Uncompressed UHD over WAN and the shift to long distance 100Gbps

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UHD is going uncompressed also over WAN

Lots of UHD WAN projects past 6 months

Both ST 2022-6 and ST 2110 maturing

ST 2110 for WAN is actively being "solved"

+ At-home production is growing fast

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Design considerations

1. WAN Bandwidth
2. Mixing UHD and HD
3. UHD client interfaces
4. Combining IP and SDI
5. Share infrastructure with file and IT

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WAN Bandwidth Need

Format	Baseband Video Bandwidth	ST 2110 Video Bandwidth
UHD / 2160p @ 59.94hz	12.3 Gbps	10.3 Gbps
UHD / 2160p @ 50hz	12.3 Gbps	8.8 Gbps

ST 2110 Format	# in 10G Eth	# in 25G Eth	# in 100G Eth
UHD / 2160p @ 59.94hz	0	2	9
UHD / 2160p @ 50hz	1	2	10

Note: Depends on tunneling mechanisms used etc.
10Gbps interface supports < 9.4 Gbps payload with 1500 byte packets.

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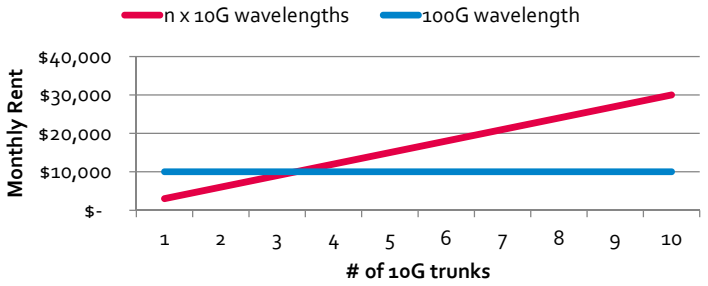
100G WAN Availability

1. 100G wavelengths

2. Cost vs 10G



3. 100G media gateways

2/7
vendors

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Manage large WAN bandwidths

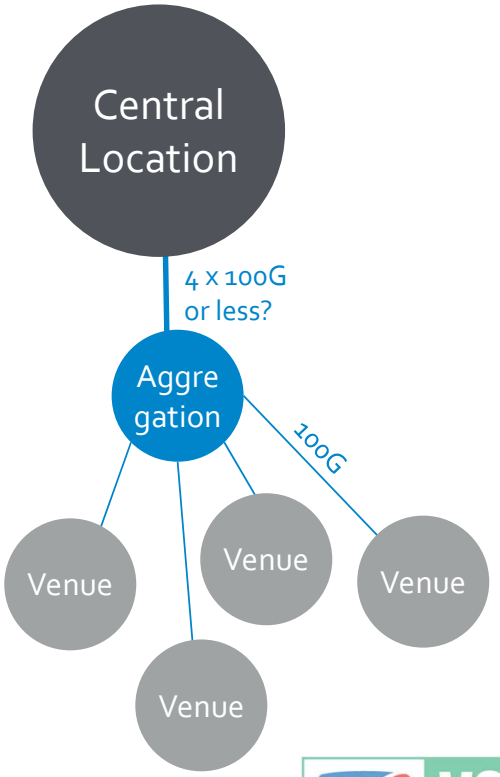
~~Non blocking design~~

- **Save links/cost**
  - Partially non-blocking
  - Only route traffic where needed
  - Aggregate at strategic hub sites
- **Retain flexibility**
  - Real-time service provisioning

~~Big bursts~~

- Receivers unlikely to handle bursty 11Gbps video
- Packet switches/routers accumulate bursts

= Need to manage burstiness before hitting receiver



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Mixing UHD and HD

#1 - Assume everything is UHD

4 x 10.3Gbps
= *41.2Gbps*

#2 – Auto scale

2 x 10.3Gbps
2 x 2.6Gbps
= *25.8Gbps*

and use admission control

2 x 10.3Gbps
2 x 2.6Gbps
= *25.8Gbps*

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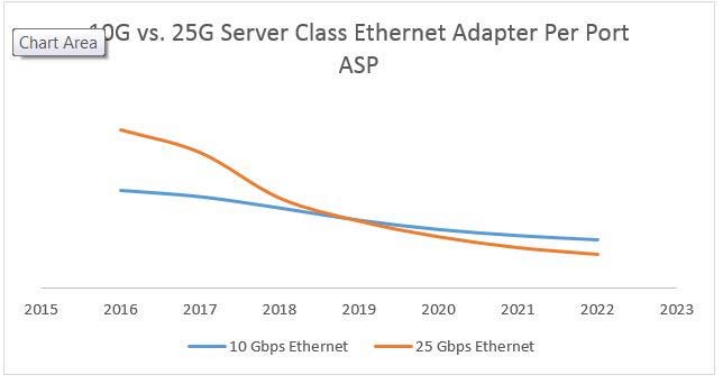
Client Interfaces

25G good fit for UHD *(12G SDI, 2022-6, 2110 59.94hz)*

Pricing on par with 10GbE interfaces

Source: January 2018 CREHAN Long-range Forecast – Server Class Adapters



Support in cameras, multiviewers and displays. But what about WAN gateways?

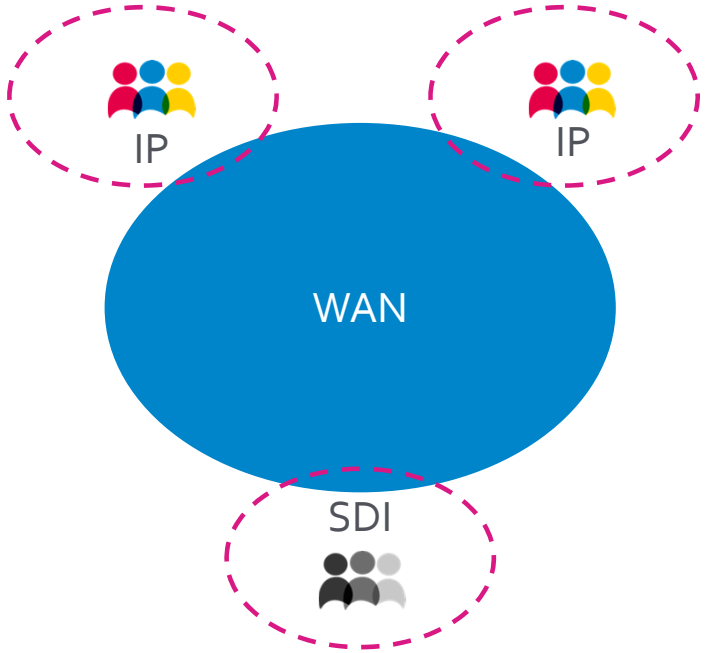
1/7 vendors

Hybrid IP and SDI

SDI to/from SMPTE ST 2110 conversion

- #1 - Convert ST 2110 at WAN edge to baseband transport
  - IS 04/05 within facility and to ST 2110 WAN edge.
  - Aligns with existing WAN operations and challenges.
  - More WAN bandwidth required.

- #2 - Migrate to broadcast quality IP/Ethernet transport
  - IS 04/05 signaling over WAN.
  - Baseband converted to ST 2110 at WAN edge.
  - All transport consolidated to 2110, demanding support for strict BW reservation, burst management and essence stream transport.



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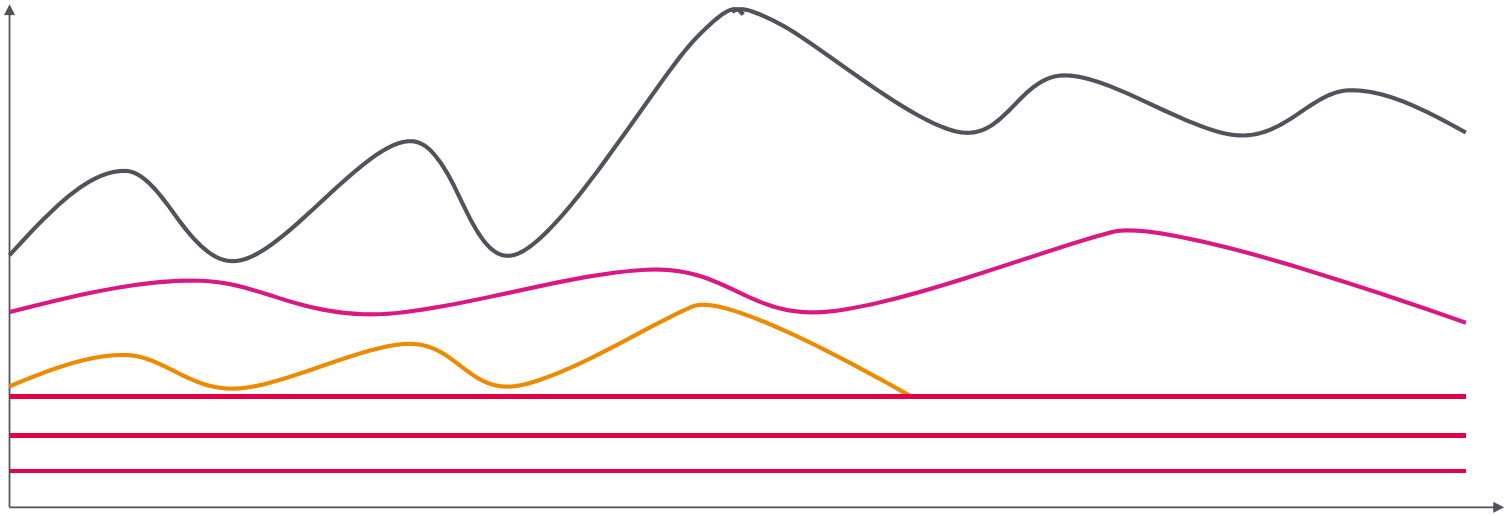
Shared video bandwidth with file and IT

No drops – No added jitter – Minimize adding fixed latency



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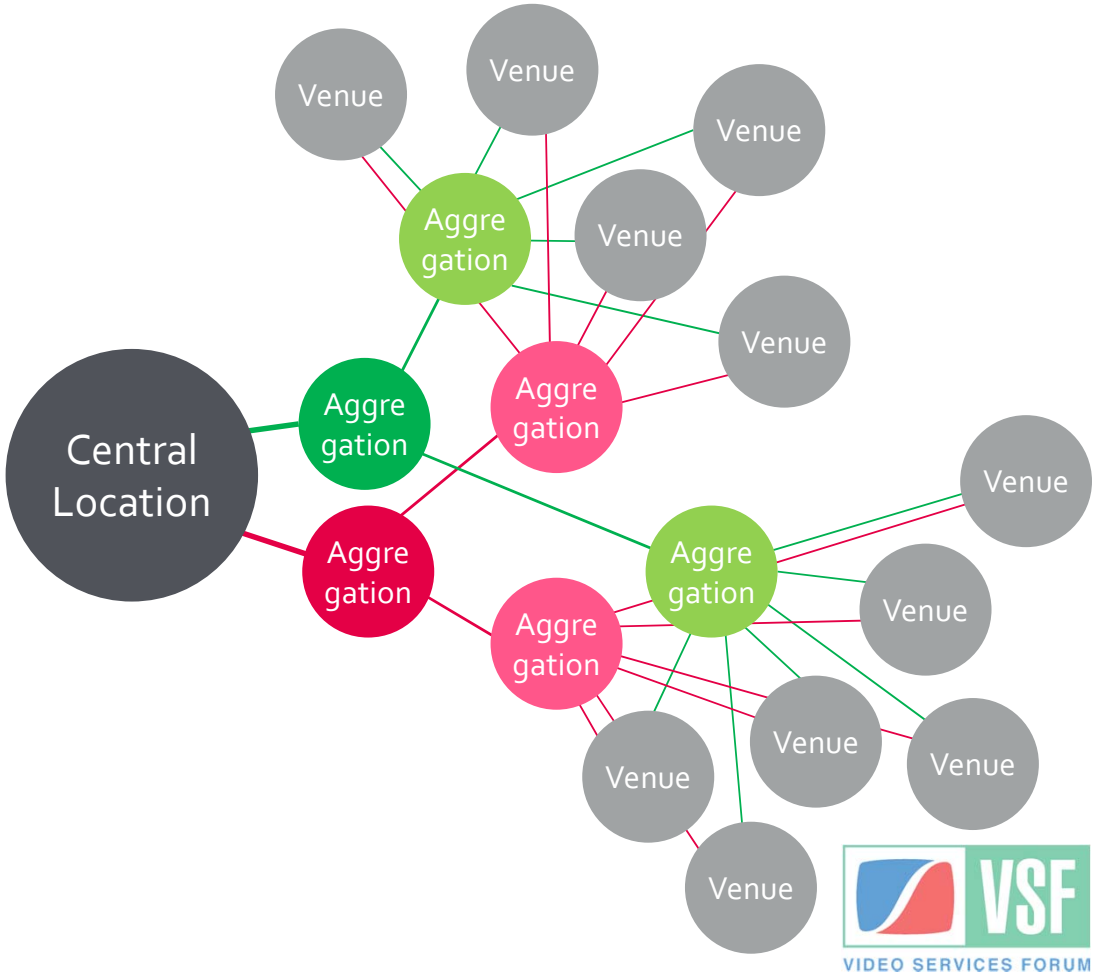
Example #1 – Live sports contribution US

30+ venues

- From west coast to east coast
- Redundant 100G per venue
- 5 x UHD Uncompressed Protected – SDI initially
- 25 x HD Compressed Protected – combination of SDI and IP
- 10G eth for data

- Two layers of aggregation hubs routing traffic to central location

- Venues use PTP based synchronization distributed from central location



Example #2 – Live sports contribution Asia

20+ venues

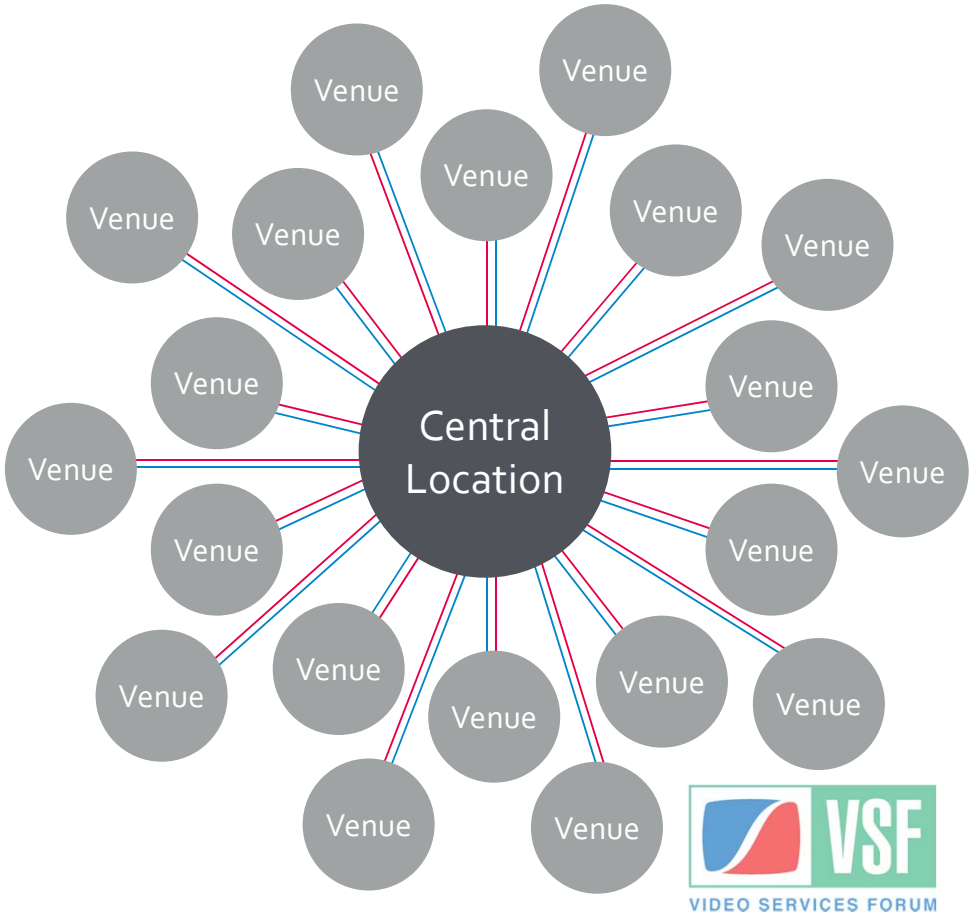
- All in one country
- Redundant 100G per venue
- 1-10 x UHD Uncompressed Protected
  - 12G / Quad SDI at venue
- ST 2110 at central location

Star topology

- One central location
- ST 2110 on 25G/100G

- About 40x 100G waves, below 25 miles

- Venues use PTP based synchronization distributed from central location



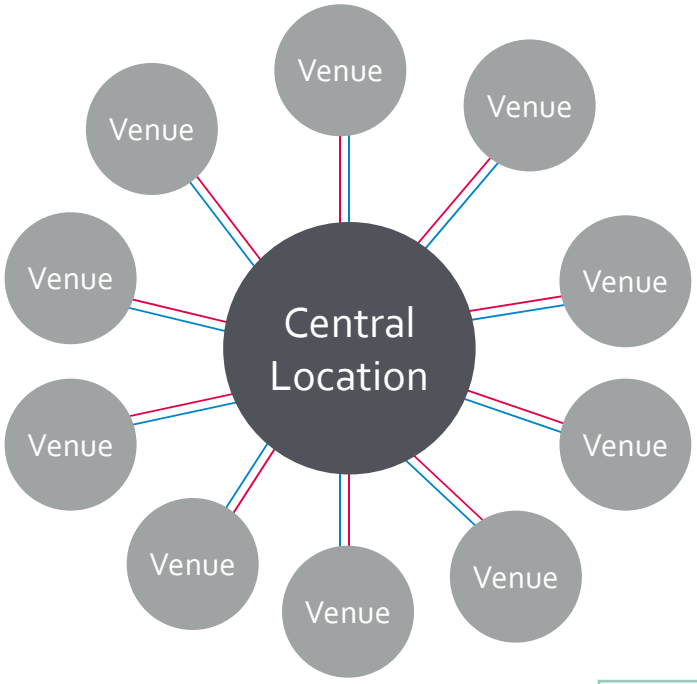
Example #3 – Live sports contribution Europe

10+ venues

- All in one country
- Redundant 100G
- 5 x UHD Light Compression Protected
  - 12G / Quad SDI at venue
- 20 x HD Uncompressed Protected
- 20 x HD Compressed Protected
- ST 2110 at central location
- Mix of permanent and temporary services

Star topology

- One central location
- ST 2022-6 handoff



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Example #4 – At-Home Production Europe

One remote venue

- 80+ SDI cameras, uncompressed HD
- Intercom, audio, data and return
- 3x 100Gbps

One central studio

- 3 control rooms
- 370 miles away

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Conclusions

Demand for 100G is here		Supply is limited		Smart design is crucial
Driven by uncompressed UHD and Large scale at-home production	+	Availability of waves limited Sometimes cost prohibitive Limited media gateway availability	=	Use ST 2110 to minimize BW Allow partial blocking design Optimize HD/UHD BW Strict isolation for sharing bandwidth w. file and live

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