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IEEE BTS Webinar, 09.12.2020

5G Opportunities for Content Production

SENNHEISER

Sennheiser R&I

Research projects and standards

5G MAG
MEDIA ACTION GROUP

EBU

3GPP
A GLOBAL INITIATIVE

ETSI

IMT-2020

2016-2018
PMSE xG

2018-2020
LIPS

2020 -2022
5G RECORDS

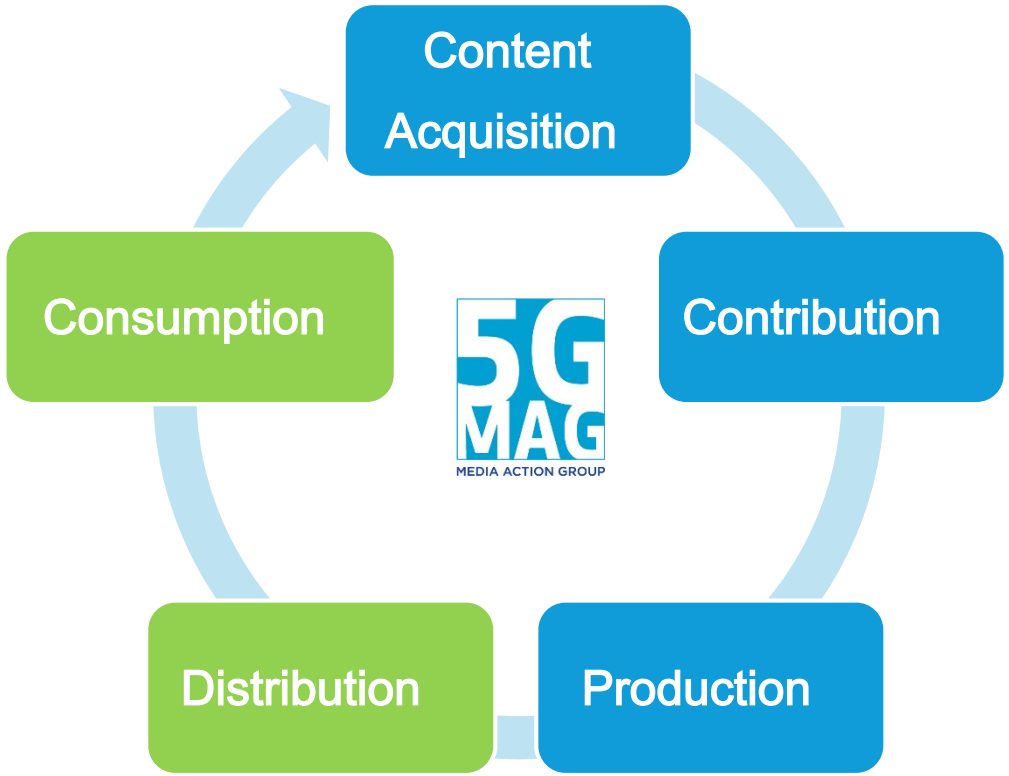
Agenda

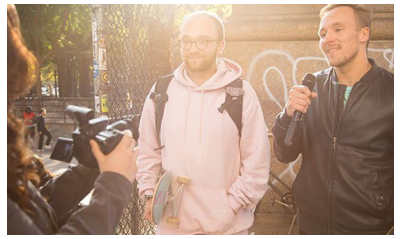
- Content Production
  - Use Cases
  - Conventional
  - Future
- 5G Opportunities & Challenges
- Engagement in 5G
  - Standardization, Industry Alliances, Research & Development

Content Production

- Use Cases
- Conventional
- Future

Content Production in the Media Industry





Diversity of Use Cases

Local Coverage		Local Coverage + WAN Connectivity		Wide Area Coverage
Fixed	Nomadic	Fixed	Nomadic	Mobile

On-site live events, Stage performers
Audience services in a venue

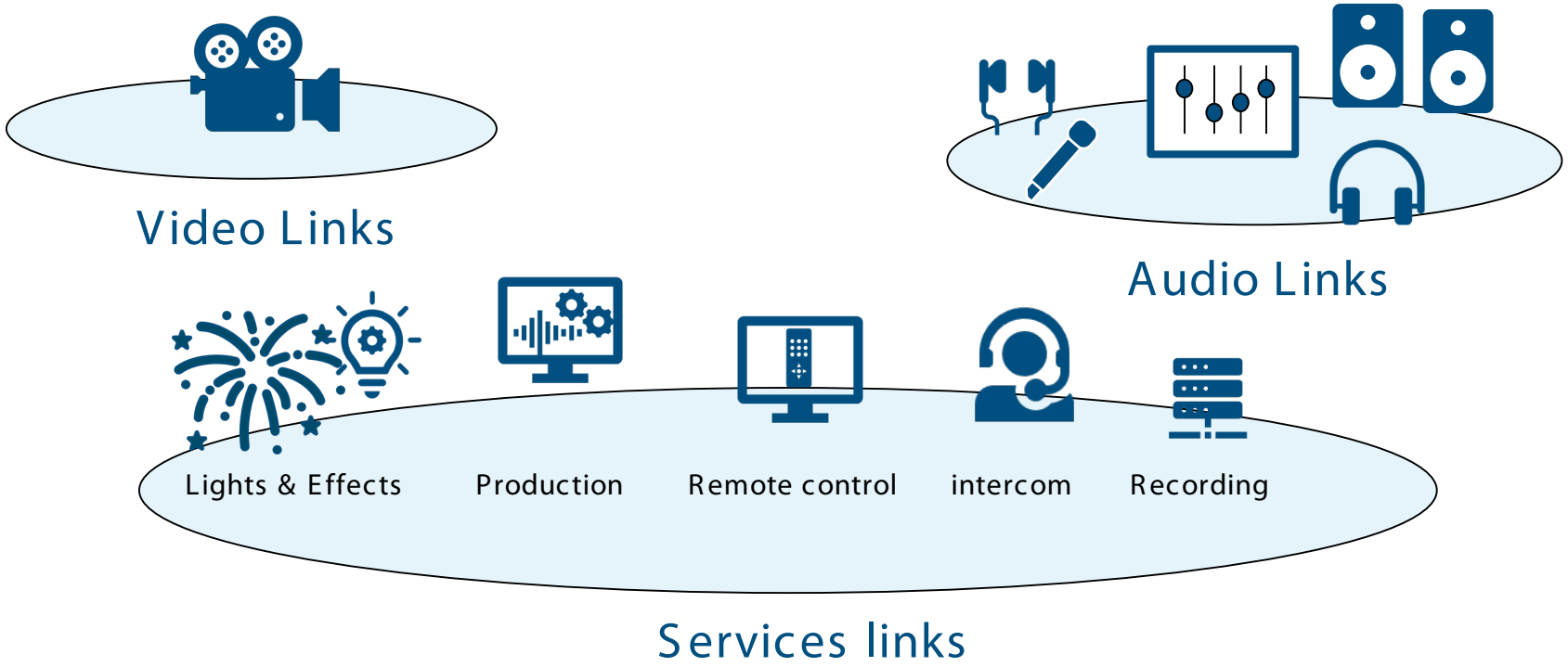
Studio-based production,
Remote production ,
Media files transfer

News Gathering ,
Mobile journalism, User generated content

Conventional Content Production Technology

PMSE: Program Making and Special Events

- '**Programme Making and Special Events** (**PMSE**) describes radio applications used for broadcasting, newsgathering, theatrical productions and special events and applications used in meetings, conferences, cultural and education activities, trade fairs, local entertainment, sport, religious and other public or private events for perceived real-time presentation of audio-visual information'.

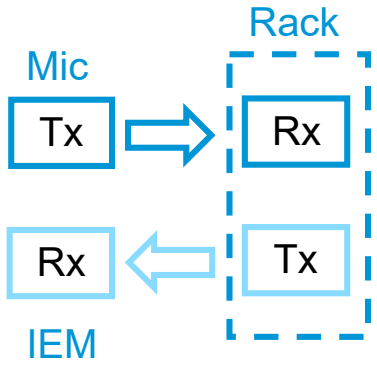


Conventional Content Production

Audio PMSE: Technologies

► Link-based Approaches

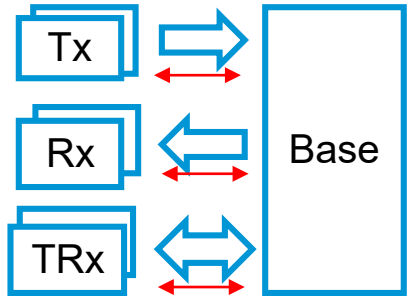
- Analog Narrowband (FM)
- Digital Narrowband



► System-based Approaches

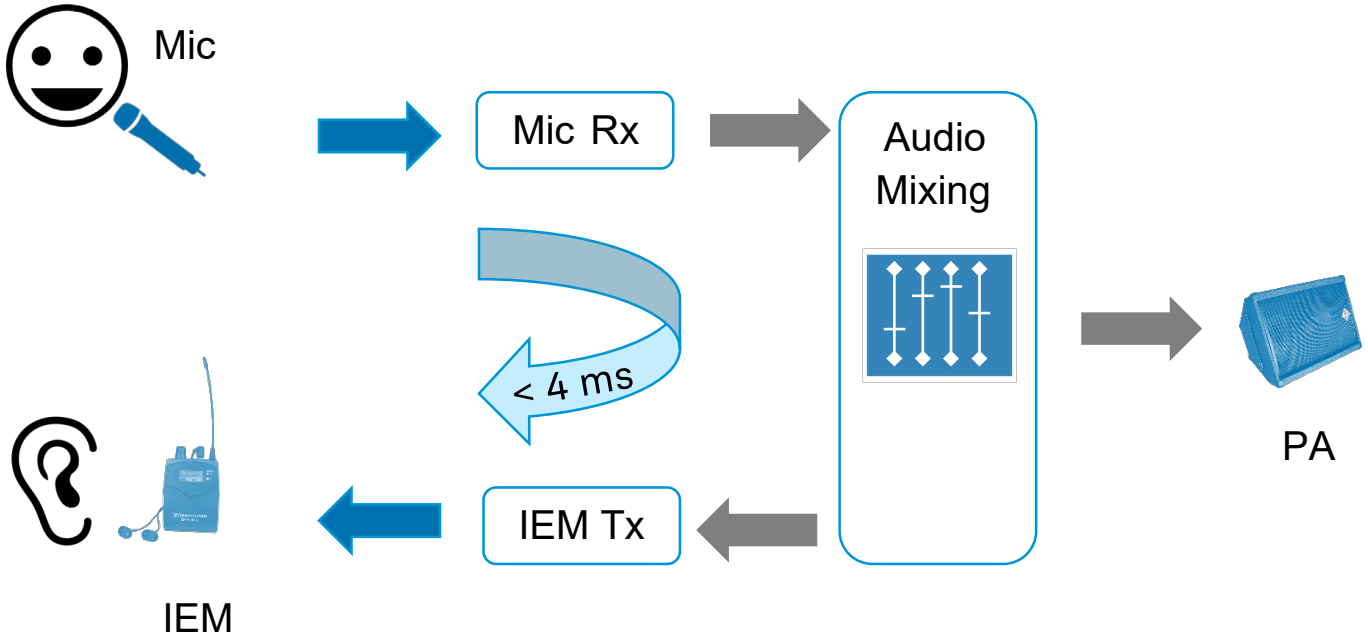
- DECT-based (evolution), which is IMT-2000
- Upcomming:
  Wireless Multi-Channel Audio System (WMAS)

  5G ??

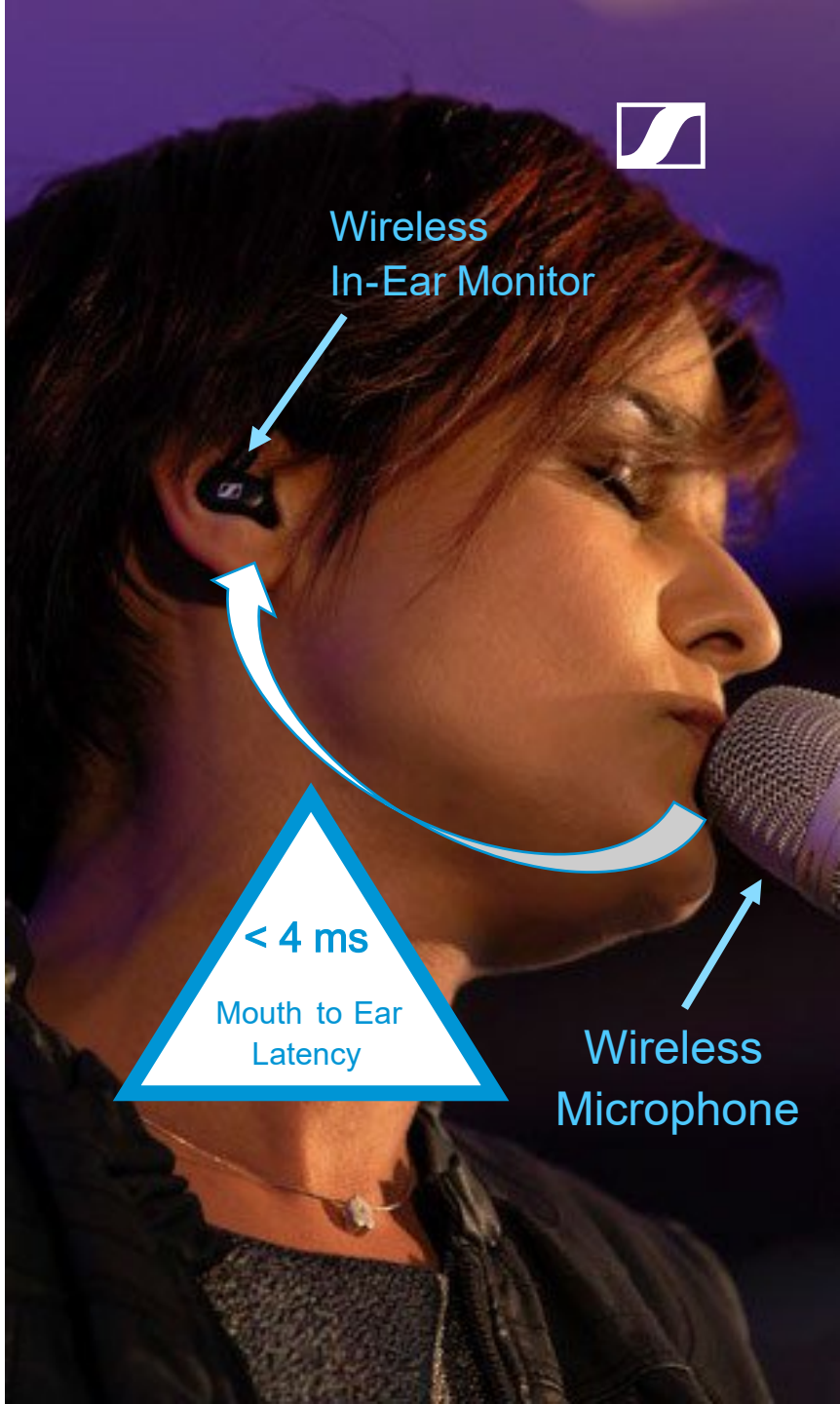


Conventional Content Production

The Wireless Mouth-to-Ear Latency Budget



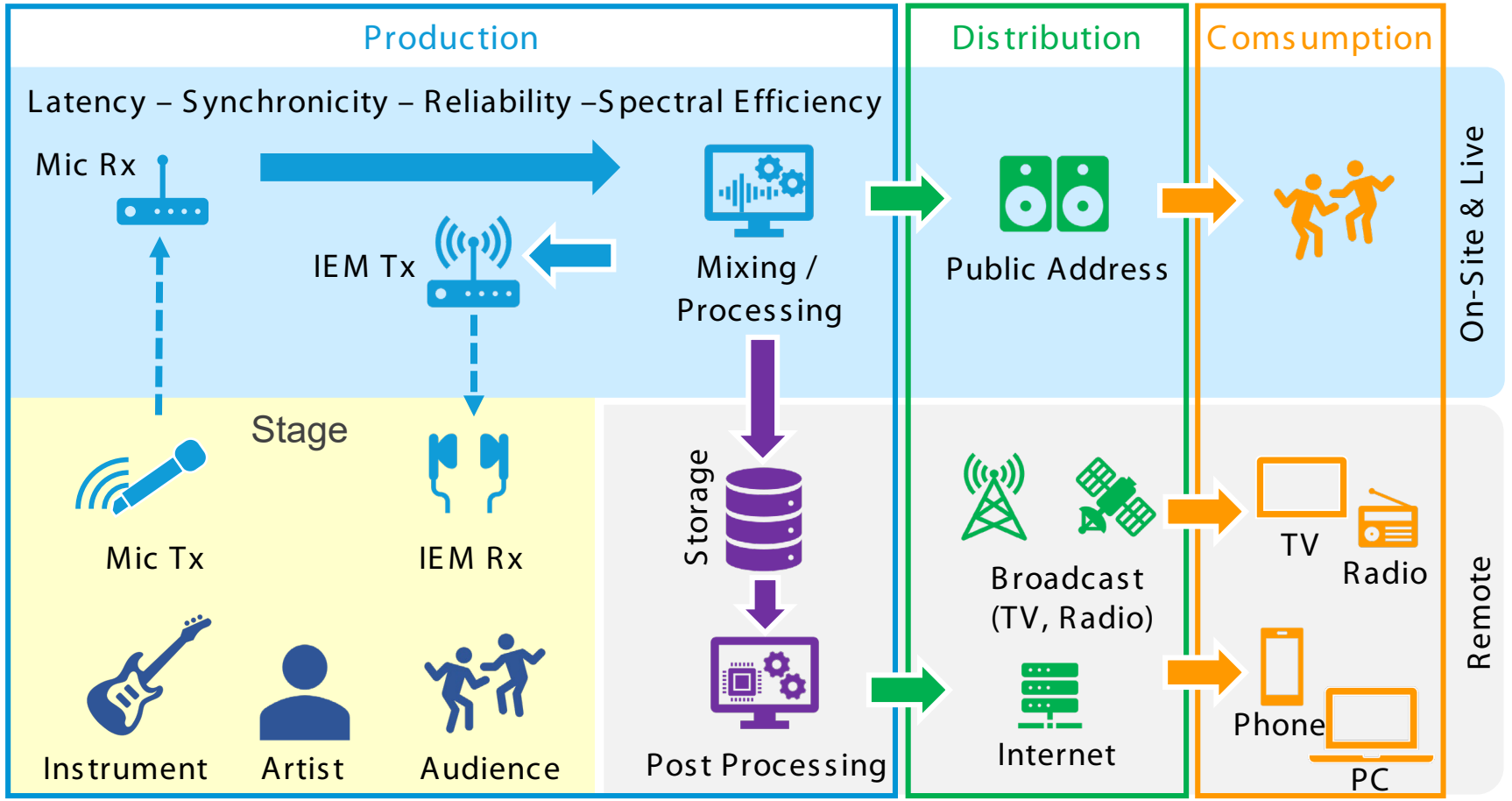
- Artist is source and sink of audio!
- Sound is also traveling directly via the bone and body, and indirectly via room reflections (isolating headphones required).
- A jitter-free turn-around streaming latency of below 4 ms on application layer is required as the artist is source and sink of audio.



Convential Content Production

On-Site & Live + Remote Distribution

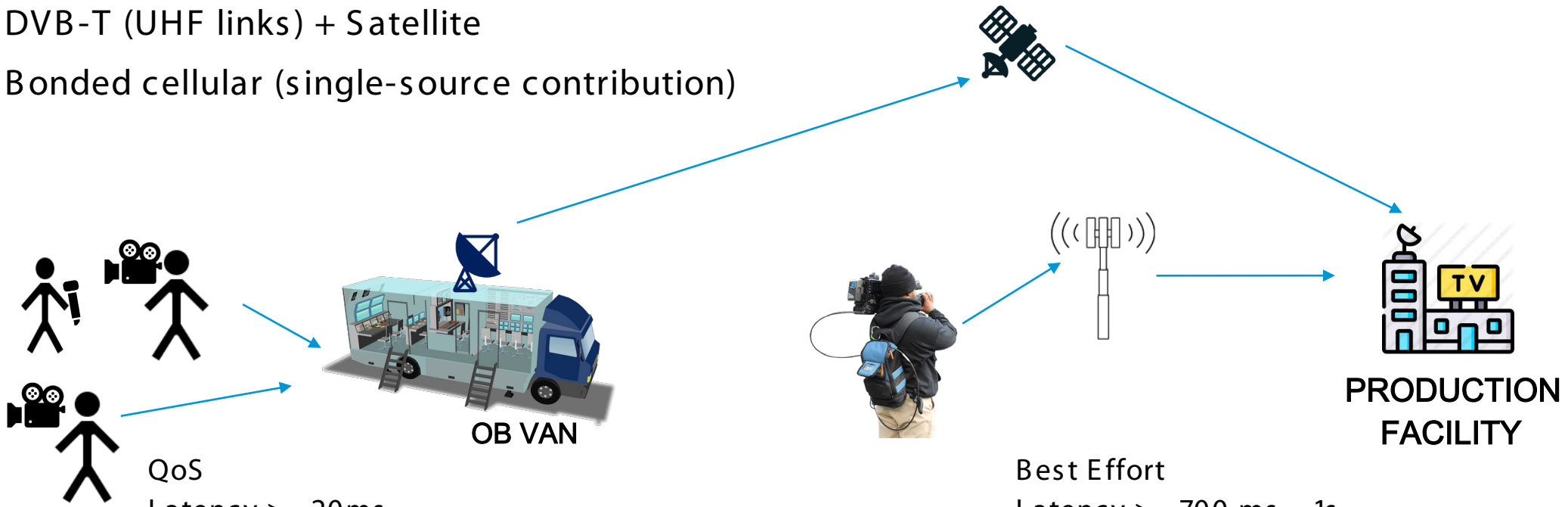
- Pick-up of sound of each instrument, artist and ambience with specific microphones.
- IEM enable the artist to perform.
- On-site mixing of all audio sources happens for the Public Address (PA) and monitoring.
- Arranging / Post Processing for additional uses (broadcast, streaming) is based on a **Master Record** of the event.



Convential Content Production :

Electronic News Gathering (ENG)

- News contribution performance from any location around the world
- Technologies
  - DVB-T (UHF links) + Satellite
  - Bonded cellular (single-source contribution)

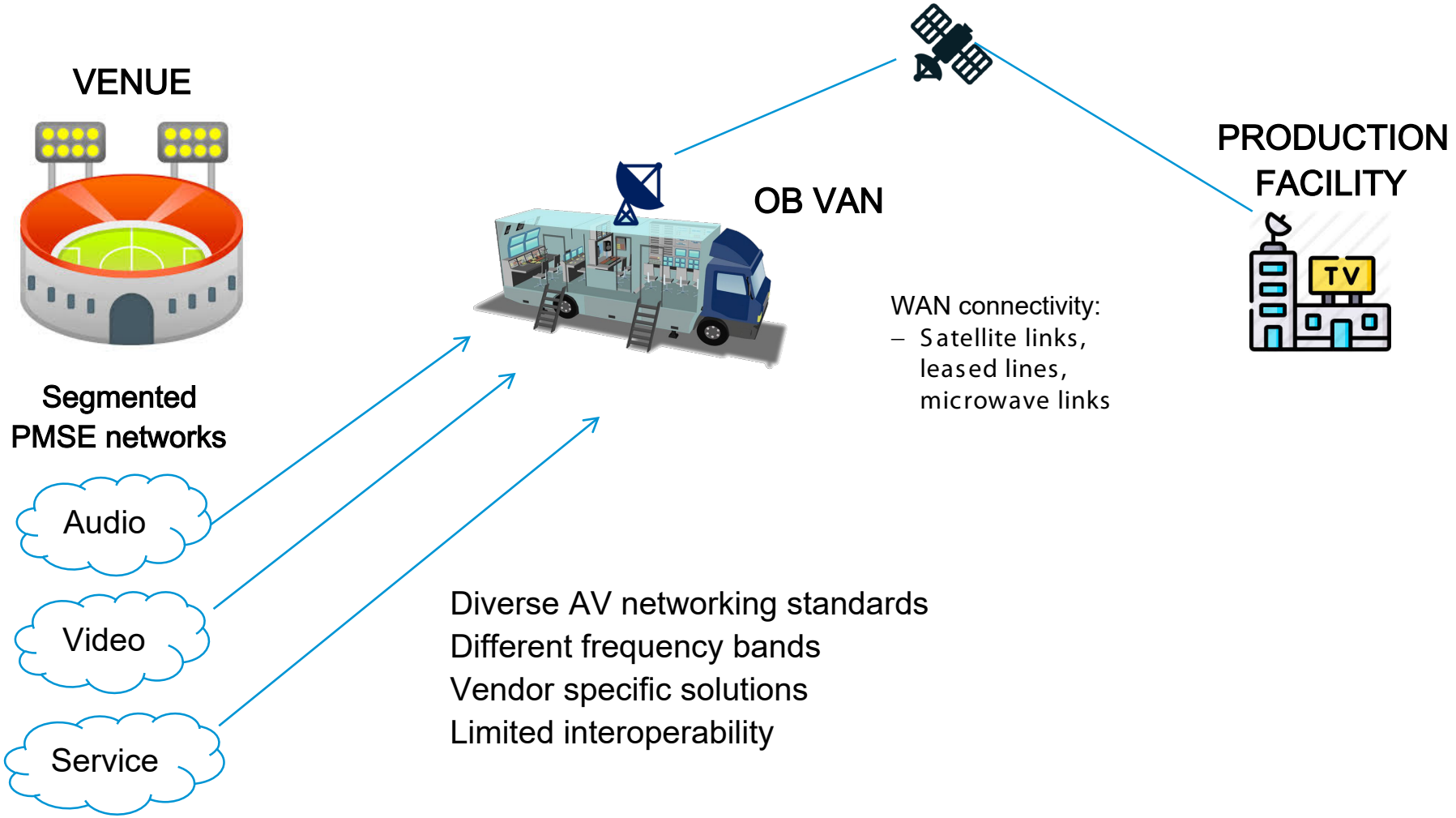


QoS
Latency >= 20ms
BW: 30/40 Mbps

Best Effort
Latency >= 700 ms – 1s
BW: 30 – 70 Mbps

Convential Content Production :

Remote Production



Conventional Content Production

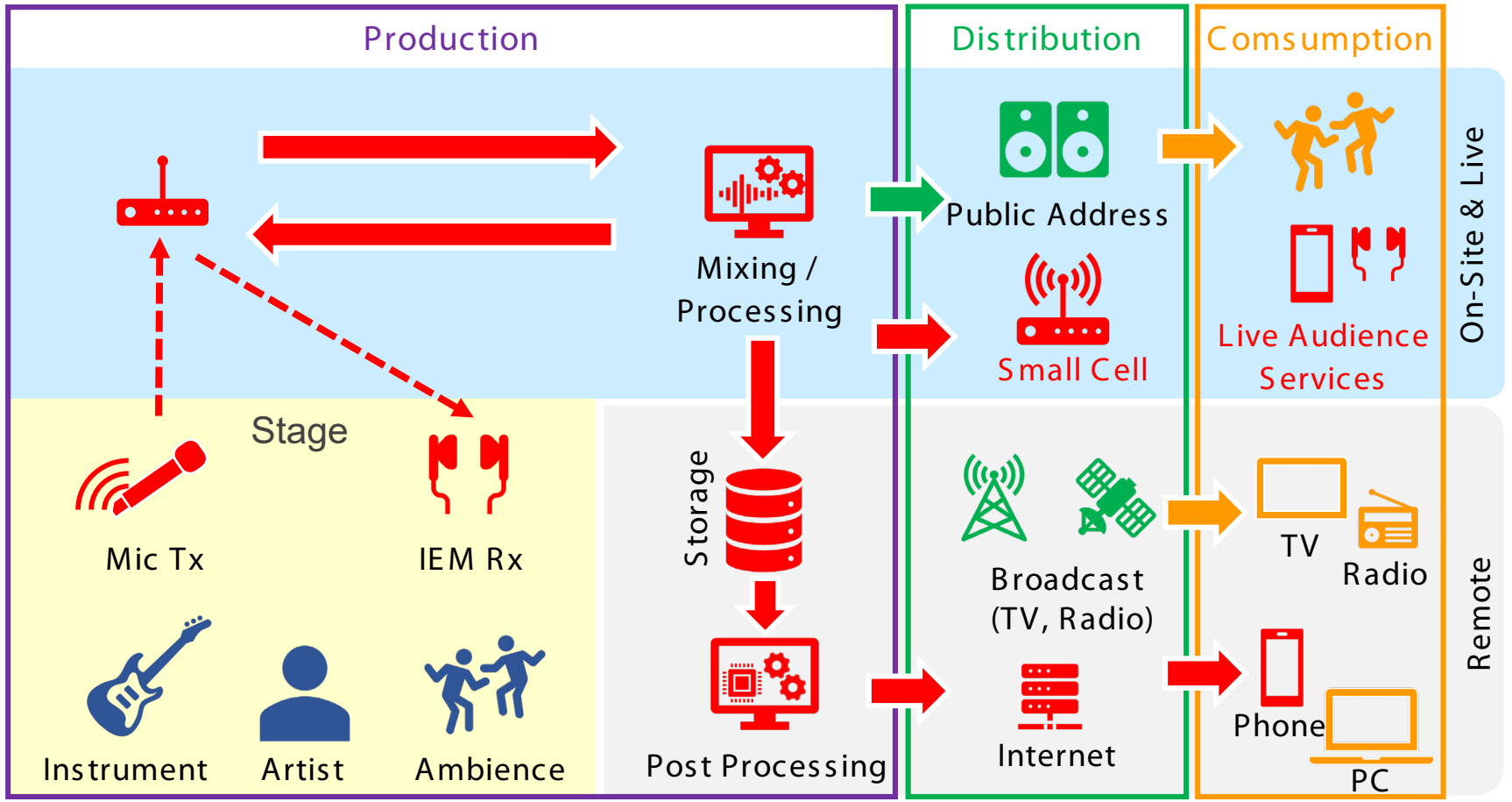
Specifics

Stringent KPIs	▪ Low latency - Very low latency for audio live performers ▪ Accurate synchronization between streams (1 – 100 us) ▪ High reliability – Critical for live performances ▪ Uplink capacity – Critical for multicamera contribution ▪ Low power consumption – long session durations ▪ Requires specialized equipment (HW & SW)
Segmented World	▪ Segmented PMSE applications (A,V, Services): Proprietary technology and networks ▪ Lack of interoperability and convergence: Intra-System (√), Inter-Sytem (X) ▪ Workarounds for compatibility (e.g. AES67, AVB/TSN, SMPTE 2110) but still lack of real interaction
Missing Functionality	▪ Control and automation of workflows at device level ▪ Discovery, registration ▪ Virtualization
Spectrum Squeeze	▪ Increasing demand for spectrum – Ambitious and Sophisticated Productions ▪ UHF band as the core PMSE band is under threat by telco industry

Future Content Production

On-site & Live + Remote Distribution

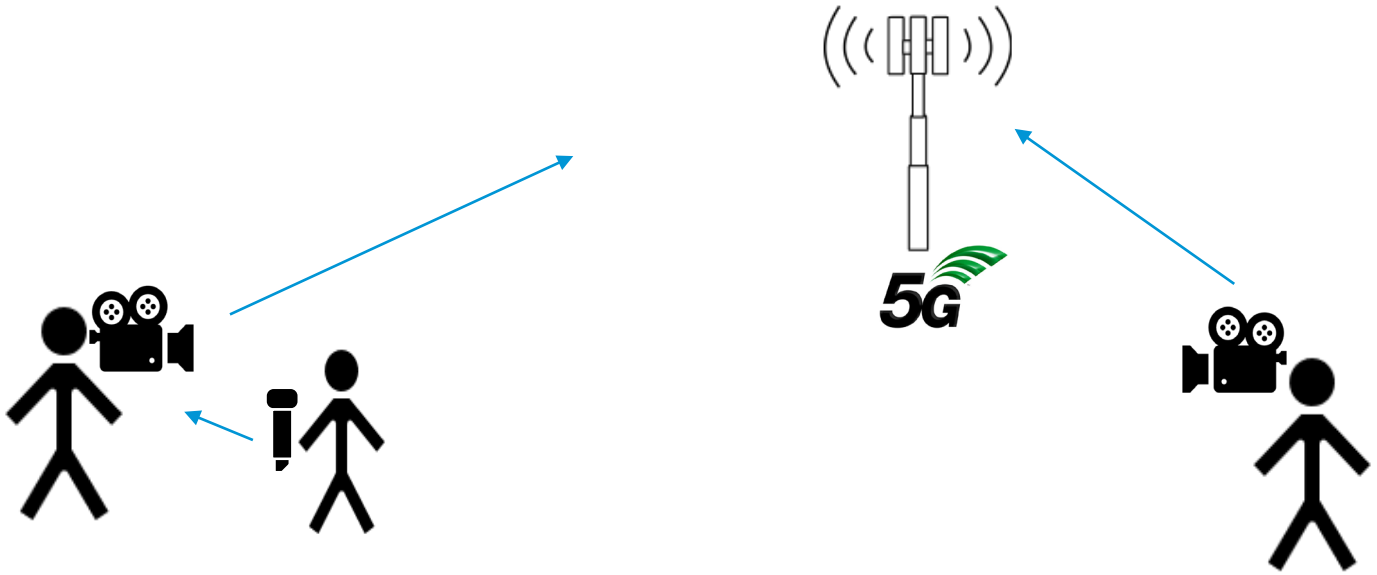
- **Convergence of production and distribution networks**
  - Less interfacing, simplification of setups
- **5G for Remote Production**
  - Wireless Wide Area Network; Cloud-Services for computing and storage
- **Wireless Mic and IEM in 5G?**
  - 5G UEs in public or non-public network?
  - Next generation of PMSE networks interworked with 5G networks?



Future Content Production :

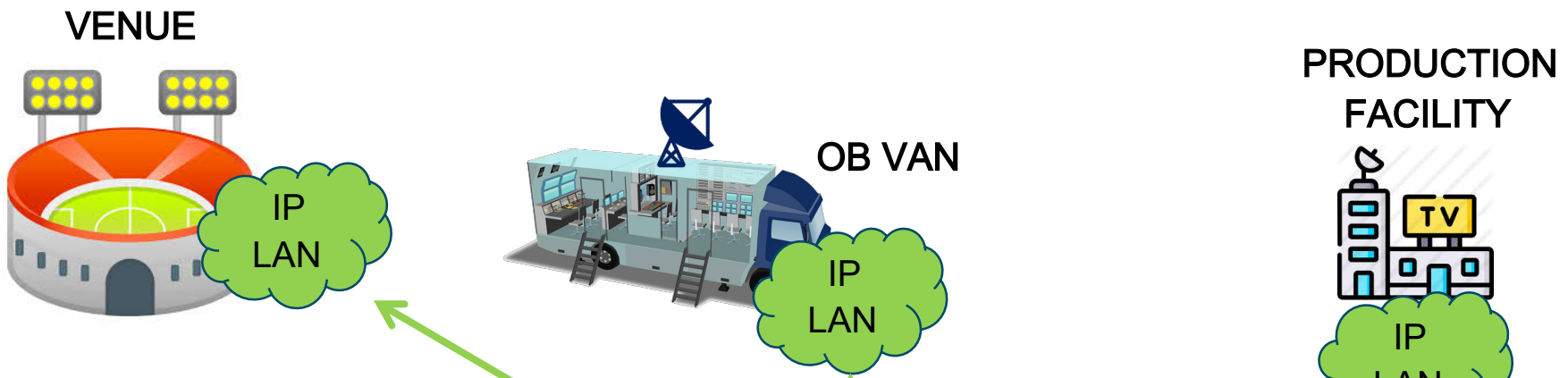
Electronic News Gathering (ENG)

- News contribution performance from any location around the world
  - Uplink capacity is key



Future Content Production :

On-going Shift towards IP based Workflows



Integration of PMSE equipment into one converged production network based on IP connectivity

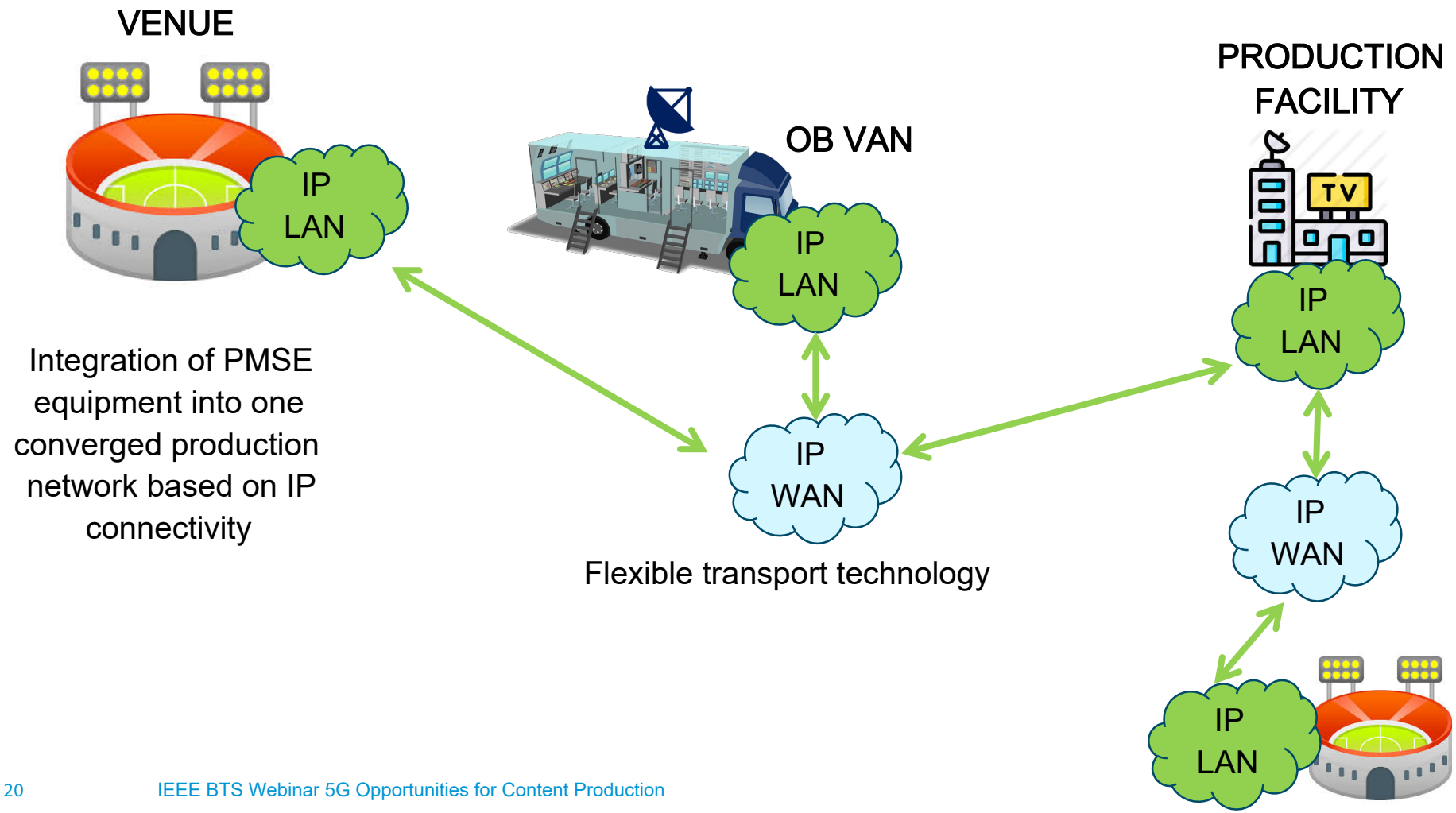
e.g. AES67, SMPTE 2120, NDI, NMOS

Flexible transport technology

Content producers want everything to be compatible with everything and to play directly with each other

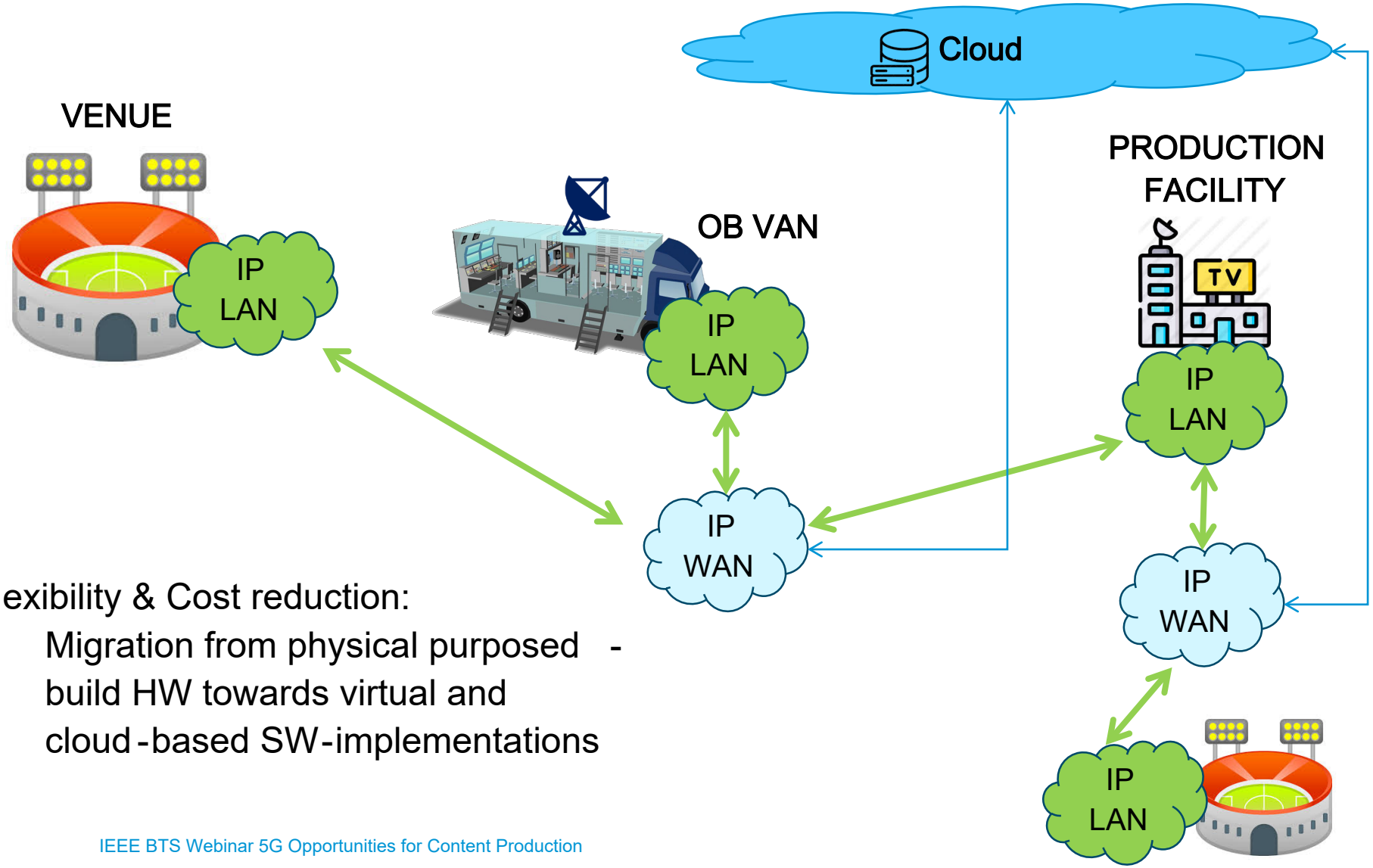
Future Content Production :

Distributed *Remote Production*



Future Content Production :

Cloud-fit *Production*

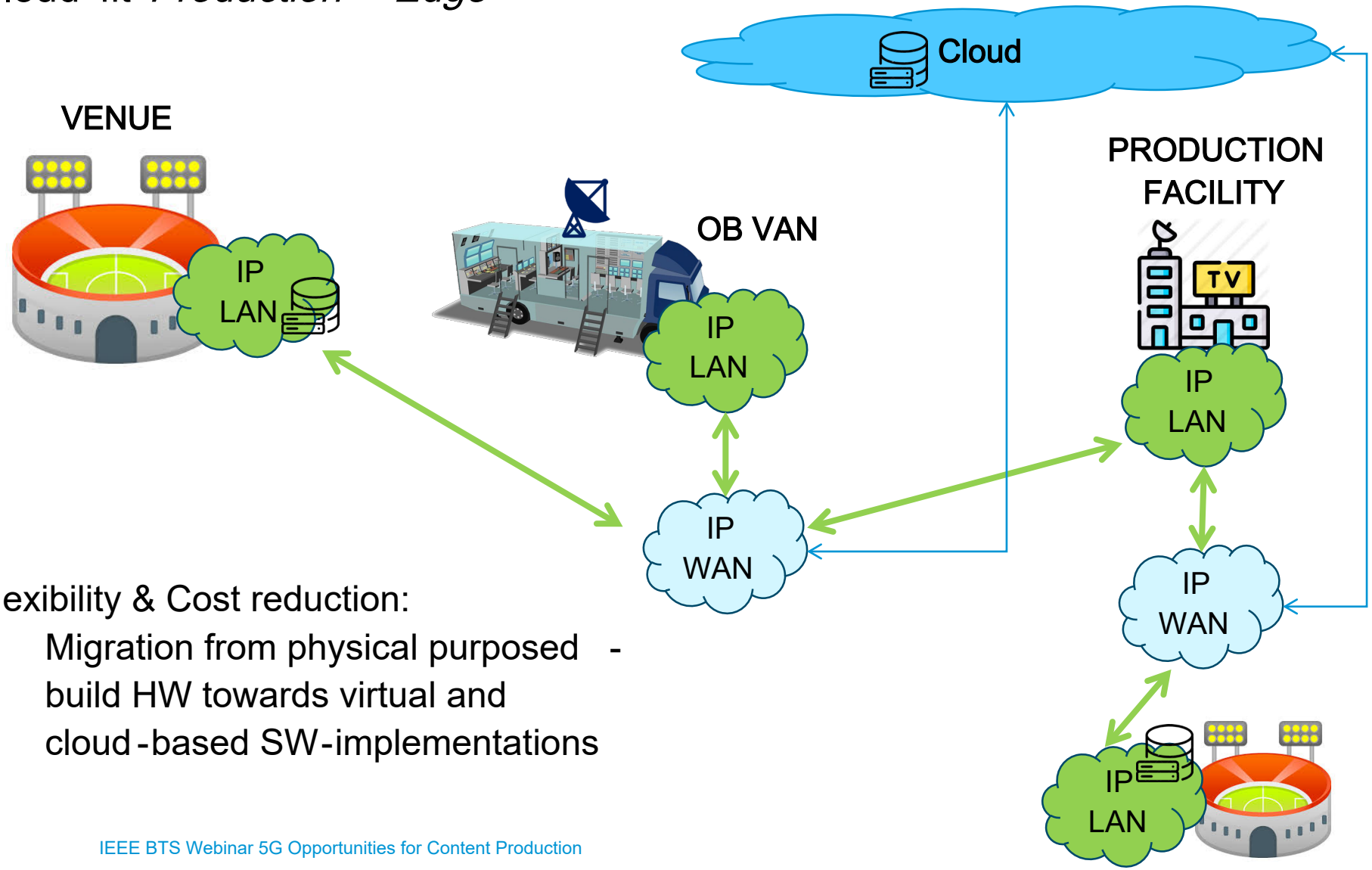


Flexibility & Cost reduction:

- Migration from physical purposed build HW towards virtual and cloud-based SW-implementations

Future Content Production :

Cloud-fit *Production + Edge*



Flexibility & Cost reduction:

- Migration from physical purposed build HW towards virtual and cloud-based SW-implementations

5G Opportunities & Challenges

5G Opportunities in Future Content Production

- **5G fits well** with the process of adoption of IP-based workflows, cloud-based and distributed production
- 5G as **wireless enabler for convergence and automation of workflows**
  - Technology convergence in content production, contribution and distribution is attractive in terms of economies of scale and the potential to develop new applications, services and business models
- 5G aims to serve many different industrial sectors (verticals) and a great variety of use cases
  - Current focus on eMBB and telco-centric business models
  - Need to **adapt 5G to the needs of the Content Production** : Technical, Operational & Commercial

Future Content Production

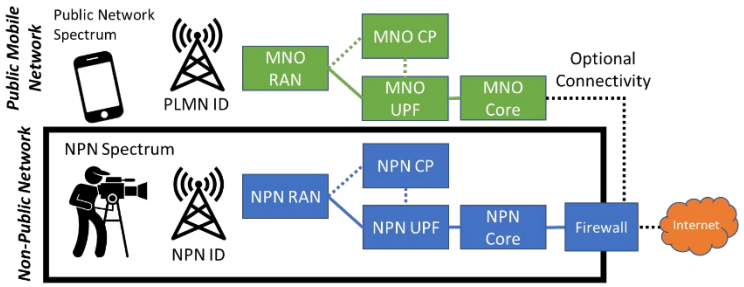
Requirements

Technology	▪ QoS (UL critical) –> Latency, Synchronicity, Reliability & Spectral Efficiency ▪ Interworking –> IP-based ▪ Everything is compatible with everything and plays nicely together ▪ Integration path into existing workflows, migration towards virtual and cloud-based deployments
Operational	▪ On-demand/ ad-hoc deployments ▪ Short set-up time ▪ Keep Control over Workflows: Monitoring & Management ▪ Process & workflow automation
Commercial	▪ Keep access to existing UHF spectrum + Access to Local Licensed Spectrum ▪ Technology convergence along the media value chain & possible with other vertical industries to generate economies of scale

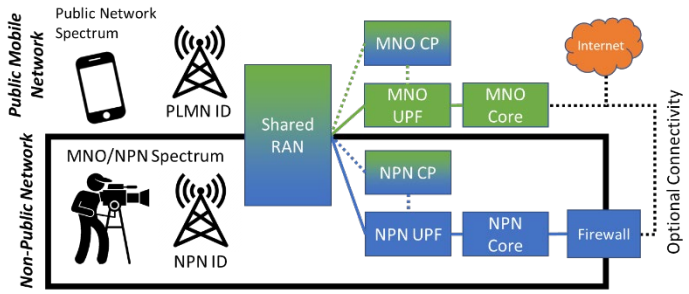
5G Opportunities in Future Content Production

Public & Non-Public Network Deployments

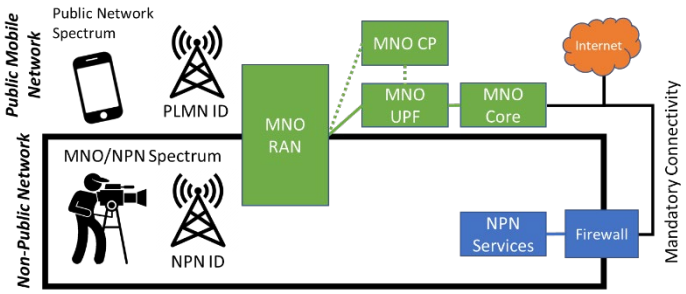
Local Coverage	Local Coverage + WAN Connectivity	Wide Area Coverage
On-Site & Live	Remote Production	ENG
Standalone Non-Public Networks (SNPNs)	Public Network Integrated Non-Public Networks (PNI-NPNs)	Public Networks (PLMNs)



Dedicated – Secure - Optimized



Flexible



As a Service

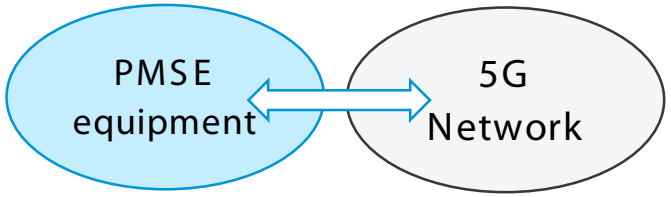
5G Challenges in Future Content Production :

- Media industry is a niche market – Content production is the smallest share
  - General adoption of 5G technology for PMSE not foreseen in the short/ mid-term
  - Conventional PMSE will continue to be important for years to come ➔ Existing spectrum allocations for PMSE activities will need to persist
- 5G is still under specification and development
  - KPIs still do not meet professional production requirements (latency, uplink capacity, reliability, power consumption..)
  - Business & deployment models are still unclear
  - Unknown target date for implementation in technical specifications of 3GPP, in the availability of solutions for PMSE and in the deployment!

Integration of PMSE and 5G in production workflows

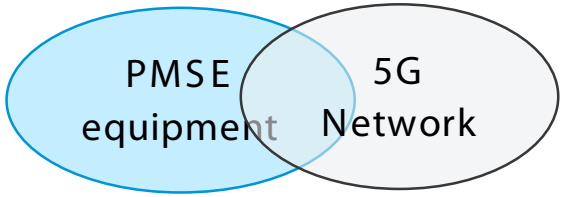
Migration path from conventional PMSE to converged IP -world of tomorrow

Connected



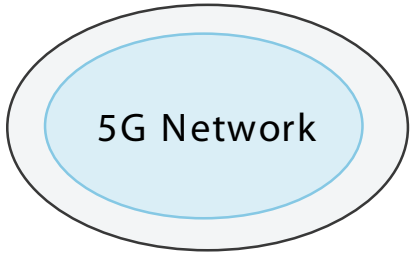
- PMSE equipment can be connected to a 5G network via a gateway and Internet Protocol (IP).

Interworking



- PMSE devices can interact directly with the 5G network via trusted or untrusted profiles.
- A device in the PMSE network can call a service of the 5G network.
- A device in the 5G network can call a service in the PMSE network.
- Devices and Services can interwork with each other.

Fully Integrated



- PMSE devices are 5G devices.
- PMSE services are 5G services.

What is the Media Industry doing?

- Standardization (3GPP)
- 5G-MAG
- Research & Development

Media Industry Engagement in 5G

Engage in 5G technology standardization and PoCs

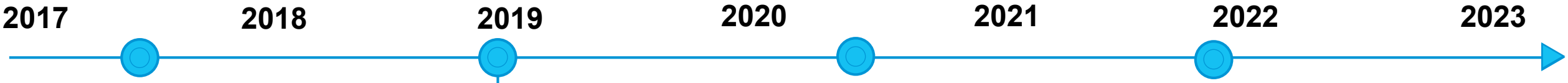
- Standardization @ 3GPP
  - Define use cases for 5G in professional content production and contribution
  - Define technical and operational requirements
  - Submit the use cases and requirements to the 3GPP
  - Collaborate with the industry partners and build support for the requirements in 3GPP
- Industry Alliance @ 5G-MAG
- Trials and PoCs: e.g. 5G RECORDs

Work in 3GPP

RELEASE 16

Network Slicing

Non-Public Networks



SA1

Requirements

AVPROD (TR 22.827)

VIAPA (TS 22.263)

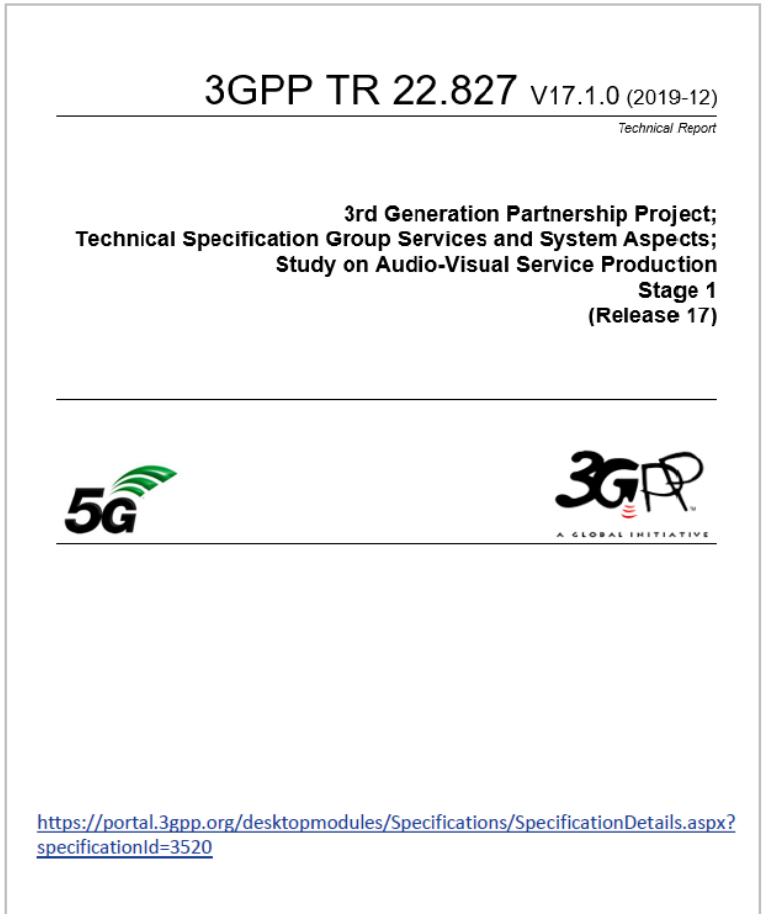
RELEASE 17

Enhanced Non-Public Networks

Industrial IoT

A GLOBAL INITIATIVE

3GPP Work in Support of Media Production Use Cases



3GPP TR 22.827 V17.1.0 (2019-12)

Technical Report

3rd Generation Partnership Project;
Technical Specification Group Services and System Aspects;
Study on Audio-Visual Service Production
Stage 1
(Release 17)

https://portal.3gpp.org/desktopmodules/Specifications/SpecificationDetails.aspx?specificationId=3520

3GPP TS 22.263 V17.0.0 (2019-12)

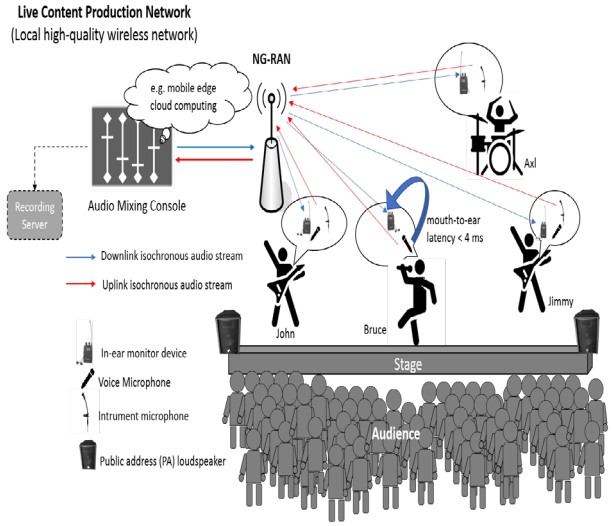
Technical Specification

3rd Generation Partnership Project;
Technical Specification Group Technical Specification Group Services and System Aspects;
Service requirements for video, imaging and audio for professional applications (VIAPA);
Stage 1
(Release 17)

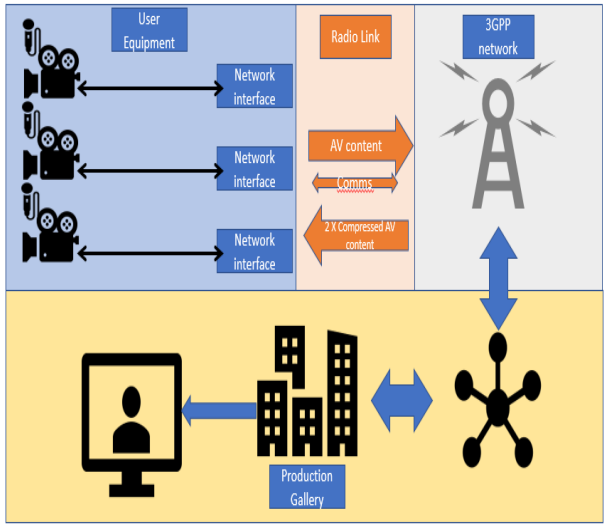
https://portal.3gpp.org/desktopmodules/Specifications/SpecificationDetails.aspx?specificationId=3648

AVPROD Selected Use Cases

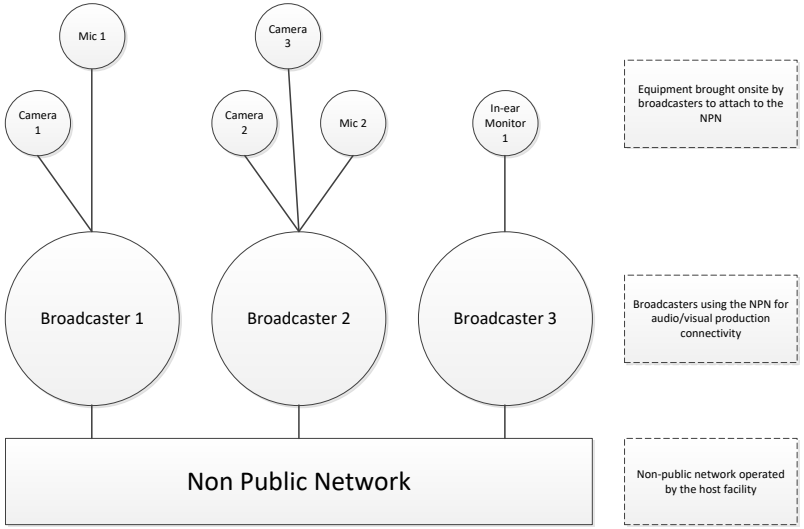
URLLC - Media Workflows - NPNs



URLLC
Clock Synchronization
Network Exposure Requirements (TSC, deterministic QoS)
Time Sensitive Communication (TSC)



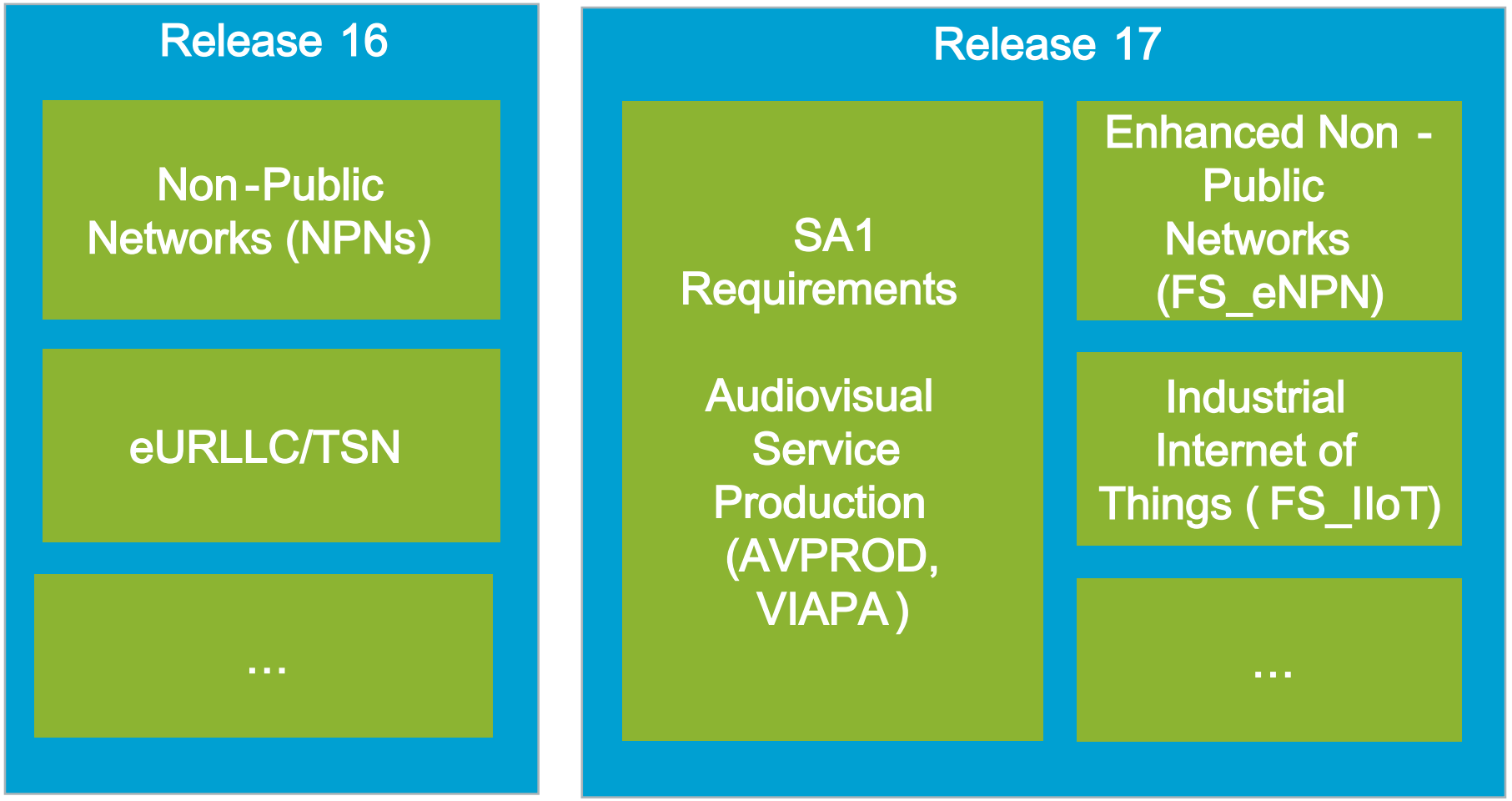
Support of media workflows
IEEE 1588 (PTP)



On-Demand SNPNs
Ad-hoc On-boarding of nomadic Equipment
Temporary Authentication/ Subscription based on Identities & Credentials (3GPP & Non-3GPP) provided by a 3rd party

Work in 3GPP

Enablers to meet KPIs of Content Production Applications



Work Areas in 3GPP Rel 17

FS_eNPN

- On-boarding of devices on ad -hoc SNPNs: temporary subscriptions using 3rd party credentials
- Service continuity between PLMN & NPN
- Multi -Connectivity UE to PLMN and NPN
- Support of IMS voice and emergency services for SNPN
- Equivalent SNPNs – Access control & service continuity
- Support of Non -3GPP Access for SNPNs

FS_IIoT

- Uplink time synchronization
- UE-UE TSC Communication
- Exposure of TSC Services (Deterministic QoS & Time Synchronization)
- Support of TSN distribute configuration model
- Use of Survival Time for Deterministic Applications (CyberCAV)

Engagement in Standardization is good but… not enough

Further Work

- Implement 5G functionality in professional production equipment and bring it to the market
  - PMSE is a niche market for 5G equipment manufacturers so this may have to be done by production technology providers
  - Build competence within production specialist companies
- Find suitable business arrangements with involved stakeholders
  - Search synergy & cooperation
- Develop the concept and ecosystem for non-public 5G networks (NPNs)
  - Different network architectures than traditional mobile networks
  - Requires access to spectrum – Engagement with regulators
  - Seamless interconnection arrangements with 'the wider 5G world'

5G MAG
MEDIA ACTION GROUP

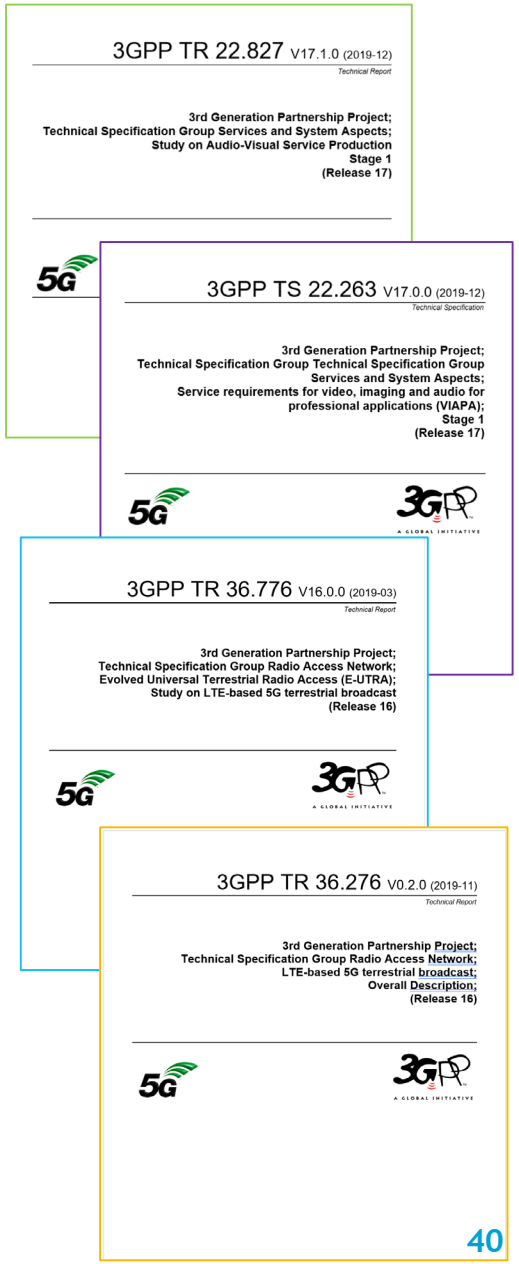
Let's work together to shape the future of media

5G Media Action Group (5G-MAG)

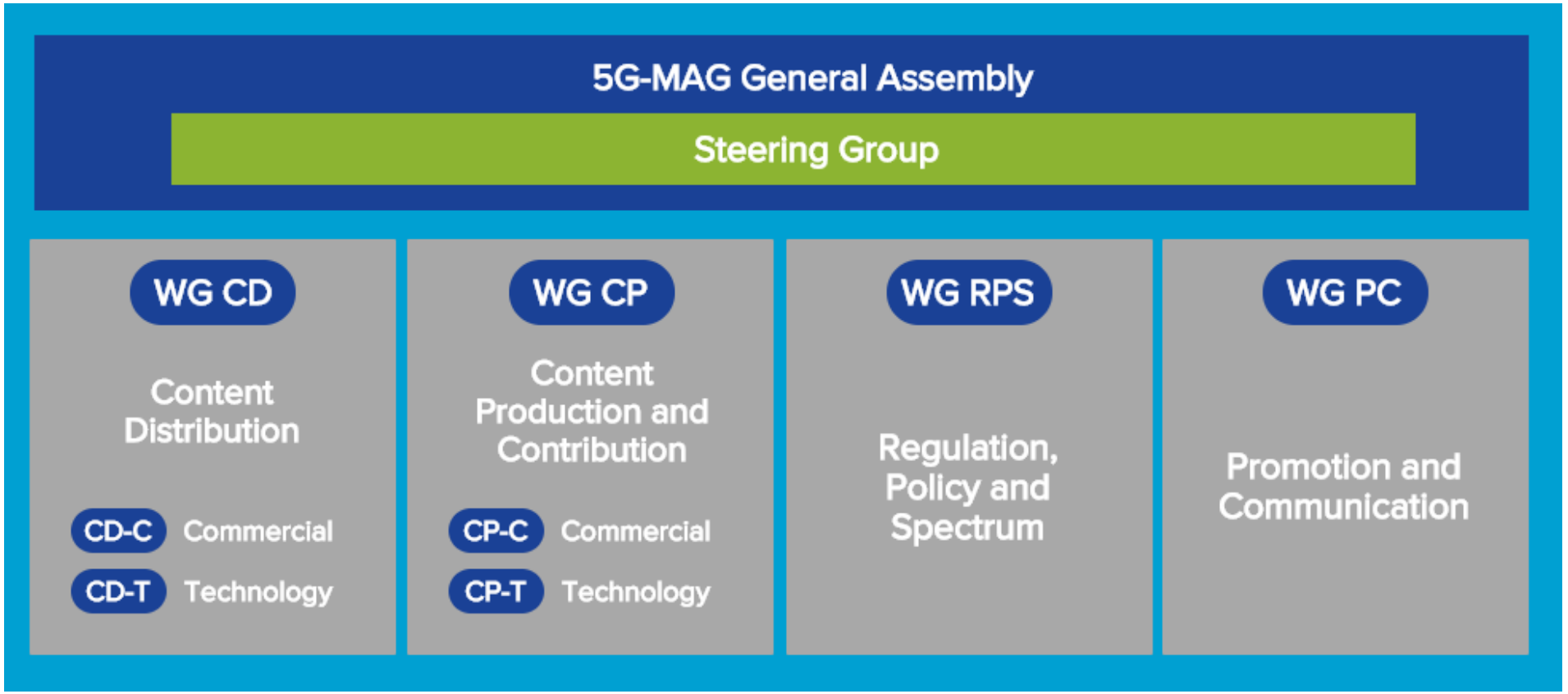
Shaping 3GPP technologies and standards according to requirements of the media industry

Standards alone are not enough as deployment and business models, equipment ecosystem and regulatory models need to be evaluated

Create critical mass for business opportunities and market adoption



5G Media Action Group (5G -MAG)



WG 2 – Content Production (Technical)

Architecture

End Devices

Network Architectures

Public Network slicing, Non-Public Networks

Features

QoS, Low and Constant Latency

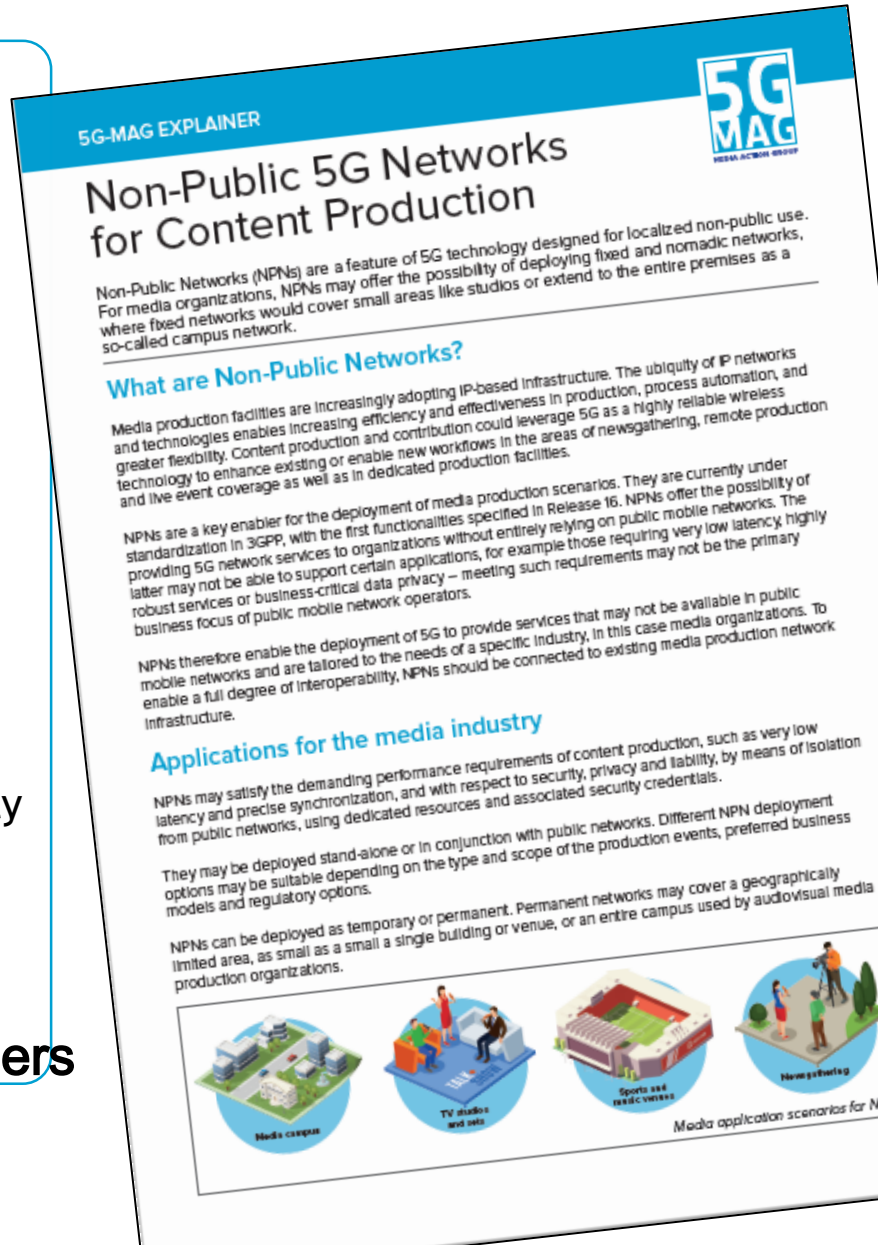
High UL Throughput

Synchronization

Inter-working

Systems Inter-networking and Integration

Mobility and Deployment Flexibility


5G-MAG EXPLAINER

Non-Public 5G Networks for Content Production

Non-Public Networks (NPNs) are a feature of 5G technology designed for localized non-public use. For media organizations, NPNs may offer the possibility of deploying fixed and nomadic networks, where fixed networks would cover small areas like studios or extend to the entire premises as a so-called campus network.

What are Non-Public Networks?

Media production facilities are increasingly adopting IP-based infrastructure. The ubiquity of IP networks and technologies enables increasing efficiency and effectiveness in production, process automation, and greater flexibility. Content production and contribution could leverage 5G as a highly reliable wireless technology to enhance existing or enable new workflows in the areas of newsgathering, remote production and live event coverage as well as in dedicated production facilities.

NPNs are a key enabler for the deployment of media production scenarios. They are currently under standardization in 3GPP, with the first functionalities specified in Release 16. NPNs offer the possibility of providing 5G network services to organizations without entirely relying on public mobile networks. The latter may not be able to support certain applications, for example those requiring very low latency, highly robust services or business-critical data privacy – meeting such requirements may not be the primary business focus of public mobile network operators.

NPNs therefore enable the deployment of 5G to provide services that may not be available in public mobile networks and are tailored to the needs of a specific industry. In this case media organizations. To enable a full degree of interoperability, NPNs should be connected to existing media production network infrastructure.

Applications for the media industry

NPNs may satisfy the demanding performance requirements of content production, such as very low latency and precise synchronization, and with respect to security, privacy and liability, by means of isolation from public networks, using dedicated resources and associated security credentials.

They may be deployed stand-alone or in conjunction with public networks. Different NPN deployment options may be suitable depending on the type and scope of the production events, preferred business models and regulatory options.

NPNs can be deployed as temporary or permanent. Permanent networks may cover a geographically limited area, as small as a small a single building or venue, or an entire campus used by audiovisual media production organizations.

Media application scenarios for N

www.5g-mag.com/explainers

Get close to the 5G Media Action Group

Web site : www.5G -MAG.com

@5GMAGnews

5G & Media Group: https ://www.linkedin.com/groups/12464739/

5G-MAG Profile: https://www.linkedin.com/company/5g -mag/

https://www.youtube.com/watch?v=Z4XgRP_aBVo

Thanks. Questions?

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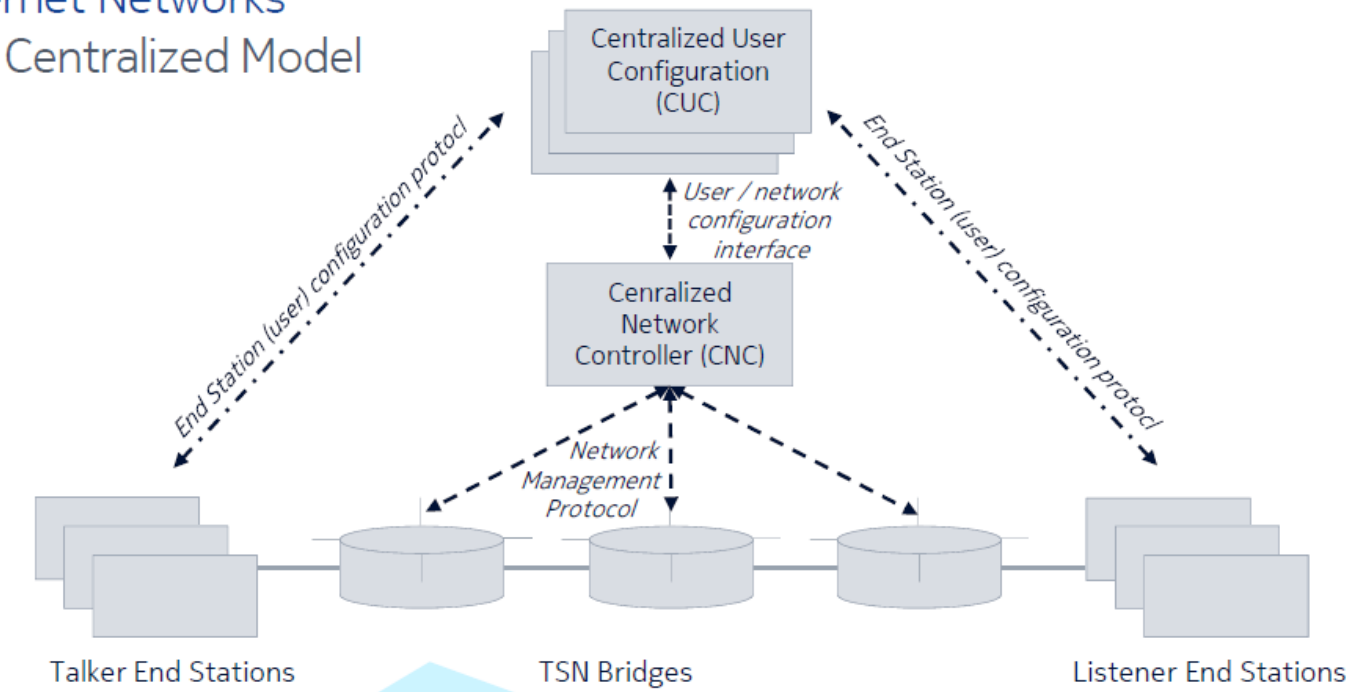
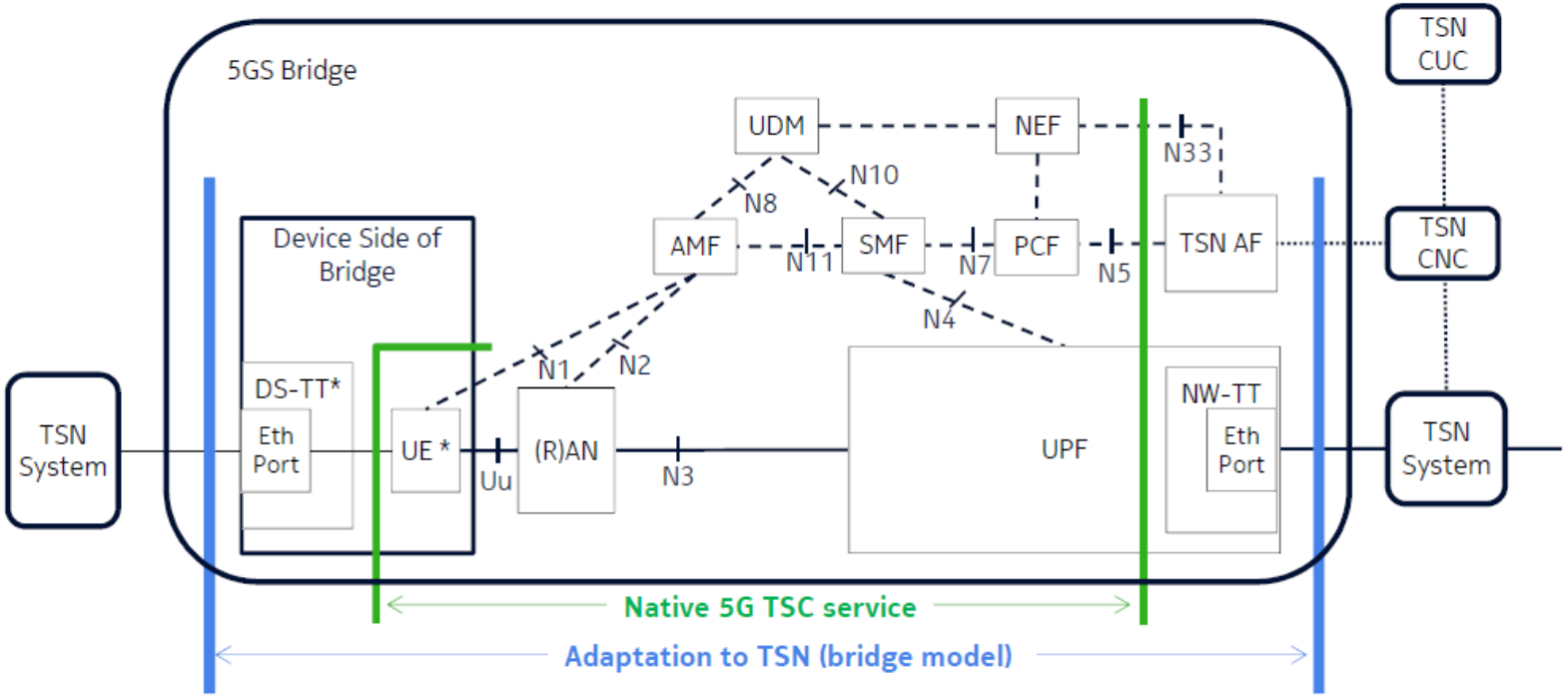
Ethernet Networks
TSN Centralized Model



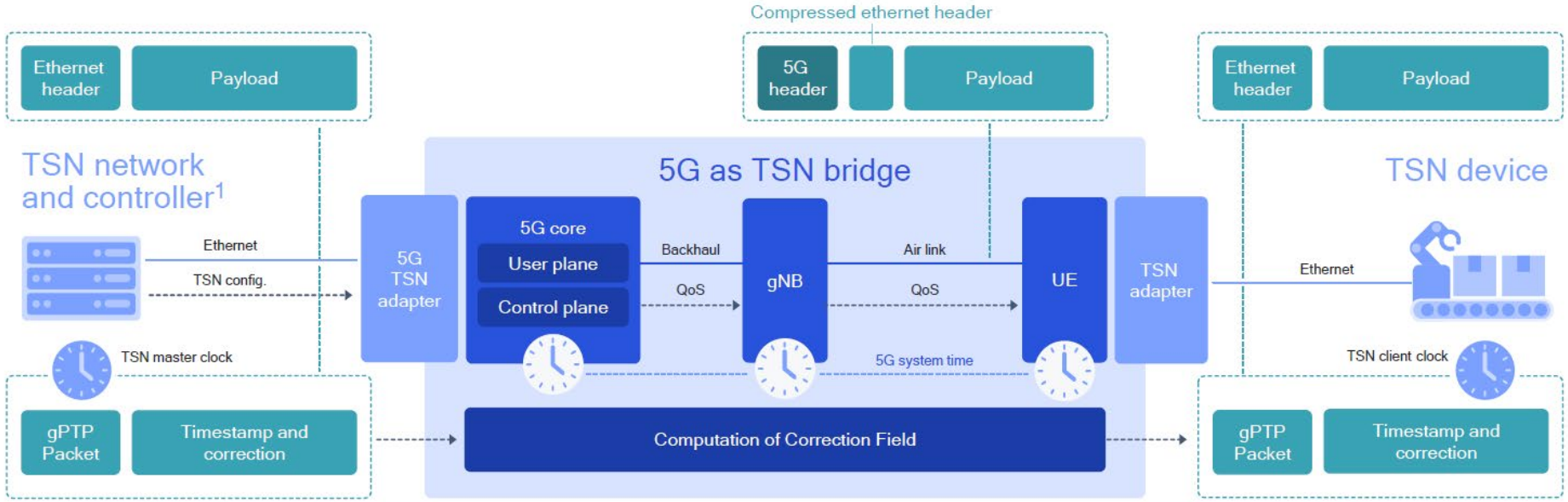
5G System (RAN, CN, OAM) acts as one or more TSN Bridges (5G Bridges)

NOKIA Bell Labs

TSC / TSN bridge model
Functional Architecture (Source : 3GPP TS 23.501)



*: Whether DS-TT and UE are combined or are separate is up to implementation



Source: Qualcomm

Requirement		Comment
Application latency	< 4 ms	Maximum allowable latency at application level, including interfacing, audio processing and AD / DA conversion
Wireless transmission latency	< 1 ms	Latency that is introduced per link of the wireless communication system including the transmission interval of the audio data; smaller than half of application latency to leave some room for additional audio processing, e.g. mixing
User data rate	150 kbit/s – 5 Mbit/s	Different user data rates per audio link need to be supported for different audio demands
Reliability	99,9999 %	The packet error ratio (PER) of the system shall be below 10^{-6} for a packet size corresponding to 1 ms audio data
# of audio links	50 – 300	Simultaneous audio links: microphones and IEMs
Service area	≤ 10.000 m^2	Event area, indoor and outdoor
Synchronicity	≤ 1 µs	All wireless mobile devices of one local audio production network shall be synchronized at the application level within the specified accuracy

Work in 3GPP

Release 17

SA1 Requirements

Audiovisual Service Production (AVPROD, VIAPA)

Enhanced Non - Public Networks (FS_eNPN

Industrial Internet of Things (FS_IIoT)

…

Release 18

- Further enhancements of NPNs:
  - Interworking support for SNPNs: Trusted access with other technologies from the domain of content production would accelerate the adoption of 3GPP technology
  - Roaming support for SNPNs and handover with for SNPNs, PNI-NPNs and PLMN.
  - Spectrum flexibility via dynamic spectrum access (e.g. eLSA, CBRS,…)
- QoS delivery for multicast service

3GPP Standardisation
Rel-17, 16

840024	FS_eNPN	Study on enhanced support of Non-Public Networks	Rel-17	S2
880008	FS_eNPN_SEC	Study on enhanced security support for Non-Public Networks	Rel-17	S3
840045	AVPROD	Audio-Visual Service Production	Rel-17	
800014	FS_AVPROD	... Study on AVPROD	Rel-17	S1
840031	AVPROD	... Stage 1 of AVPROD	Rel-17	S1
850012	FS_IIoT	Study on enhanced support of Industrial IoT	Rel-17	S2
880010	FS_IIoT_SEC	Study on security for enhanced support of Industrial IoT	Rel-17	S3
860245	NR_IIOT_URLLC_enh-Perf	... Perf. Part: Enhanced Industrial Internet of Things (IoT) and ultra-reliable and low latency communication (URLLC) support for NR	Rel-17	R4

860008	IESNPN	IMS emergency support for SNPN	Rel-17	S1

870023	OAM_NPN	Management of non-public networks	Rel-17	S5

820002	5GMSA	Media streaming architecture	Rel-16	S4

3GPP Standardisation
Rel-18

890023	FS_PALS	Study on 5G Networks Providing Access to Localized Services	Rel-18	S1

Allow to setup temporary authorization/access for UEs to PLMN services via a NPN
Discovery of available NPN/PLMN services via the PLMN/NPN

880037	FS_5TRS	Study on 5G Timing Resiliency System	Rel-18	S1

880041	FS_PIN	Study on Personal IoT Networks	Rel-18	S1