At-home production on the move to distributed IP workflows

Larissa Görner
CTO-Team & Strategic Product Management
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The Net Insight business areas

NIMBRA
Media transport
Live Media Contribution over Private and Public Networks

SCHEDUALL
Resource Management
Intelligent Scheduling, Conflict Management and Visualized Workflows

SYE
True live OTT
Synchronized and ultra low delay Live-OTT solution
Over 500 customers globally
Remote production: a core competence of Net Insight

- London Olympics 2012 SVT reducing production crew from 58 to 9 people
- US college Football starting remote production
- Olympic Games Sotchi with SRG doing remote production from 4 venues
- TV2 Denmark starting with regular 3 production per week for handball
- Rio 2016 with 5 leading RHBs to perform remote production on the Nimbra platform
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- TATA Pro Kabaddi League win with Nimbra
- The Switch starting cumulus service
- SRG and TV2 with remote production from Olympics in South Korea
- Gearhouse & 7Networks for Australian open 2018
- Pyeongchang Olympics FIFA Worldcup 2018

Companies starting remote production

- BBC
- SVT
- ESPN
- CNN
- NBC
- Fox Sports
- ESPN Deportes
- CBS
- NBC Sports
- ARD
- DFB
- TATA
- VISTA
- Movistar
Traditional production vs remote/at-home production

Production Today

Traditional outside broadcast with OB vans and significant resources on site

Remote production

Resources stay “at-home” at the central production hub to produce more content with less resources
Drivers for remote production

More content
Less equipment

Increase productivity
Higher quality

Less travel
Use more talent
Large & Multi venue events

Examples: Asian cup Football, European games, FIS Downhill Ski WC, Rugby WC...

Limited in time, 2-4 days to 4 weeks
ARD & ZDF European Championship Athletics 2018 Berlin
ARD & ZDF European Championship Athletics 2018

Swimming
Gymnastics
Rowing
Triathlon

10 Gb/s link between Glasgow and Berlin

90 people in Berlin from German crew instead of Glasgow

JPEG2000
@160 Mb/s
Uncompressed
MADI

4 control rooms to remotely and parallel control Glasgow venues

Studio at George Square remote controlled
Swiss SRG in Rio 2016 & Pyeongchang 2018

- 4x 1G link to Zurich
- Net Insight Nimbras on 5 venues and 1x on House of Switzerland
- All 680s with J2K and MADI (protected streams)
- 688 Centrally connected to Switzerland
Recurring Event Production

La Liga, Bundesliga, Cricket, MLS, MLB, Handball
Every week multiple games, standard production

Venue 1
Venue 2
Venue 3
Venue 4

Production Hub

Remote production

WAN
TV2 Denmark’s remote production
2015-2018

500+ productions until today, no failures

Increased number of venues from to 25

Reduced production cost by 25% and enabled to launch an additional sports channel

260 ms roundtrip for return feed

No production truck, but 3 production kits with maximum 32 kg weight

Rio & Pyeongchang Tour de France 100+ sport events outside of Denmark
Spain Movistar’s basketball
Remote Venue

VIDEO
- S 2022-6
- SDI
- GENLOCK

AUDIO
- AES/EBU
- AES-67
- MADI

DATA & SYNC
- CTRL TALLY
- WORDCLK
- BB, Genlock

BACK-UP

At-Home Gallery

VIDEO
- S 2022-6
- SDI
- GENLOCK

AUDIO
- AES/EBU
- AES-67
- MADI

DATA & SYNC
- CTRL TALLY
- WORDCLK
- BB, Genlock

BACK-UP

Encoding
- SMPTE 2022 & 2110
- JPEG 2000 or uncompressed
- MADI
- AES
- AES-67
- MADI

Decoding
- SMPTE 2022 & 2110
- JPEG 2000 or uncompressed
- MADI
- AES
- AES-67
- MADI

Internet

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Net Insight Remote Production 2.0

Video
Traditional point to point camera transmission

Each camera has its own cable to a dedicated base station

SMPTE hybrid fiber cable
Grass Valley Direct IP camera transport

Each camera has its own cable to a dedicated base station.

- 10 Gb/s Direct IP fiber interface
Camera transport for a remote production today

Today’s remote productions require a variety of different input and output signals from the camera base stations are transmitted from the production site to the studio building.

Solutions require full camera chains at the production site and large racks for base stations.

Leave the base stations at home
Direct IP Plus camera transport with Nimbra

Save 40% of rackspace and weight at the venues
Reuse of CCUs for Multiple productions
Reduce bandwidth by 90%

Leave the base stations at home
XF Transmission with Direct IP+

Wide area network

1 Gb/s Full duplex
Direct IP+ & Net Insight

1x 1080i 2022-6; 1,8Gb

10 Gb/s

Analog Audio Stereo 24 Bit
Digital Audio Stereo 24 Bit
-i-com Prod Audio 16 Bit
-i-com Eng Audio 16 Bit
C2IP
Private data

AES-67 Audio & Data services
MADI Audio, AES-67

Media Acceleration Module with J2K encoding

1x 1080i 2022-6; 150Mbit/s

Nimbra ETS Module with PTP enhanced transport

1 Gb/s Full duplex

Nimbra Trunk for IP/MPLS, SDH or DWDM

100% link usage and 93-97% payload usage of link capacity

AES-67 Audio & Data services
MADI Audio, AES-67

Nimbra MADI & AES/EBU Module

Wide area network

AES-67 Audio & Data services
MADI Audio, AES-67

AES-67 Audio & Data services
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Grass Valley Direct IP+ specs with Nimbra

- Net Insight Nimbra SFP based Media Acceleration module
- 16x bi-directional encoding per module
- **Encoding:** 10-250 Mbps for 1080i & 10-500 Mbps for 1080p
- Access with fully integrated Embrionix SFP+
- UHD enabled

Visually lossless compression on 1080i with J2K @160Mbps and 1080p with J2K @320 Mbps...

Approximately 10x less bandwidth required compared to uncompressed

Overall latency - except IP network – approximately 100msec
Media Acceleration Module
High-density live contribution with JPEG2000

16-channel hybrid JPEG2000 codec for live production and contribution
SVT’s remote production 2012-2018

- 800+ productions since 2012
- Reduced production cost by 35%
- Tripled number of channels at the Olympics
- Doubled the amount of live content at the Olympics
- Biggest remote production ever with 45 cameras in Vasaloppet 2018
- London 2012
  Sotchi 2014
  Fis SKI Are 2018
Net Insight Remote Production 2.0

Audio
Advanced audio remote production

Today audio remote production struggles huge delays on the signal path, creating echoes and challenges for synchronization.

Moving processing to the venue side with Calrec’s RP1 erases on site delays. Transporting over a Nimbra Network shrinks the audio delay to an acceptable minimum.
Remote mixer controls mapped to main mixer surface

Providing seamless control workflows, truly bringing the remote production home. Operation is the same as if the venue was in the studio next door.
Wide Choice of Audio Formats

Compact, 1-box solution for all audio processing and interfaces with IP network. Flexibility, Familiarity, Plug & Play Connectivity.
Australian open 2018
Gearhouse for Seven Networks
Gearhouse for Seven Networks at Australian Open 2018

80+ feeds from venue to production hub

Preliminary cost saving estimates about 20-30% due to not renting venue space

150 people in the production hub instead of on site

Use one ink instead of 86 service circuits by local service provider

Produce programs for Seven, seven two, seven sports and OTT channel seven channel

Will do also Olympic winter games from the hub
Net Insight Remote Production 2.0

Transport
Remote production over Wide Area Networks

A reliable transport solution must avoid **packet loss** and **synchronization issues** and must cope with **bandwidth restrictions** and **delay**.
Challenges for Remote: Delay

• **Jitter**: Variation of packet delay

• **Encoding delay**: Added by encoding for compression, e.g. MPEG-4, JPEG 2000

• **Latency**: Round-trip-time 299,792,458 m/s + $\Delta t_{\text{optic}} = \sim 5 \mu s/km$
Challenges for Remote: Synchronization

**Video sync:** different video streams have to start the line of video at the same time

**Distributed workflows:** Video & Audio are separated streams and need to be synchronized on a time stamp and an external clock

**Different paths:** Signals travel over different paths in the network and have different delays

**With SDI and SDH transport, synchronization was inherent in the transport, this is not the case with IP transport. For IP an explicit synchronization solution is needed.**
Restricted Bandwidth

A Media application requires guaranteed bandwidth end to end

Bandwidth availability is between 1 and 10Gb/s in Europe

Last mile challenge for broadcast: no high bandwidth access at stadiums or event locations

Packet Loss

When Mixing traffic streams and aggregate traffic: packet loss is a fact
High volatility (many and few packets send)
Several aggregations
Higher load makes it worse
How can those challenges be solved?
Network protection

**1+1 Hitless Protection:** Seamless Switch-over from one stream to another

**Forward Error Correction:** Adding additionally transmitted packets

**ARQ:** Uses message acknowledgements to indicate correctly received data.

Service isolation

**End to end resource allocation** to avoid overprovisioning

**Traffic shaping and admission control** at ingress protect the overall QoS
JPEG 2000 for superior video quality

**BEST IN CLASS QUALITY***

- **Lowest delay:** INTRA-Frame nature of JPEG2000 allows independent encoding and very low latency down to 2,5-3,5 frames

- **Visually lossless compression:** Resolution scalability facilitates post-production and multiple generations

- **No image corruption** other than that directly related to the compression process. Resolution scalability facilitates post-production and multiple generations

*Test performed at IRT, Germany
Remote control and monitoring

- **Network performance monitoring** to allow link utilization monitoring
- **Service-aware provisioning** of the video, audio and data services

- **Automatic signal routing** across large networks to allow easy source and destination routing
- **Fault management** to enable and automate the right mechanisms in case of error
Camera Transport

REMOTE VENUE

90% reduction in bandwidth with low latency JPEG 2000 encoding

Save weight, cost and space at remote locations

AT HOME Production Facility

Cutting edge transport technology for zero packetloss and 100% QoS

Integrated orchestration over all networks

Synchronization mechanism over any path

SMPTE 2022-6

NIMBRA 640

NIMBRA 640
Audio transport

REMOTE VENUE

Access for MADI, AES-EBU and AES-67

PTP transparent clock transport

NIMBRA 640

Wide Area Network

AT HOME Production Facility

Fully transparent audio transport and service isolation

100% link capacity utilization and bandwidth reservation over any infrastructure

Synchronized output and resync capabilities

Full control over service performance
Intercom transport
AES-67

Ethernet/ETS transport with Riedel’s Artist and Bolero products
Exceptional jitter performance allows transparent PTP transport
Remote production

Venue
- Net Insight Media Fabric
  - Service isolation
  - Bandwidth reservation
  - Software defined

Proposition
- One infrastructure
- Agile & assured services at highest utilization
- Schedule shared resources & automate workflows

Broadcast Facility
- Video & Audio production
- Camera control
- Transcoding
- Graphics
- Archive
- IT and Intranet
- Synch

Value
- Lower cost of production
- Produce more & better
- Adapt the end-product faster
- Full financial visibility
Distributed production
The next level of production

Enable best production by eliminating local restrictions
Use your best resources at every location
The next step

Distributed production
Shift towards IP production

Only a change of cable?
Requirements for Transformation

- **OB Production**: Requires...
- **Remote Production**: Requires...
- **Distributed Production**: Requires...
- **Cloud Production**: Requires...
- **AI Production**: Requires...

**Requirements:**

**Operations**

- **Resource optimization**: Manage & optimize resources for cost optimization and business decision support.
- **Workflow consistency**: To enable scale advantages, workflows must be consistent across geographic locations.
- **Automation**: Automation is the key to industry-level gains in production efficiency.

Reliability, service flexibility, clear demarcation, domain integrity
Challenges of 2110 over WAN

- **Multi domain** – Interconnect the broadcast controllers between sites
- **Hybrid implementation** – SDI and 2110 side-by-side (control and data plane)
- **Traffic aspects** – Strict BW reservation & control
- **Burst control** – Preserve 2110-21 over WAN
- **Audio delays** in 2110 – FEC
- **Exact clock** is needed for 2110 over WAN
Broadcast transport evolution

Net Insight contributions

- SDI/ASI
  - BW flexibility
  - Dynamic capacity
  - Interface conversion

- SDI/ASI
  - Centralized control
  - Per Service BW reservation
  - Interface conversion

- IP
  - 2022-6 & 2110
  - Centralized control
  - Per Service BW reservation
  - Timing
  - Burst control

- SDH/SONET

- IP

- IP
COTS Wide-area Network Services

Media specific requirements vs standard WAN service offerings

MEF: Metro Ethernet Forum
Clear definition of service characteristics without limiting technology and innovation
New VSF Activity Group: SMPTE 2110 over WAN

- Flow protection
- Flow trunking
- Essence alignment
- Low latency handling
- Format conversion
- Compression

- Protection of other data flows
- Security
- PTP trunking
- WAN timing
- Associated control (NMOS) filtering and border proxying
Conclusions

The future of live production lies in the move to new distributed workflows and ST-2110 is the key enabler.

Remote production open the path into new workflows, but it just the first step.

To reach full potential, we emphasize the importance of running native ST-2110 essence streams end-2-end over any WAN infrastructure.

For consistency, we need to adapt to service providers’ existing WAN portfolio, such as MEF.
Thank you

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