5G for live broadcast production

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IP SHOWCASE

Audio Engineering Society · AIMS Alliance for IP Media Solutions · AMWA Networked Media. Working. · EBU · SMPTE · VSF Video Services Forum

5G for live broadcast production

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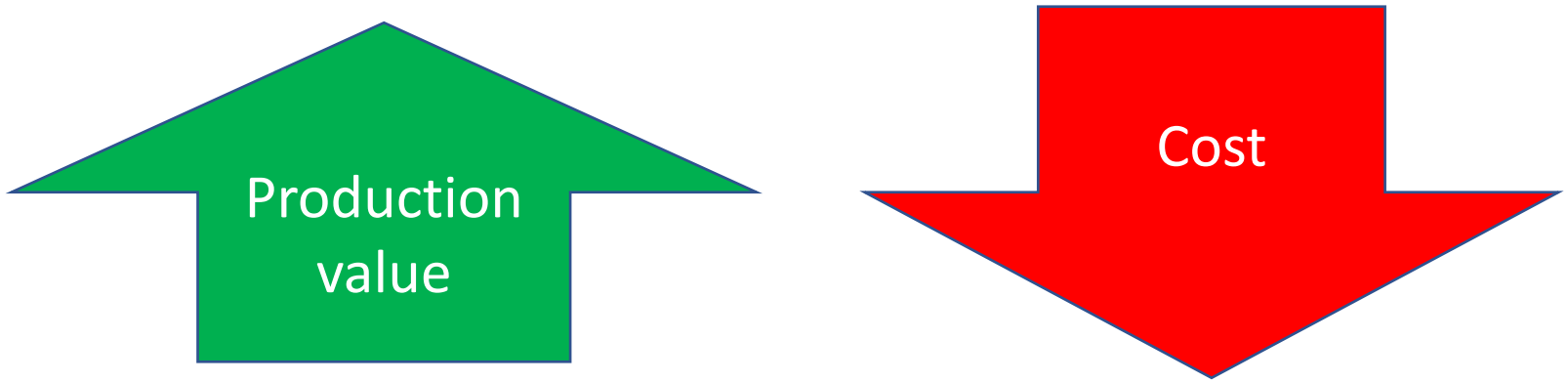
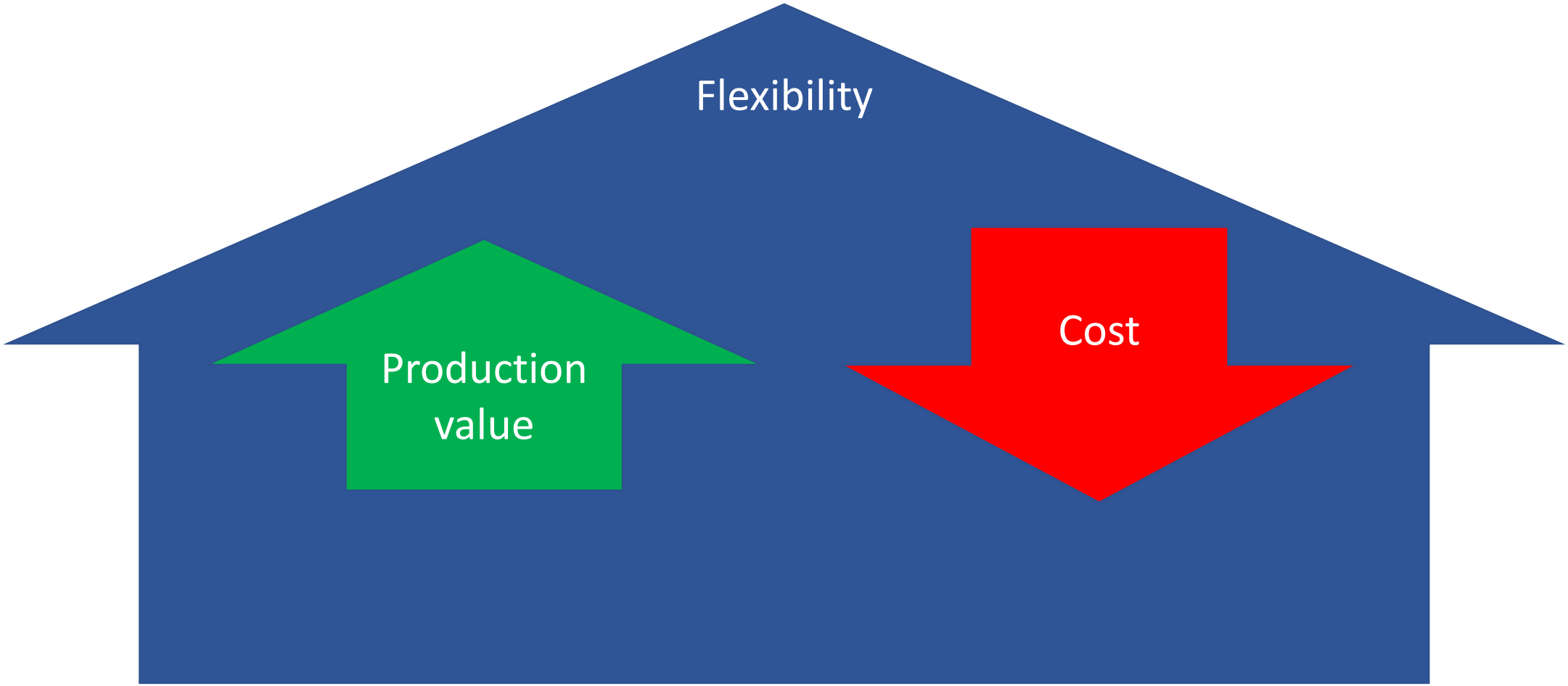
A Sony Group Company

Come and catch up on the Sony stand C10901 in the Central Hall

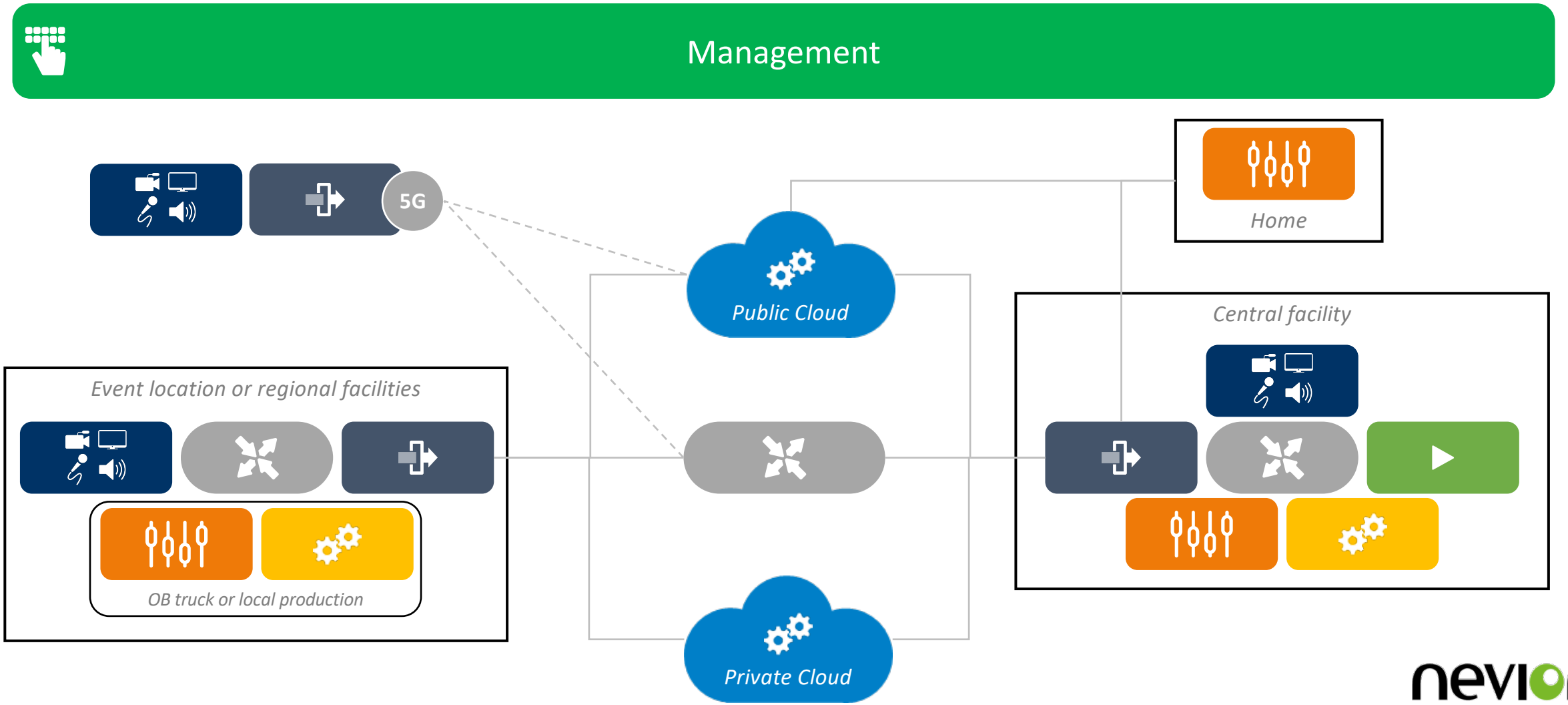
Content producer desires



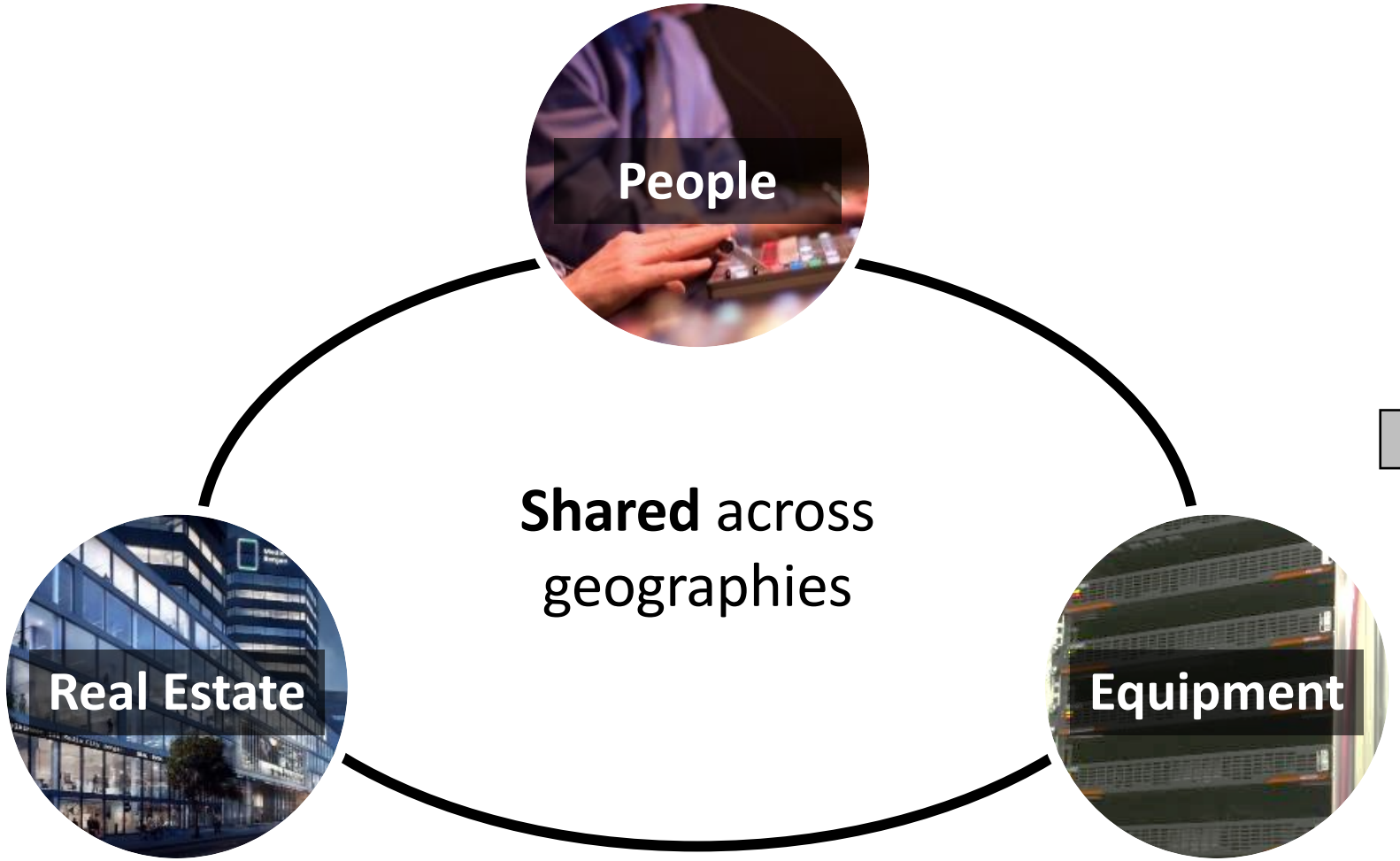
Content producer desires



Distributed production

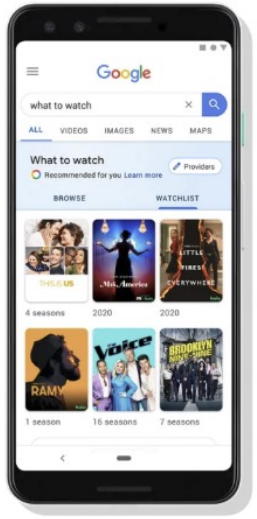


IP is transforming production workflows



Nimbler and **more cost-effective** production, using the very **best resources**

Potential for broadcast

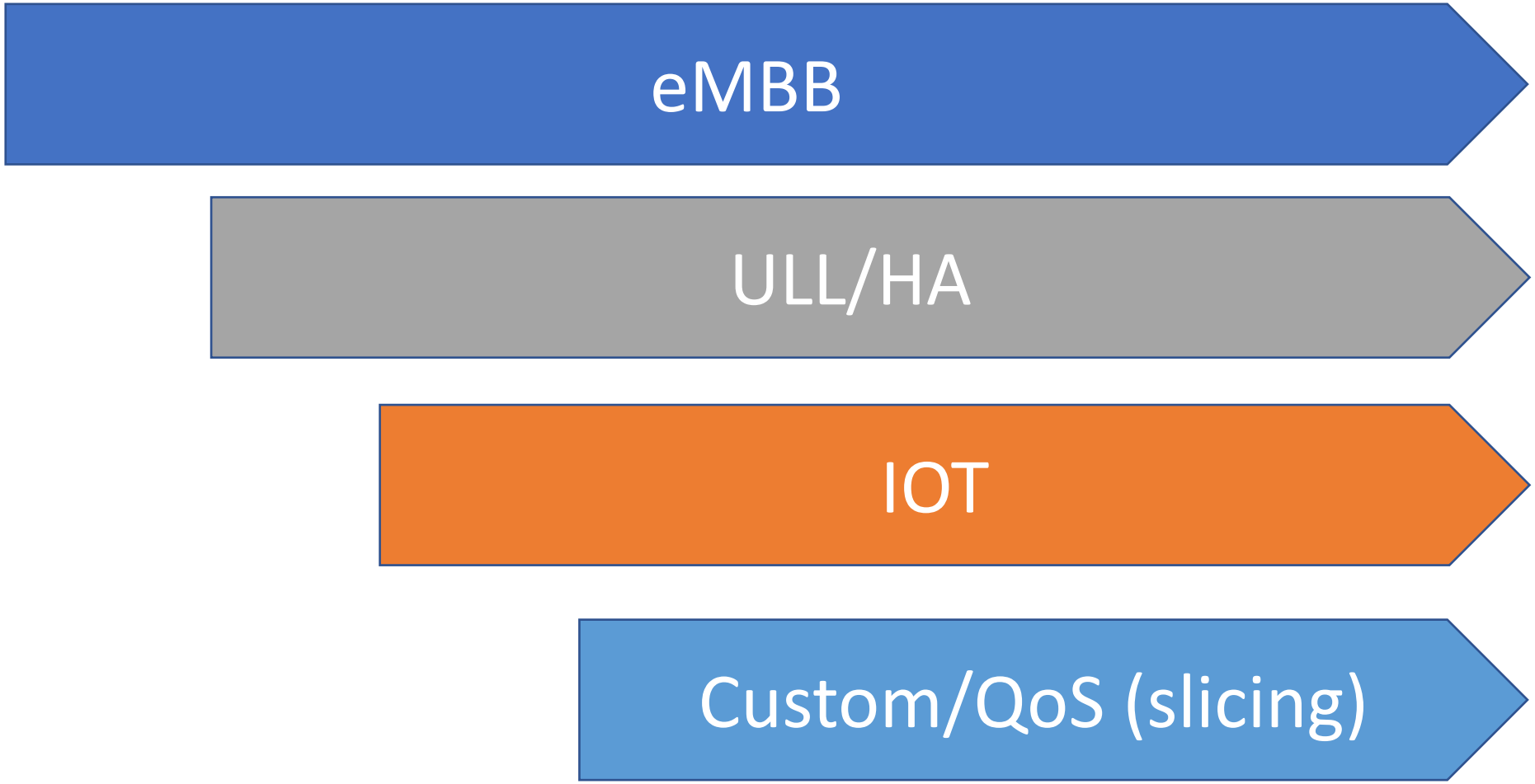


Mobile consumption

Fixed consumption

Mobile production

5G deployment prioritisation

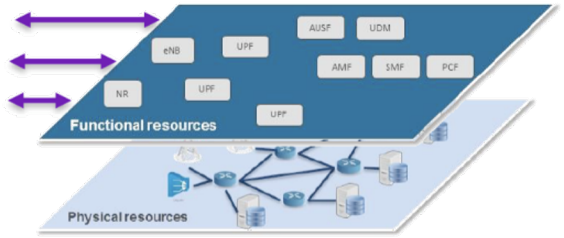


5G – technology & service

Non-**P**ublic **N**etwork
Radio Technology
toolkit

Mobile **N**etwork **O**perator
Telecommunications
service

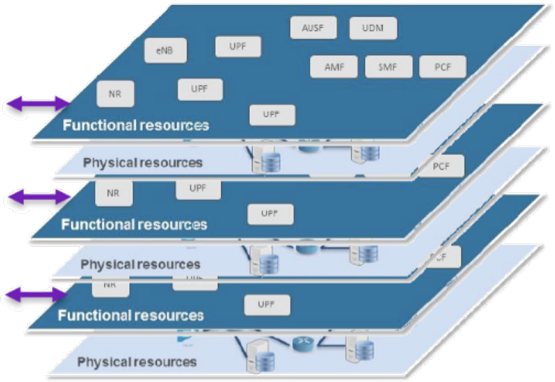
5G architecture options



Single Network

Shared functional layer

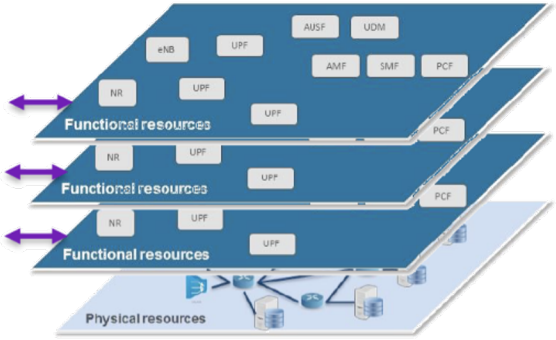
Shared physical resources



Separate Sub-networks

Dedicated functional layer

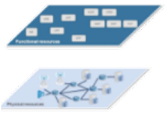
Dedicated physical resources



Network Slices

Dedicated functional layer

Shared physical resources



Functional resource layer

Physical resource layer

Nevion 5G project trial involvement

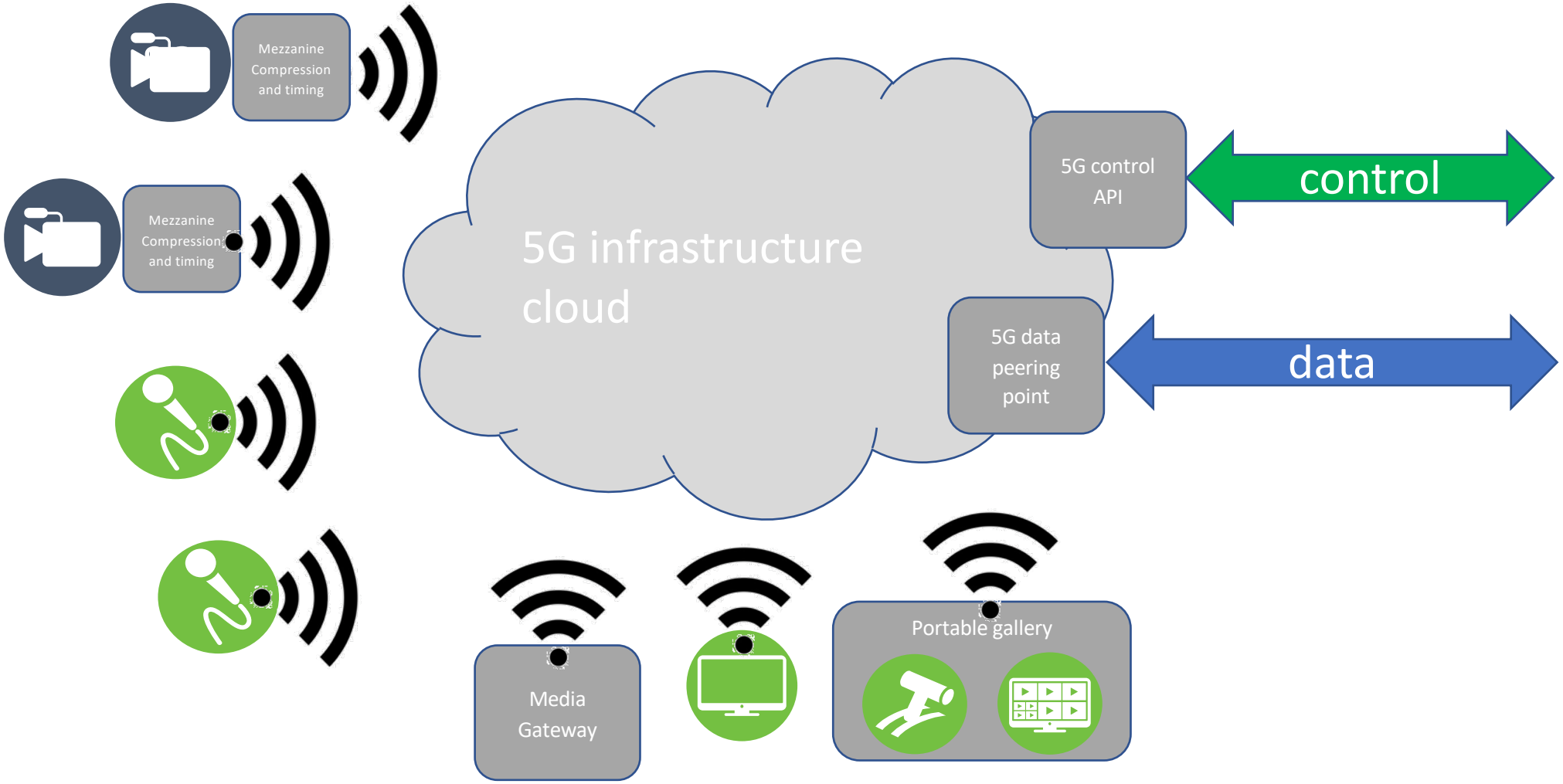
- Virtuosa

- 5G-VINNI

- 5G-RECORDS 5G key technology enableRs for Emerging media COntent pRoDuction Services

Horizon 2020
European Union Funding
for Research & Innovation

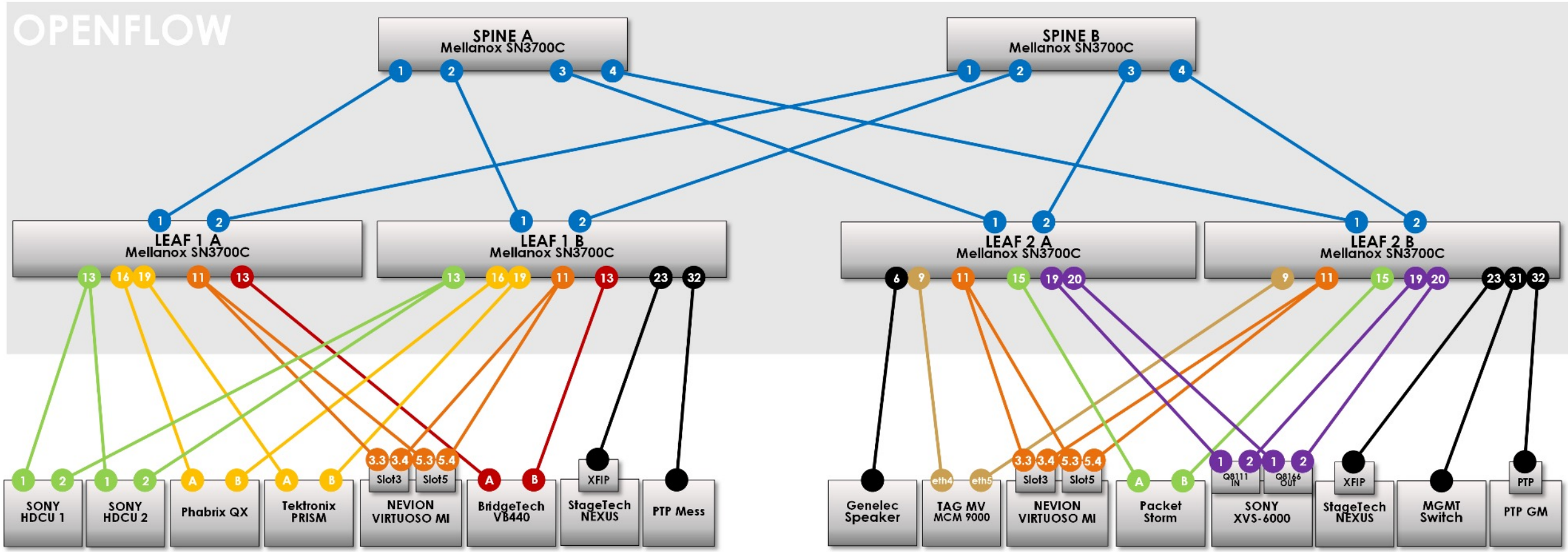
5G live broadcast production



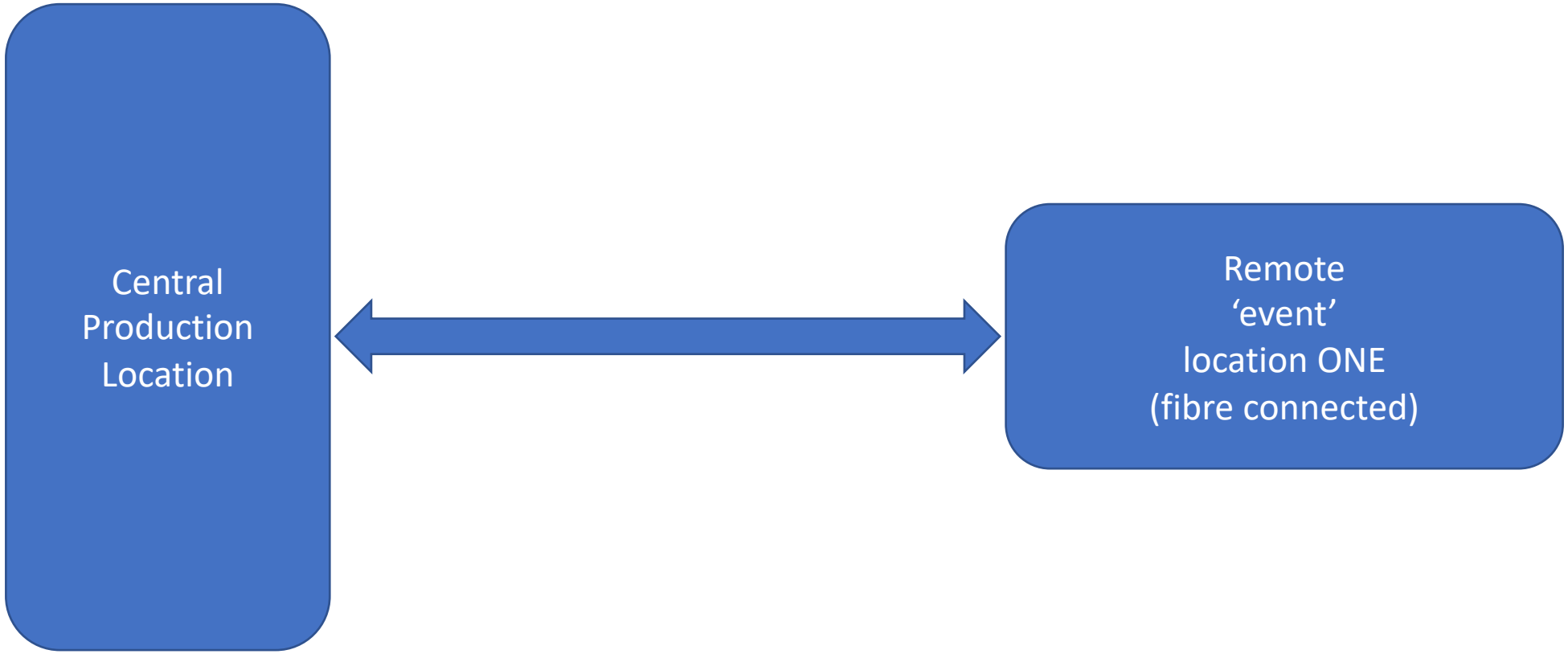
The Virtuosa partners & supporting friends

Phase I LAN

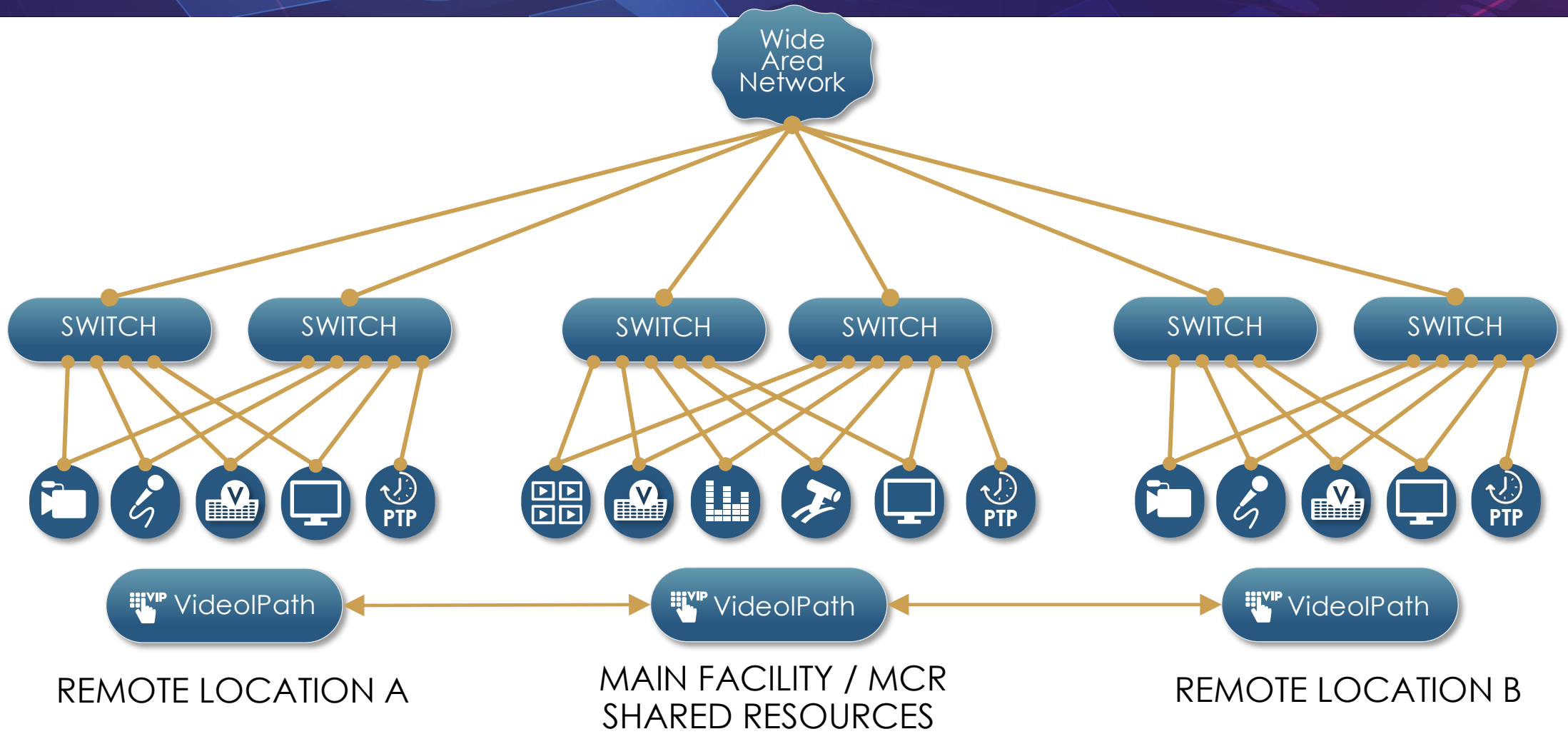
Phase 1 – LAN production



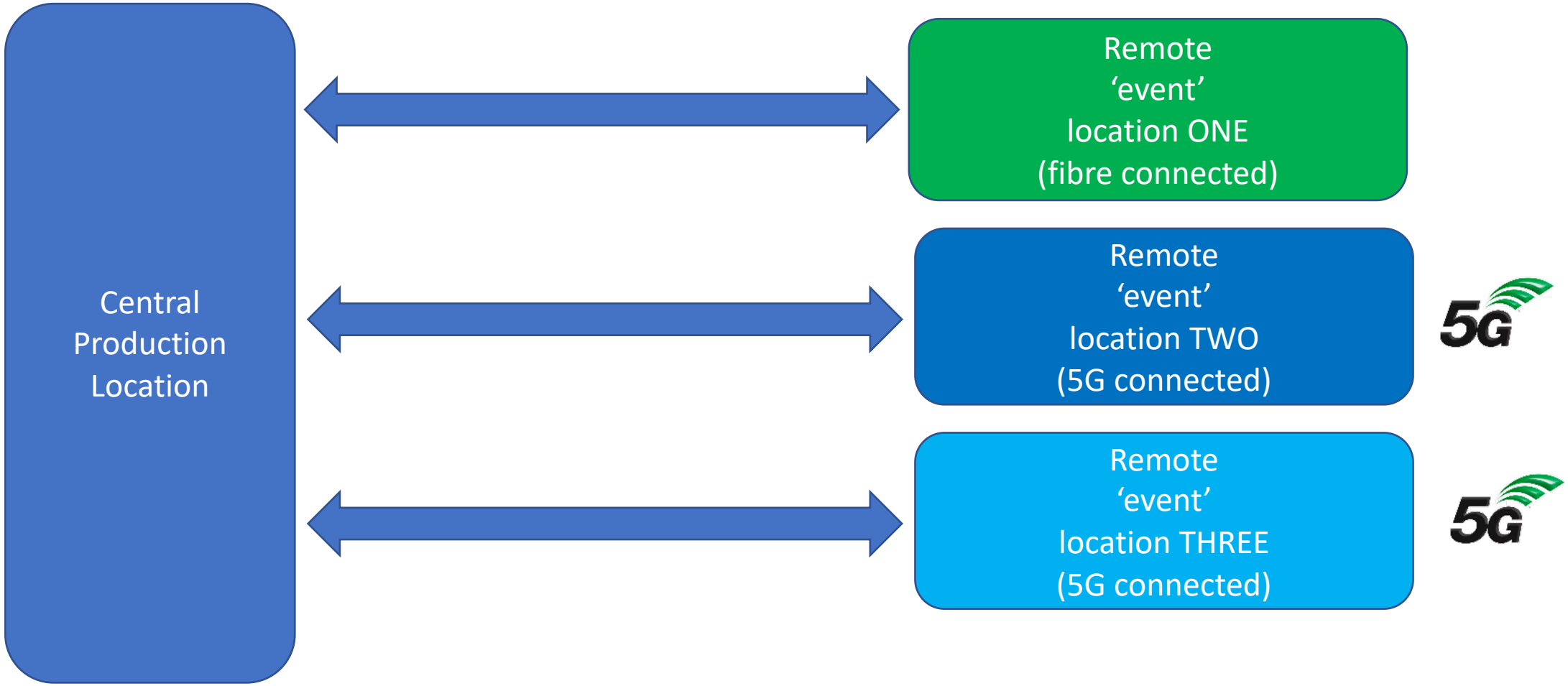
Phase II LAN/WAN



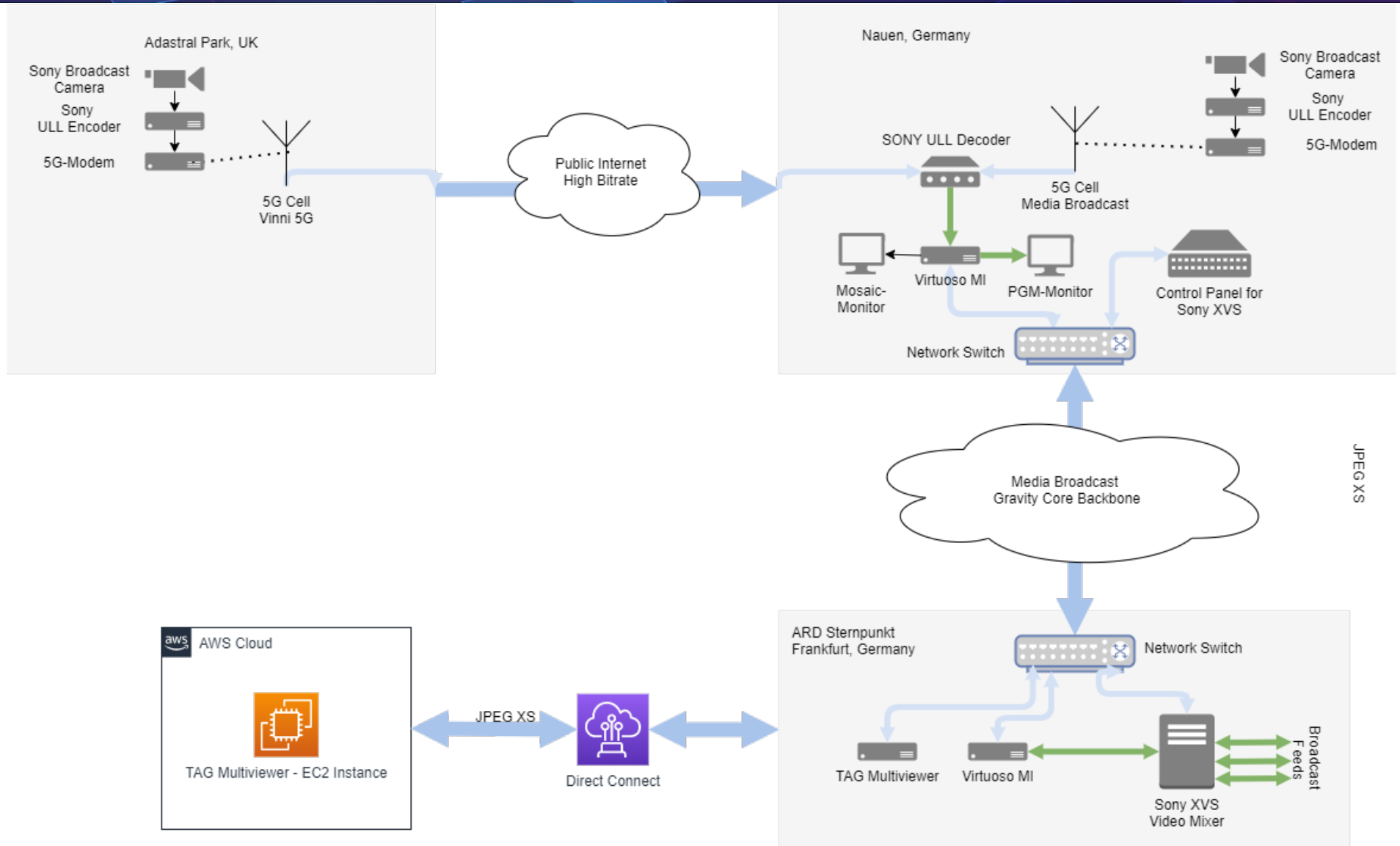
Phase 2


Wide Area Network
SWITCH
SWITCH
SWITCH
SWITCH
SWITCH
SWITCH
PTP
PTP
PTP
VideoIPath
VideoIPath
VideoIPath
REMOTE LOCATION A
MAIN FACILITY / MCR SHARED RESOURCES
REMOTE LOCATION B

Phase III LAN/WAN + 5G

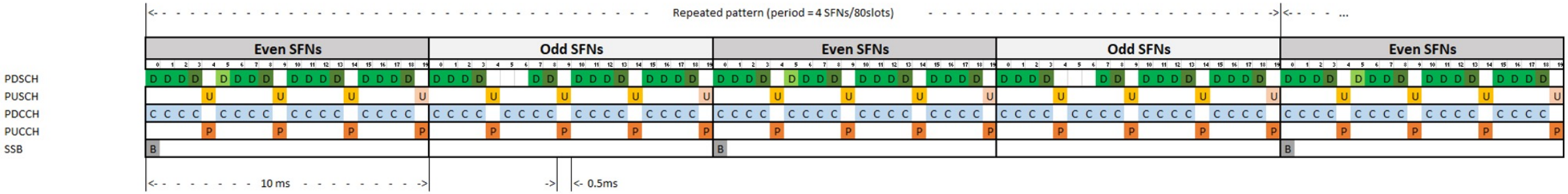


Phase 3

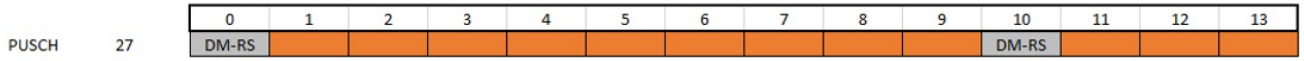

Adastral Park, UK
Sony Broadcast Camera
Sony ULL Encoder
5G-Modem
5G Cell Vinni 5G
Public Internet High Bitrate
Nauen, Germany
Sony Broadcast Camera
Sony ULL Encoder
5G-Modem
SONY ULL Decoder
5G Cell Media Broadcast
Mosaic-Monitor
Virtuoso MI
PGM-Monitor
Control Panel for Sony XVS
Network Switch
Media Broadcast Gravity Core Backbone
JPEG XS
AWS Cloud
TAG Multiviewer - EC2 Instance
JPEG XS
Direct Connect
ARD Sternpunkt Frankfurt, Germany
Network Switch
TAG Multiviewer
Virtuoso MI
Sony XVS Video Mixer
Broadcast Feeds

The 5G transport technology testing

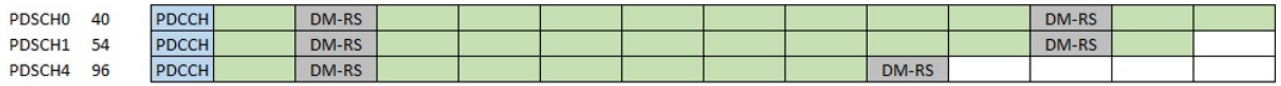
Frame structure



1 PUSCH configurations seen (16 configured):



3 PUSCH configurations seen (15 configured):



PDSCH	D	Time = 13 symbols, Freq = Full BW
PDSCH	D	Time = 12 symbols, Freq = Full BW
PDSCH	D	Time = 7 symbols, Freq = Full BW
PUSCH	U	Time = 14 symbols, Freq = Full BW (273 PRBs)
PUSCH	U	Time = 14 symbols, Freq = 249 PRBs
PDCCH	C	Time = 1st OFDM symbol
PUCCH	P	
SSB	B	
TRS	T	
CQI	Q	

Max throughput estimation

Uplink

```
Configuration:
- Frequency Range           : FR1
- Sub-carrier spacing       : 30        kHz
- System BW                 : 100       MHz
- PUSCH time allocation     : 14        #OFDM symbols per allocated slot
- #layers                   : 1         layer(s)
- mcs table                 : 2
```

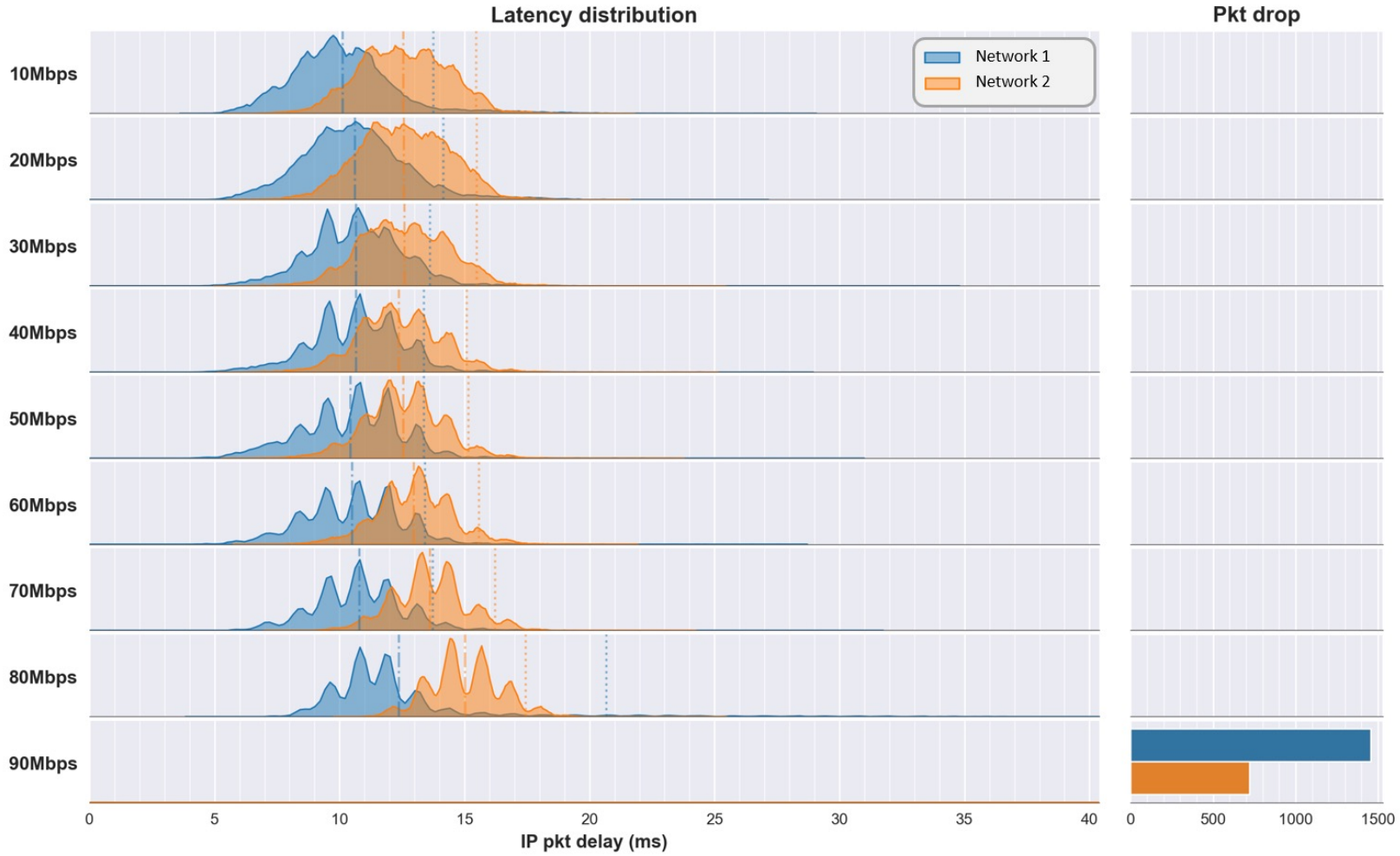
mcs	modulation	tbs1(KB)	tbs2(KB)	tput(Mbps)
0	QPSK	1.248	1.122	3.893
1	QPSK	2.017	1.825	6.301
2	QPSK	3.201	2.946	10.039
3	QPSK	4.612	4.227	14.450
4	QPSK	6.273	5.763	19.666
5	16QAM	7.813	7.172	24.489
6	16QAM	8.961	8.197	28.064
7	16QAM	10.247	9.222	31.970
8	16QAM	11.525	10.497	36.058
9	16QAM	12.802	11.781	40.150
10	16QAM	13.569	12.549	42.605
11	64QAM	14.599	13.322	45.695
12	64QAM	16.141	14.599	50.418
13	64QAM	17.925	16.141	55.933
14	64QAM	19.472	17.422	60.670
15	64QAM	20.997	18.951	65.554
16	64QAM	22.547	20.497	70.510
17	64QAM	24.078	22.026	75.408
18	64QAM	25.622	23.572	80.350
19	64QAM	27.141	25.101	85.219
20	256QAM	28.185	26.122	88.542
21	256QAM	29.722	27.141	93.046
22	256QAM	31.257	28.697	97.974
23	256QAM	32.797	30.215	102.885
24	256QAM	34.847	31.772	109.050
25	256QAM	36.897	33.822	115.610
26	256QAM	37.905	34.847	118.850
27	256QAM	39.973	35.872	124.633

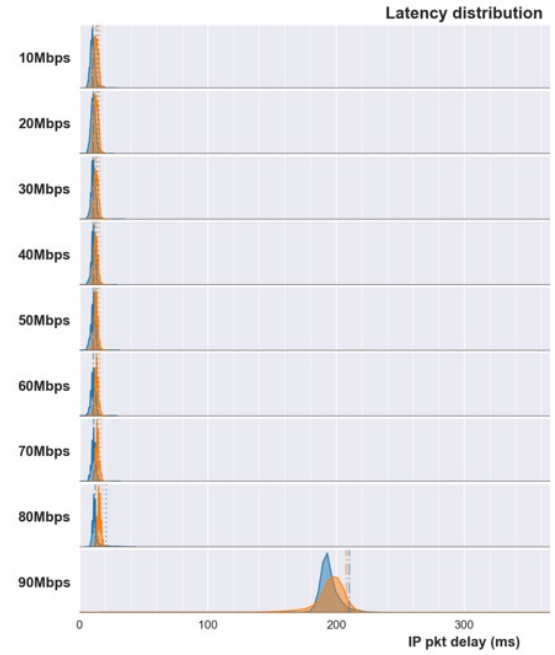
Downlink

```
Configuration:
- Frequency Range           : FR1
- Sub-carrier spacing       : 30        kHz
- System BW                 : 100       MHz
- Max freq allocation       : 273       PRBs
- #layers                   : 4         layer(s)
- MCS table                 : 2
```

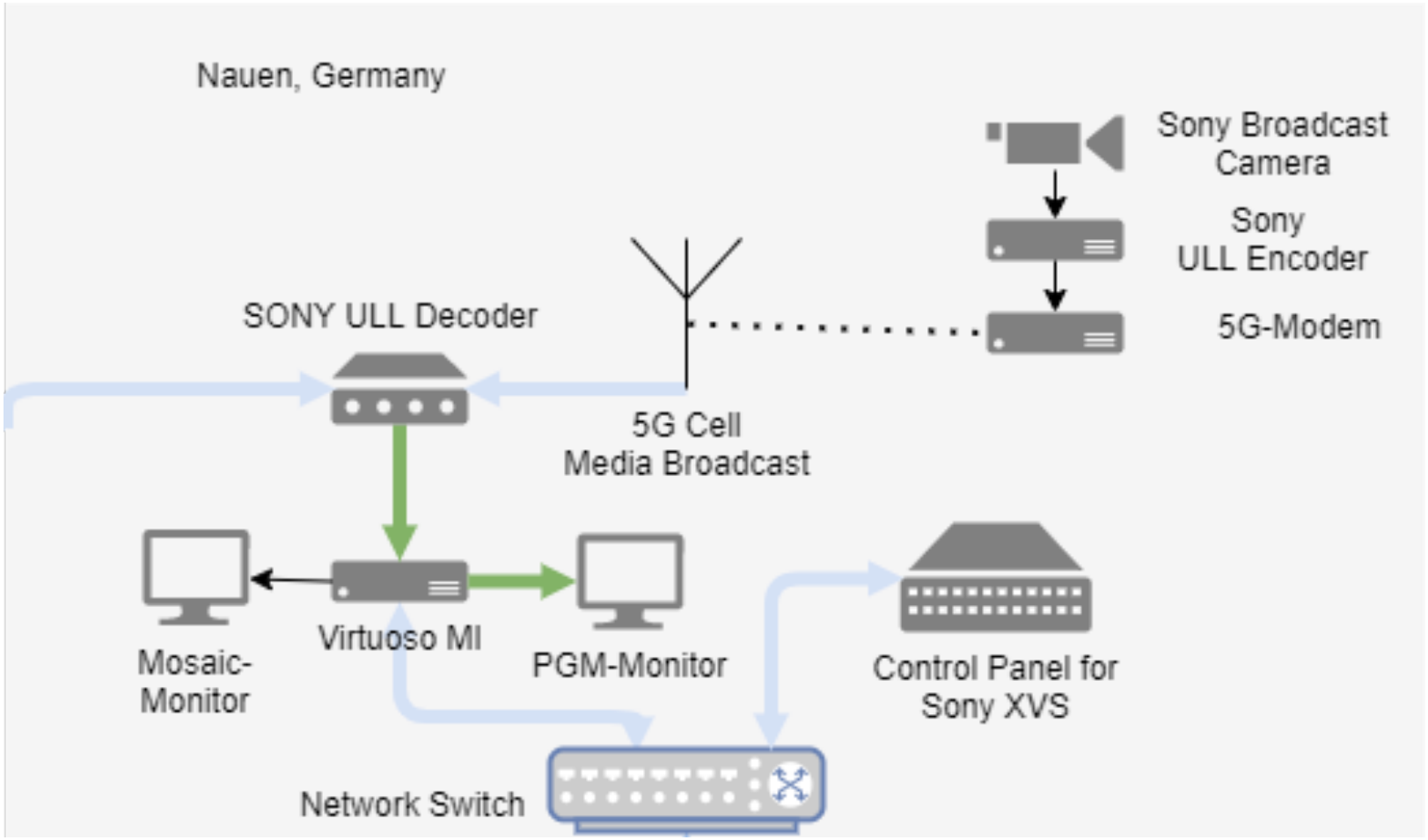
mcs	modulation	tbs1(KB)	tbs2(KB)	tbs3(KB)	tput(Mbps)
0	QPSK	4.227	2.691	3.840	45.654
1	QPSK	6.792	4.357	6.146	73.454
2	QPSK	10.755	6.913	9.737	116.358
3	QPSK	15.885	9.987	14.347	171.131
4	QPSK	20.997	13.569	19.472	227.584
5	16QAM	26.647	16.912	24.078	287.584
6	16QAM	30.747	19.472	27.672	331.654
7	16QAM	34.847	22.026	31.257	375.701
8	16QAM	38.921	24.597	35.872	419.996
9	16QAM	43.047	27.672	38.921	465.714
10	16QAM	46.109	29.722	41.997	499.225
11	64QAM	49.159	31.257	45.061	530.982
12	64QAM	54.285	34.847	49.159	587.168
13	64QAM	59.448	37.905	54.285	642.373
14	64QAM	65.580	40.986	59.448	705.806
15	64QAM	69.677	45.061	63.498	754.881
16	64QAM	75.813	48.159	69.677	818.809
17	64QAM	81.975	52.247	73.766	885.287
18	64QAM	86.097	55.329	79.873	932.217
19	64QAM	92.221	58.405	83.997	995.151
20	256QAM	96.321	61.475	88.113	1041.062
21	256QAM	100.413	63.498	90.125	1082.713
22	256QAM	106.587	67.597	96.321	1150.170
23	256QAM	112.668	71.688	102.407	1216.776
24	256QAM	118.873	75.813	108.573	1284.564
25	256QAM	124.947	79.873	112.668	1350.216
26	256QAM	129.024	81.975	116.769	1392.829
27	256QAM	135.189	83.997	120.862	1452.723

Streaming Uplink IP-pkt delay

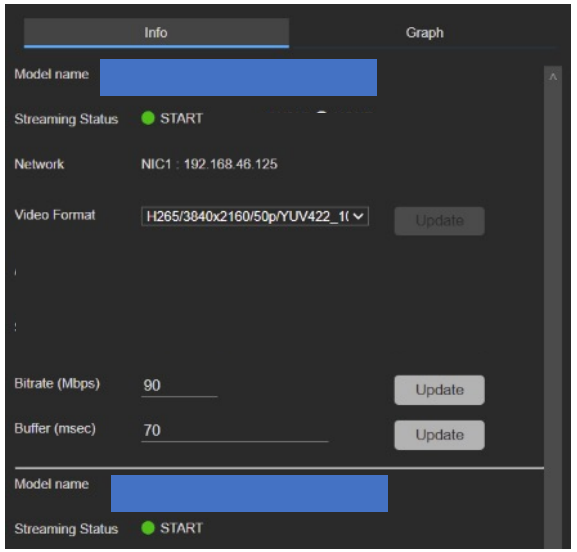


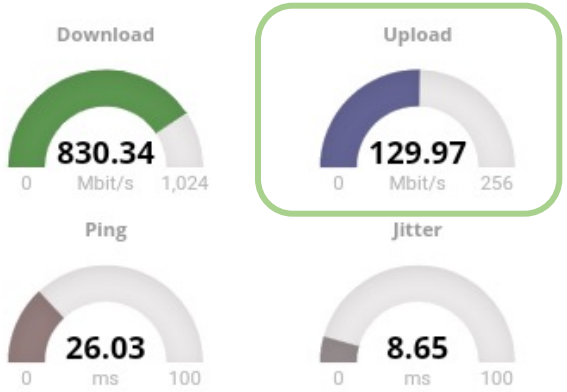


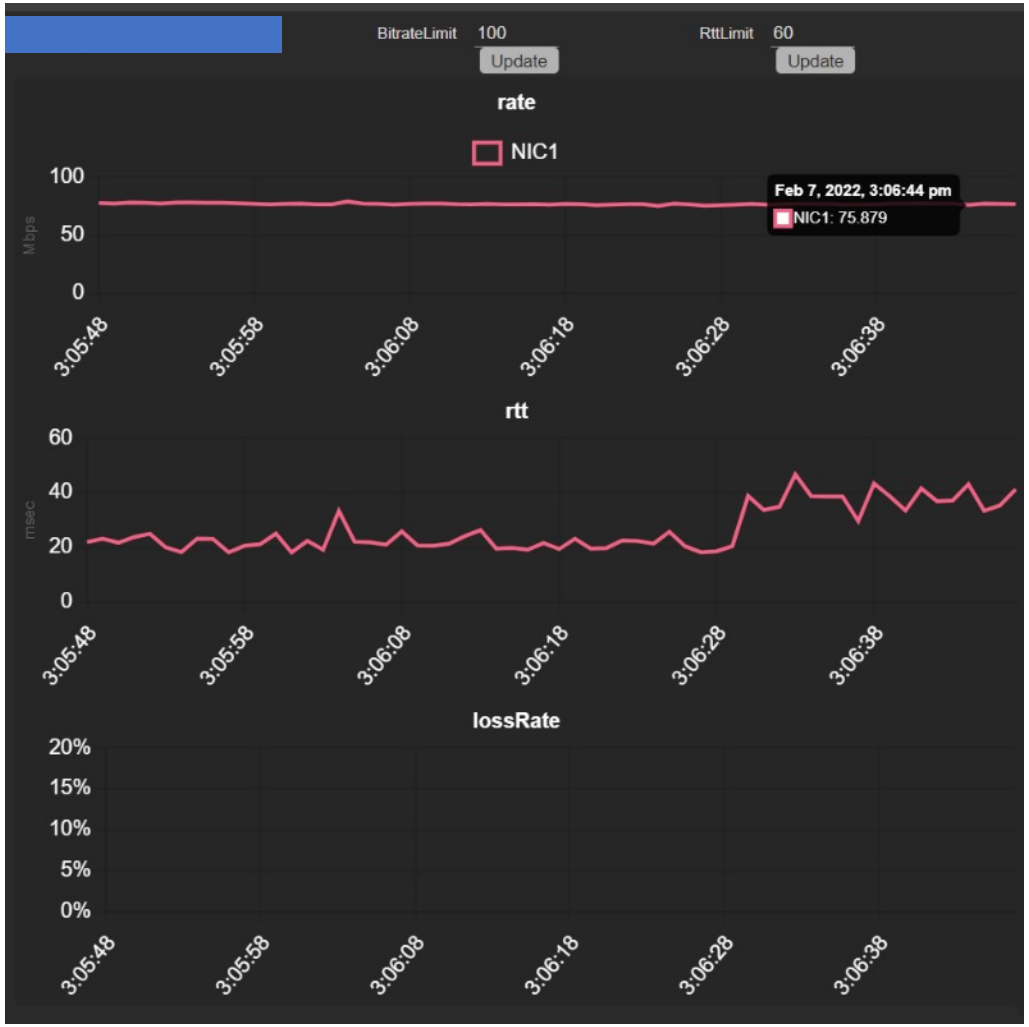
The 5G broadcast technology testing



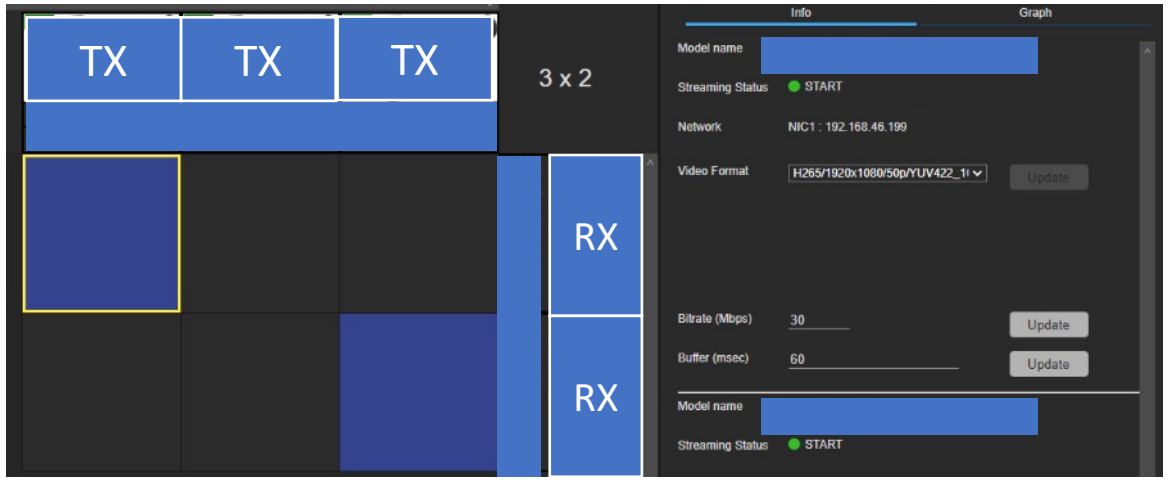
UHD & HD testing

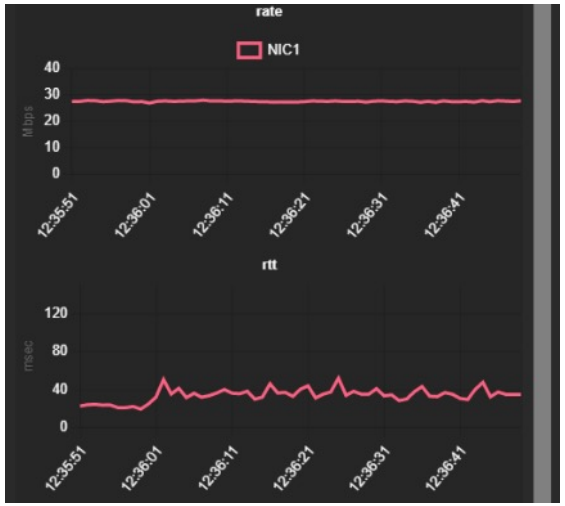




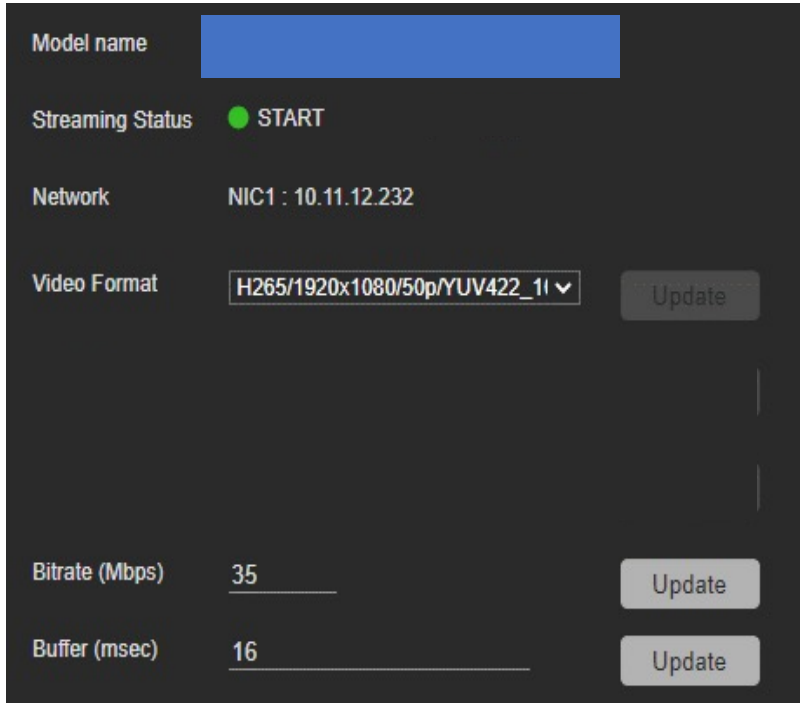


2 streams 1 local and 1 international



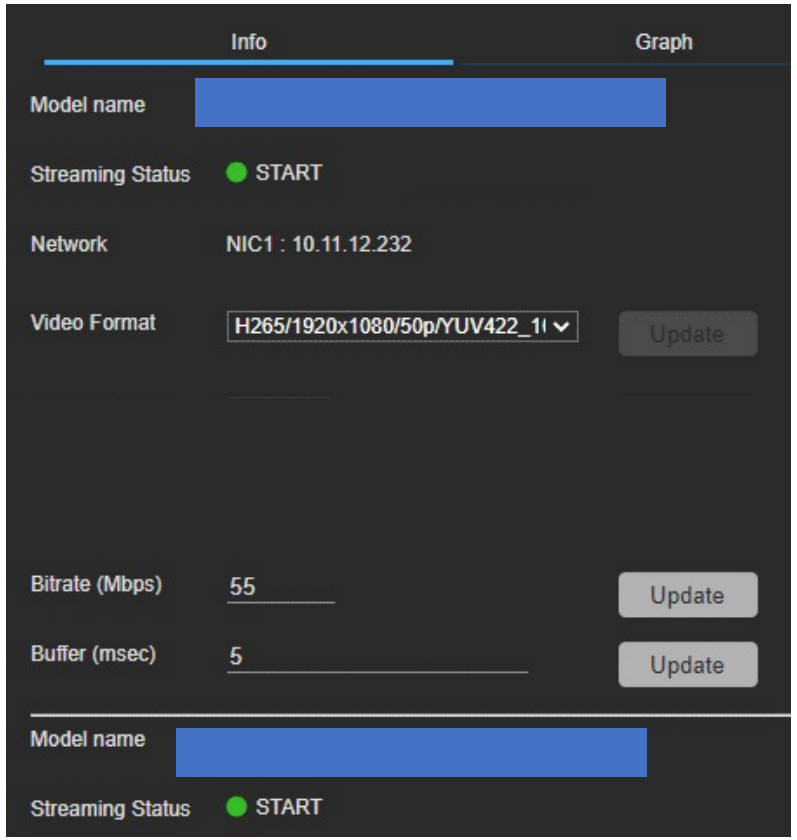


End to end Latency measurements



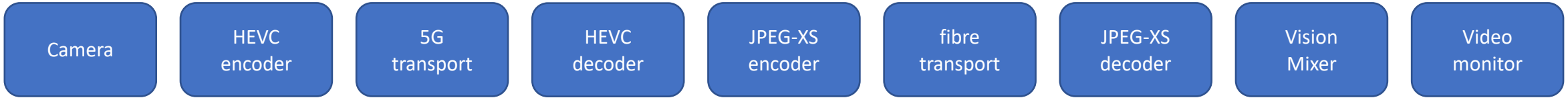
Mode	SD-SDI/HD-SDI
Video Standard	3G-A 1080p/50
SMPTE 352 Payload ID 1	3G-A 1080 50p 4:2:2 YCbCr 10bit Ch1
SMPTE 352 Payload ID 2	3G-A 1080 50p 4:2:2 YCbCr 10bit Ch1
Current Configuration	1 (Static)
Signal Present	Present
Stream Synchronisation	OK
Video Source Freq. Accuracy (ppm)	-4.48 (i)
Frame Offset (µs) (Ref=1)	-1690.69
AV Diff. Latency (ms) (Ref=1)	38.308
Audio Video Delay (ms)	6.2
Audio Video Delay Polarity	Video leading

ULL codec performance



Glass to glass latency measurements

Latency components



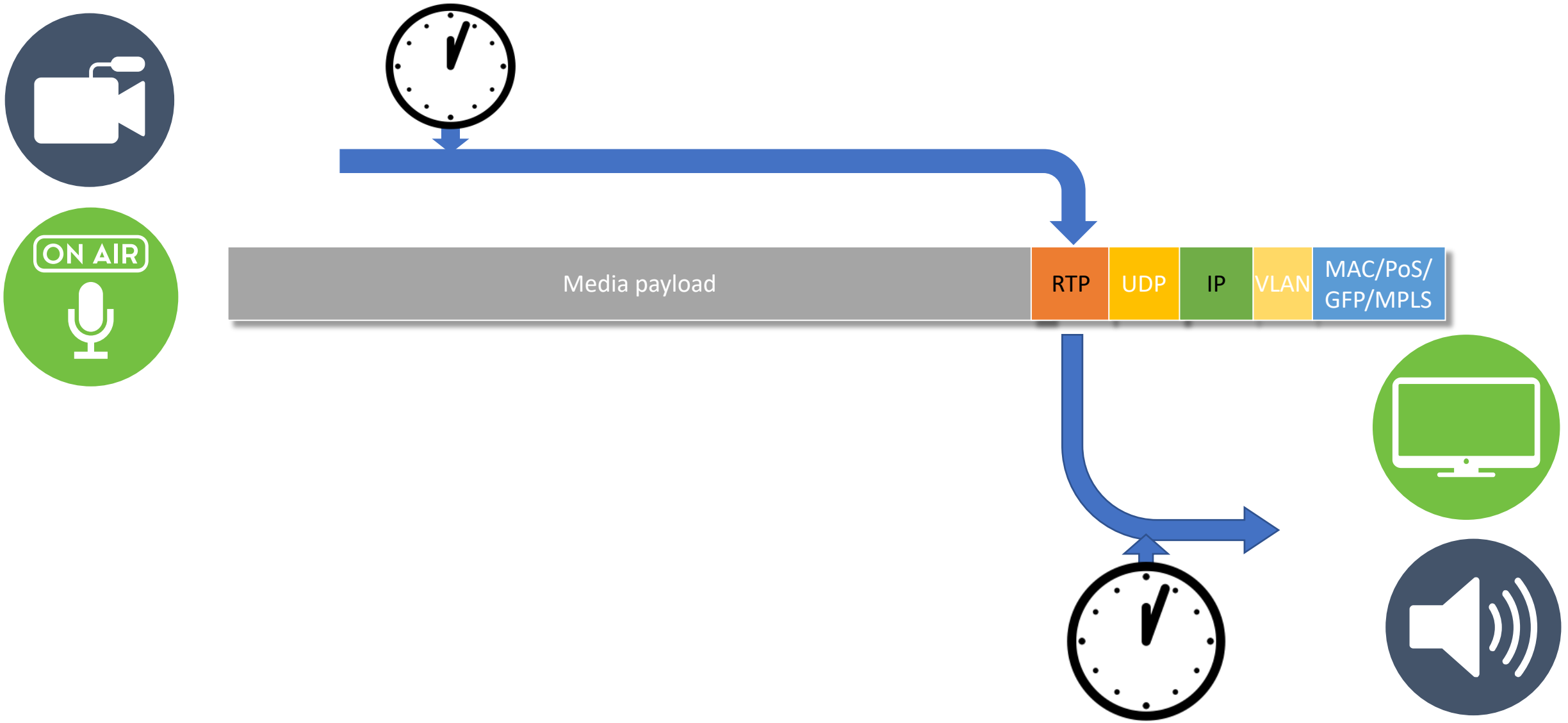
Element	latency
HEVC encode & decode	35ms in total
UK → Nauen (Berlin)	25ms each way (IP) (50ms RTT)
XS encode & decode	1ms (+9ms buffering)
Nauen → Frankfurt	6ms each way (IP) (12ms RTT)
5G transport	25ms - 40ms (network dependant)
Don’t forget camera and monitor!	60ms total!
Total international latency (compression, 5G, WAN)	140ms
Total local latency (compression, 5G)	60ms

Don’t forget the audio!

Synchronising the Cameras

ST2059 – applying PTP IEEE1588 to media

Timing the generated RTP packets

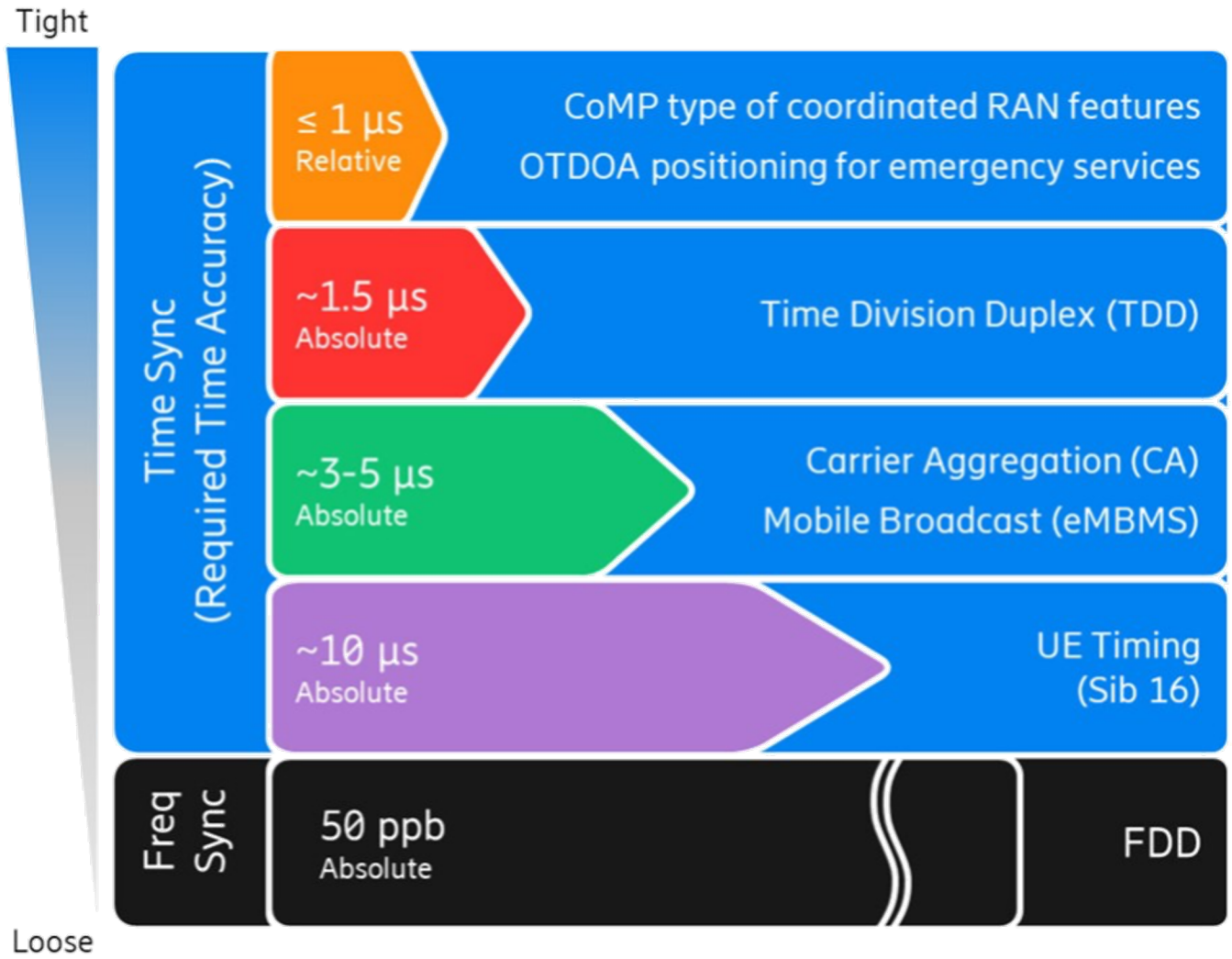


5G systems know about time!

GNSS

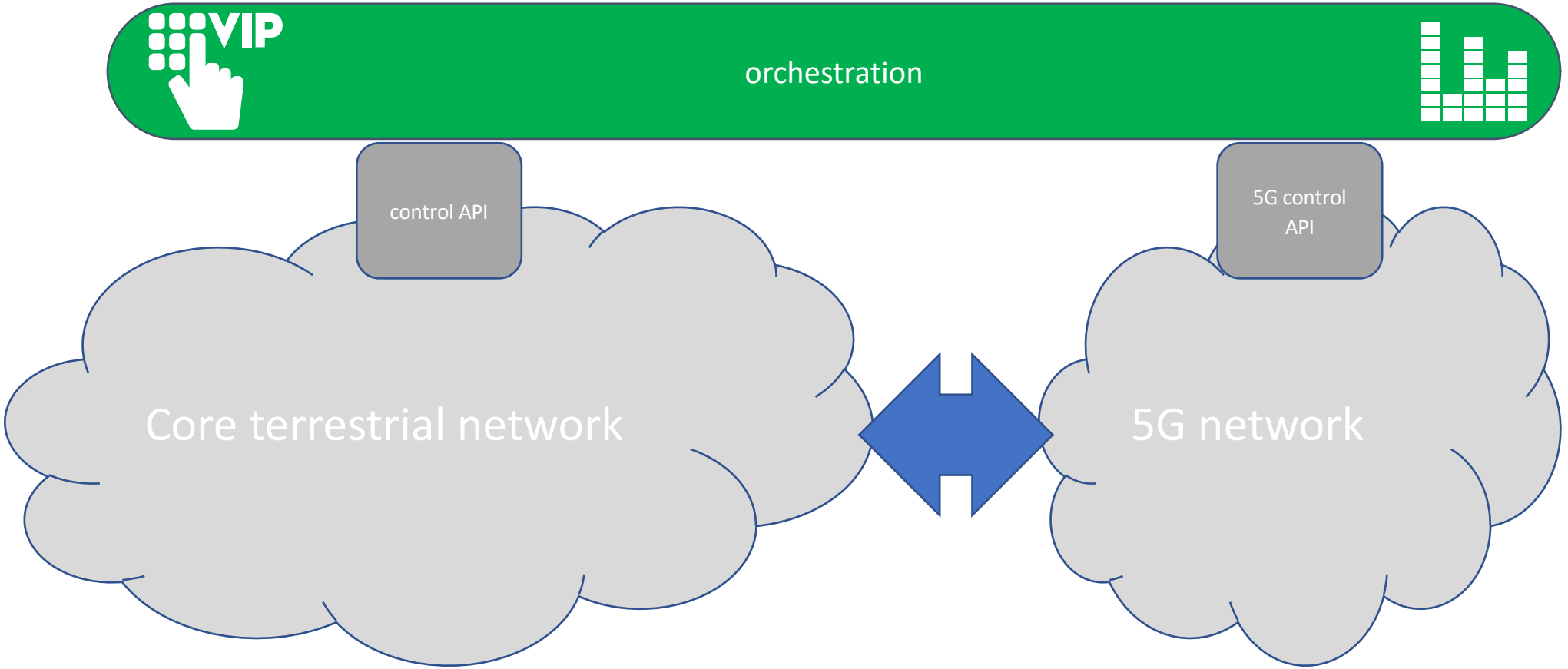
GPS GALILEO GLONASS

TaaS



Ref: Ericsson

Dynamic & integrated end to end orchestration

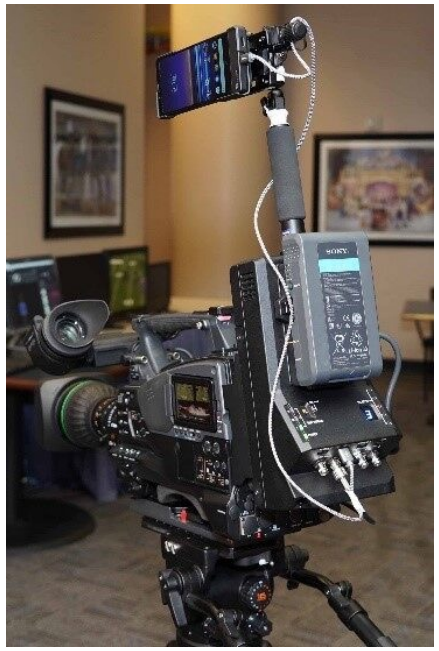


Germany use cases

MEDIA BROADCAST 5G

SPORTCAST

Sony 5G live broadcast trials

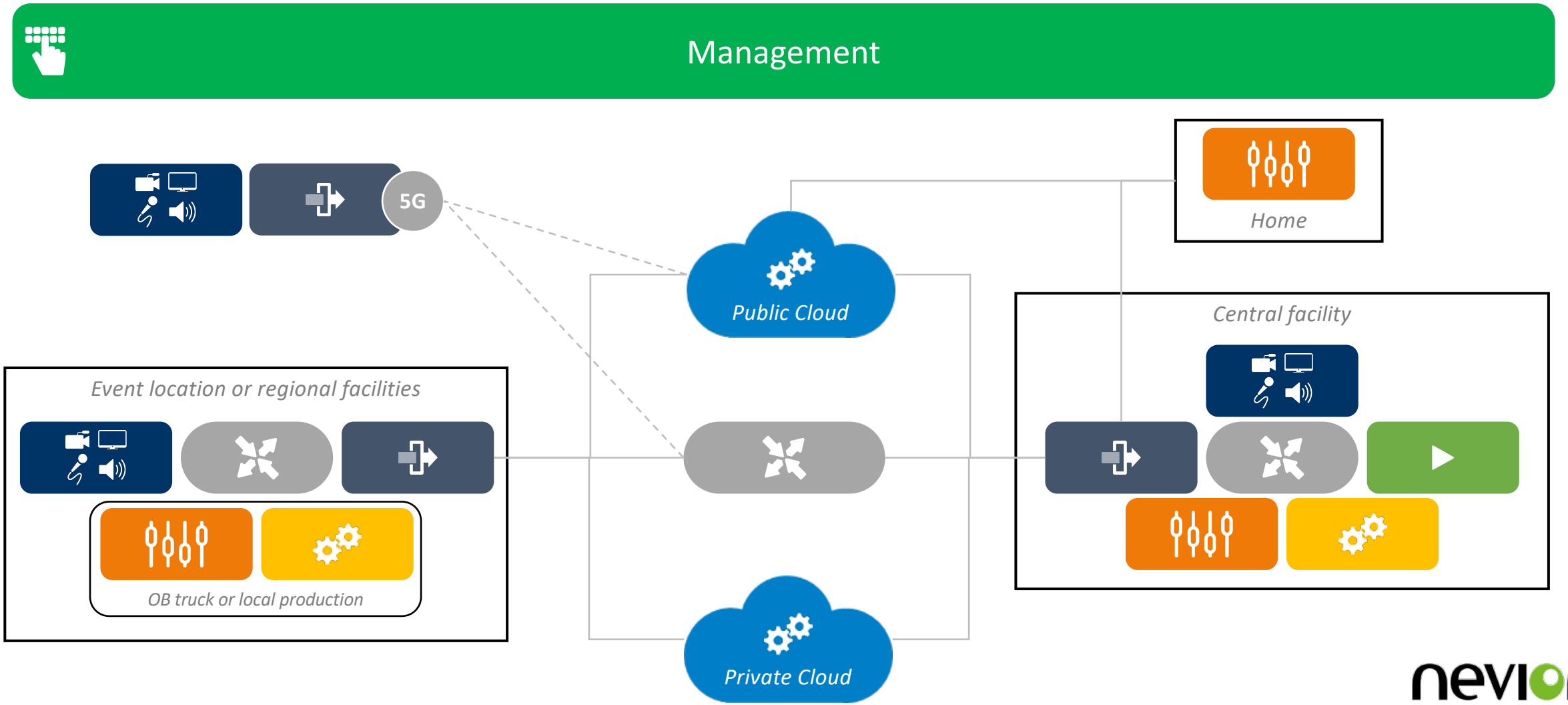


Sony & Verizon December 2019
NBC Sports

Sony & Deutche Telecom
Berlin Marathon 2019

Ref: Sony public web site

Distributed production



Thank you!

Andy Rayner Chief Technologist

arayner@nevion.com +44 7711 196609

nevion

A Sony Group Company

Come and catch up on the Sony stand
C10901 in the Central Hall

Any Questions?

Andy Rayner Chief Technologist, Nevion
arayner@nevion.com +44 7711 196609

IP SHOWCASE

Audio Engineering Society AIMS Alliance for IP Media Solutions AMWA Networked Media. Working. EBU SMPTE VSF Video Services Forum