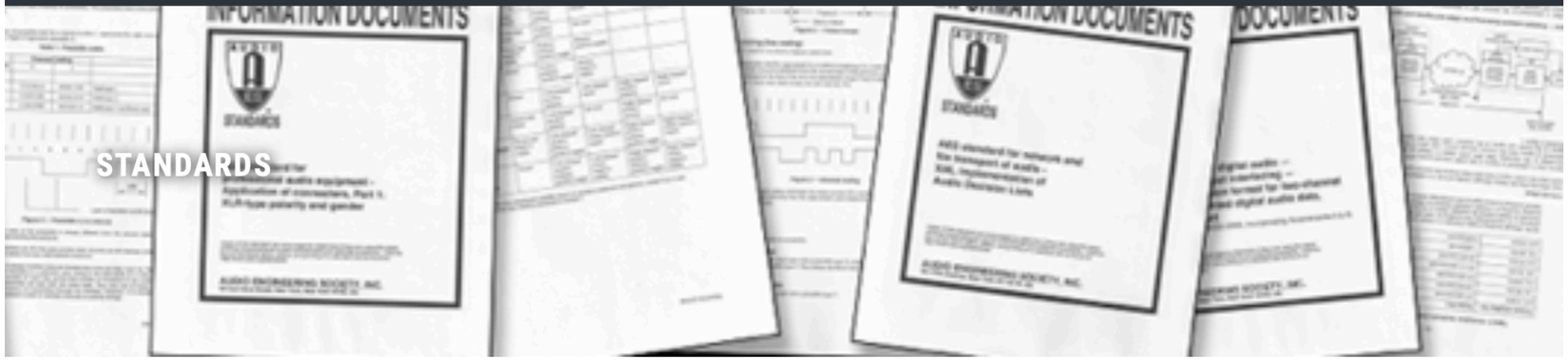
- IEEE 802.1AS-2011: Timing and Synchronization for Time-Sensitive Applications (gPTP);
- IEEE 802.1Qav-2009: Forwarding and Queuing for Time-Sensitive Streams (FQTSS);
- IEEE 802.1Qat-2010: Stream Reservation Protocol (SRP);
- IEEE 802.1BA-2011: Audio Video Bridging (AVB) Systems;

ХОЧУ ВСЕ ЭТО БЕСПЛАТНО ЗАПУСТИТЬ И ПОЭТОМУ ПОЙДУ В AES67!

Audio Engineering Society

AES Statement on Racial Injustice in America

EVENTS MEMBERSHIP PUBLICATIONS STANDARDS AUDIO TOPICS COMMUNITY EDUCATIO

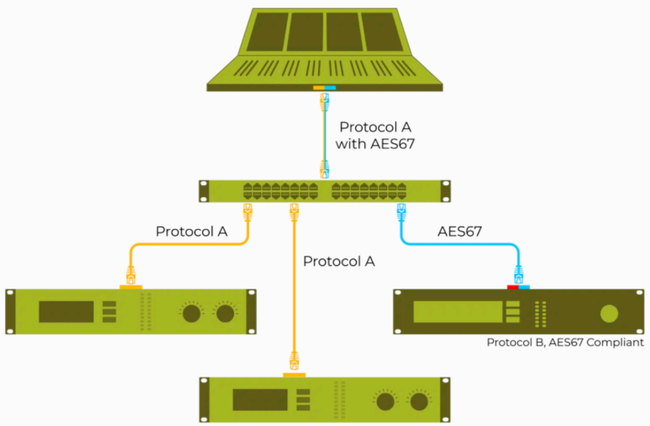


AES STANDARD

AES67-2023: AES standard for audio applications of networks - High-performance streaming audio-over-IP interoperability

ДА, но НЕТ

AES67 Practical Guide



A Practical Guide to Setting Up an AES67 System

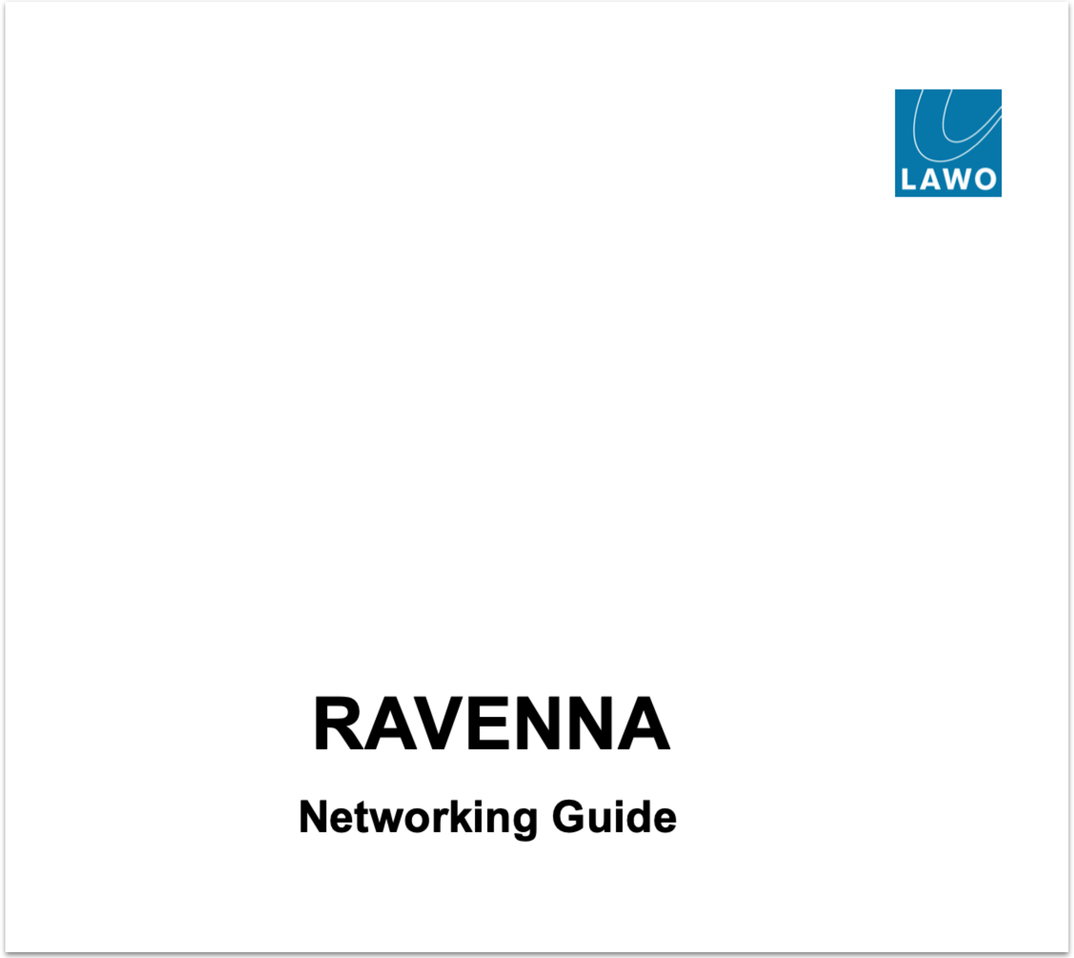
As the adoption of AES67 becomes ever more widespread, we thought it was high time we provided a comprehensive, practical guide on setting up and configuring an AES67 system.

While the standard defines what protocols and functions need to be supported, it still leaves various choices open to the implementer, which means that it doesn't serve very well as a user's guide; as a result, the thought of using AES67 to enable equipment using different native network protocols to interoperate can be a daunting prospect, even for the most experienced audio networking experts.

To make things clearer and to help avoid some of the common pitfalls in setting up an AES67 network, our RAVENNA/AES67 expert, Andreas Hildebrand (with input from Nicolas Sturmel at Merging Technologies) has dedicated a lot of time into distilling the process into a number of easy-to-follow steps.

The document covers everything you need to know, from an introduction to AES67 that covers all the basic principles of the standard, before moving on to explain how to create and configure a typical AES67 system. We cover system planning, device configuration, synchronisation and stream configuration. The final section looks at emerging technologies and industry standards that can be used with and have an impact on AES67.

This is a must-have document for anyone involved with multi-protocol audio networking. You can download it in our documentation section.


LAWO
RAVENNA
Networking Guide

Рекомендованный свитч

PTP-Aware Switches (recommended)

- **Arista 7150S** - www.arista.com/en/products/7150-series

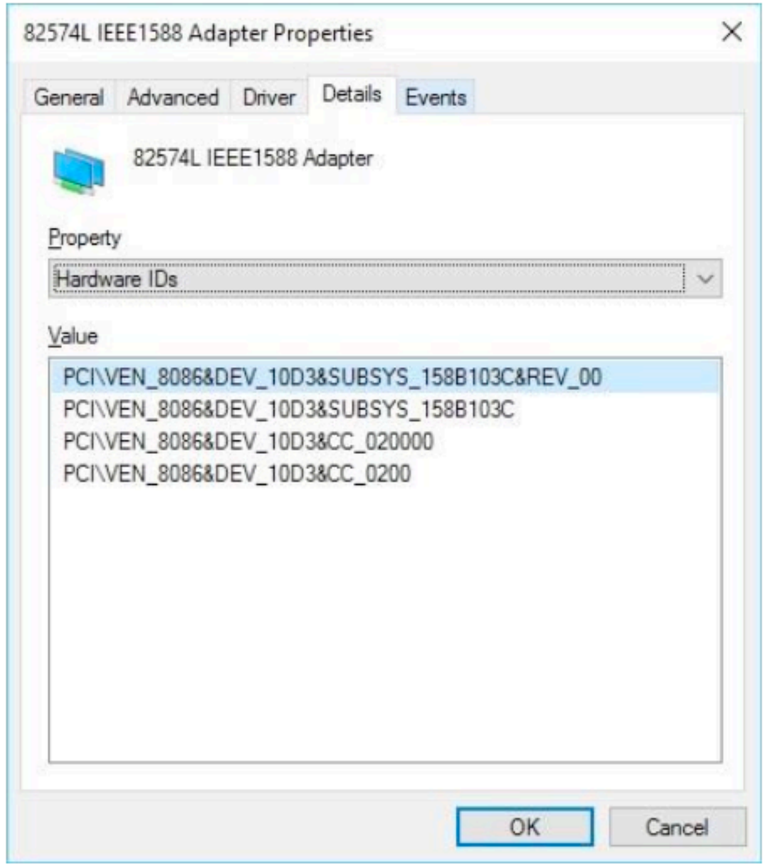
Other PTP-Aware Switches (we have experience of)

- **Extreme Networks X460 Gen2** - www.extremenetworks.com/product/summit-x460-series
- **Cisco Nexus 3000 family** - www.cisco.com/c/en/us/products/switches/nexus-3000-series-switches
- **Hirschmann Mach 104 family** - www.e-catalog.beldensolutions.com
- **ARG stagebox switch** - www.arg.co.uk/network-products/stagebox-html
- **Juniper** (latest firmware Beta)

List of currently supported NICs:
(applies to ravenna-free-1.6.10287)

82574L
i210
i211
i217LM/V*
i218LM/V*
i219LM/V*
i350-AM2
i350-AM4

*: Intel created a mess with PCI device IDs with these chips. If you can't load the network/PTP driver for one of the i217/218/219 NICs, please email its PCI device ID (see picture below) to: support@alcnetworx.com.



Бюджетное сетевое оборудование Mikrotik для ptpv2

Supported Devices

- **CRS326-24G-2S+:** Supported only on Gigabit Ethernet ports.
- **CRS328-24P-4S+:** Supported only on Gigabit Ethernet ports.
- **CRS317-1G-16S+:** Supported on all ports.
- **CRS326-24S+2Q+:** Supported on SFP+ and QSFP+ interfaces.
- **CRS312-4C+8XG:** Supported on all ports.
- **CRS318-16P-2S+:** Supported only on Gigabit Ethernet ports.
- **CRS318-1Fi-15Fr-2S:** Supported only on Gigabit Ethernet ports.

PTP Support Added in RouterOS Version 7.16 and Later:

- **CCR2116-12G-4S+:** Supported on all ports.
- **CCR2216-1G-12XS-2XQ:** Supported on all ports.
- **CRS518-16XS-2XQ:** Supported on all ports.
- **CRS504-4XQ:** Supported on all ports.
- **CRS510-8XS-2XQ:** Supported on all ports.
- **CRS520-4XS-16XQ:** Supported on all ports.

PTP Support Added in RouterOS Version 7.17 and Later:

- **CRS320-8P-8B-4S+RM:** Supported only on Gigabit Ethernet ports.
- **CRS326-4C+20G+2Q+:** Supported on all ports.

PTP Support Added in RouterOS Version 7.20 and Later:

- **RDS2216-2XG-4S+4XS-2XQ:** Supported on all ports.

PTP on VLAN Ports

When PTP ports are also part of VLANs on your boundary clock device, you must add a bridge interface as an untagged port in the Bridge VLAN Table for every entry that includes a PTP port.

This is necessary because the bridge interface functions as a bridge port towards the CPU. Therefore, it must be included in the VLAN table along with the PTP ports ensuring that packets can be correctly received from the physical port and forwarded to the CPU via the bridge. Let's continue with our previous configuration to make this clearer:

```
# Create a new bridge interface
/interface/bridge/add name=bridge1

# Assign the ports that will be part of this bridge
/interface/bridge/port add bridge=bridge1 interface=sfp28-1 pvid=10
/interface/bridge/port add bridge=bridge1 interface=sfp28-2 pvid=20

# Create new entries for Bridge VLAN Table
/interface bridge vlan add bridge=bridge1 vlan-ids=10 untagged=bridge1,sfp28-1
/interface bridge vlan add bridge=bridge1 vlan-ids=20 untagged=bridge1,sfp28-2
```

Тестирование на живых сигналах

-Don’t think you are.
-**Know** you are!

Для работы сетей для АВ-индустрии нужно учитывать и знать

Время (допустимые задержки)
Полосу пропускания
Спецификацию протоколов и методы передачи данных (unicast, multicast, broadcast)

Нужны ли специфические функции от сетевого железа и сетевых интерфейсов (ptpv2, gptp и тд) ?

L2 на объемах и безграничная посчитанная полоса с неблокирующей аппаратной коммутацией

L2-NAT, L2-VPN расчехляем и имеем всегда под рукой

Данных по L3 никто не обещал

L3 иногда ПЛАТНО

НУЖНО L3?

тестируем инфраструктуру на реальных сигналах

маршрутизация должна быть только аппаратной

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Благодарю за внимание!

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ОЦЕНИТЬ ДОКЛАД