Transporting ST2110 over WAN VSF Technical Recommendation Activity Group

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Key Activity Group Objective & timings

"To enable effective transport of ST2110 media flows and associated control data across Wide Area Networks *in an interoperable manner*."

ST2110→WAN

Phase 1: NAB 2019

Phase 2: IBC 2019
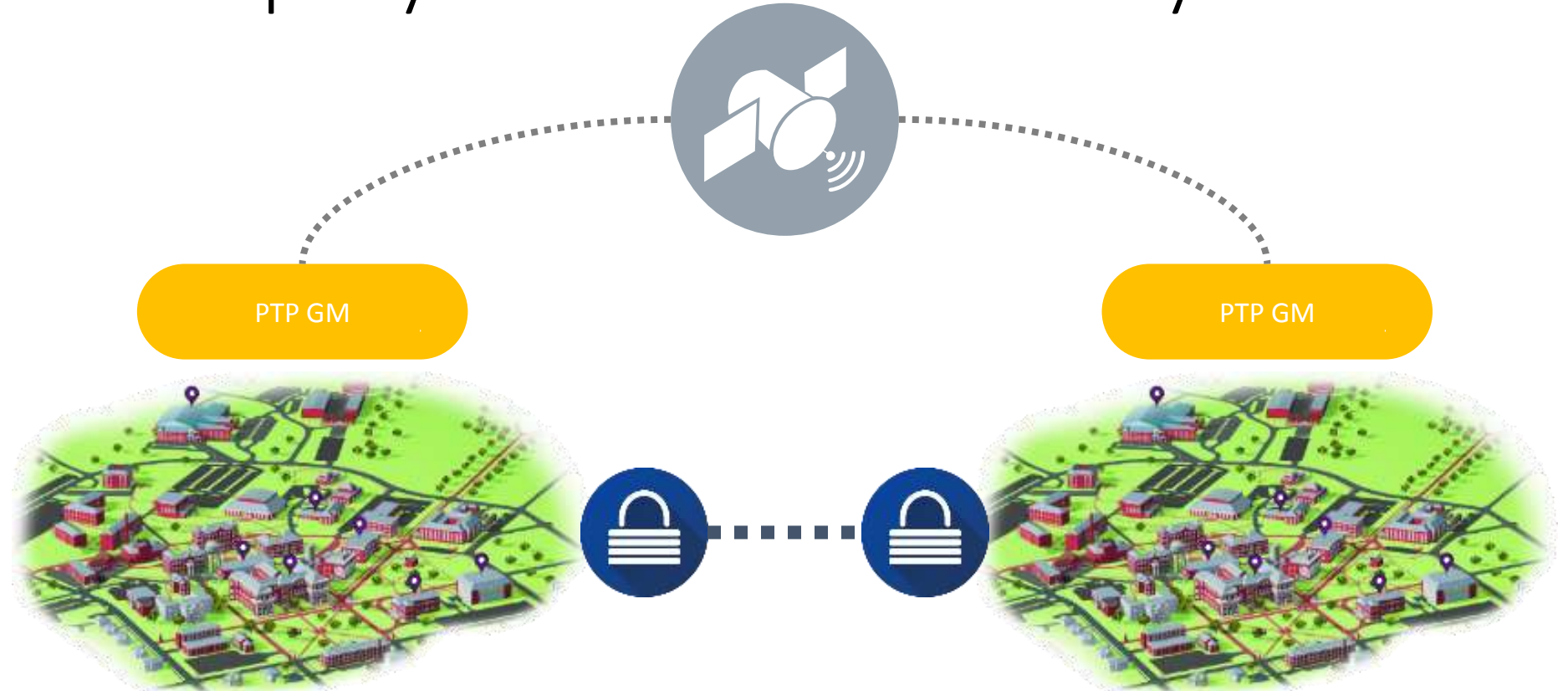
Activity Group Team represents:

- Vendors: Nevion, Imagine, GV, Evertz, Netinsight, Matrox, Medialinks, Mellanox, Packetstorm, Intopix, Sony, Artel
- Users: Disney DTCI, (BT), BBC, ESPN, AT&T, Century Link, Zayo, IRT

Key user scenarios:
Event remote production connectivity
Inter-company facilities connectivity
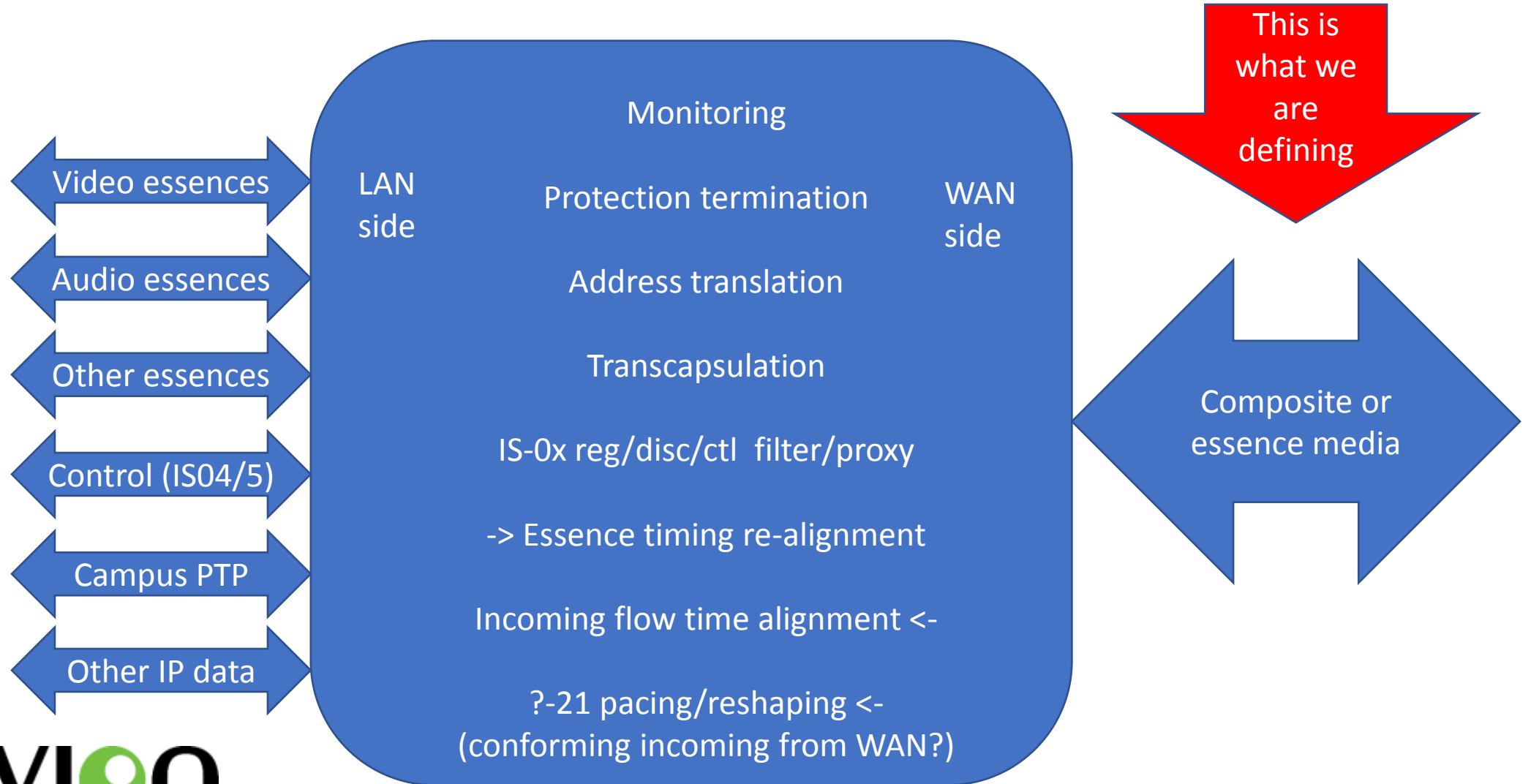Intra-company facilities connectivity

PTP GM

PTP GM

ST2110 over WAN
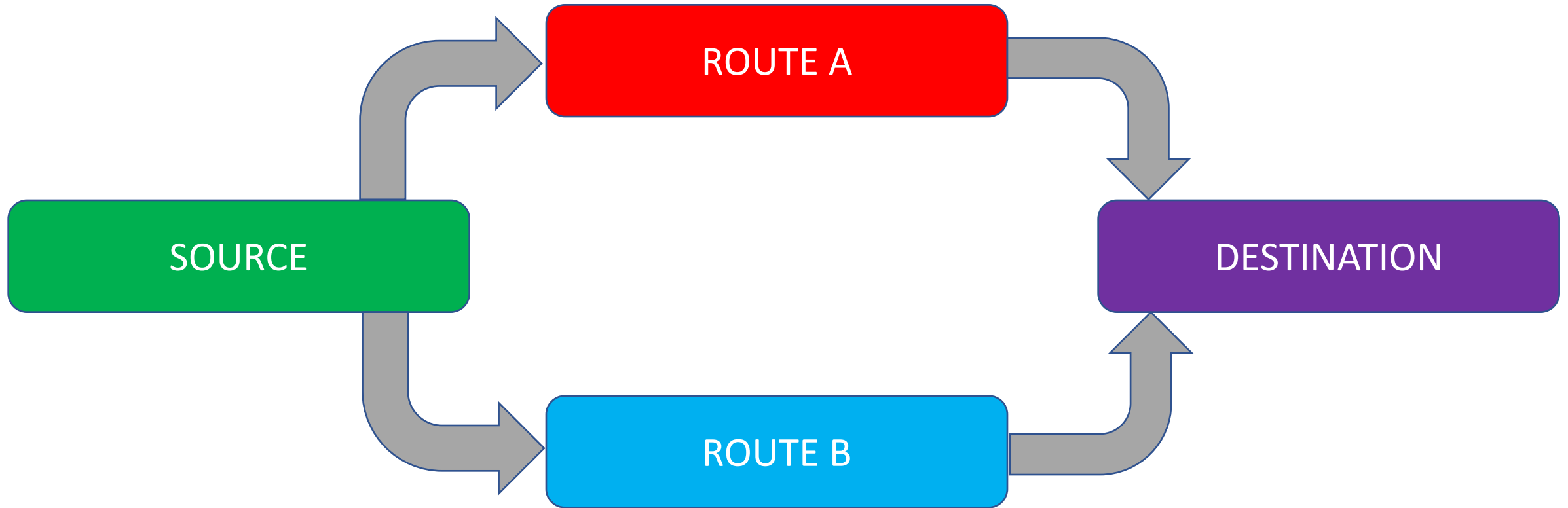# for inter-facility & OBs

WORK IN PROGRESS

- 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

Next topic

What we are talking about:

This is what we are defining

LAN side		WAN side
	Monitoring	
	Protection termination	
	Address translation	
	Transcapsulation	
	IS-0x reg/disc/ctl filter/proxy	
	-> Essence timing re-alignment	
	Incoming flow time alignment <-	
	?-21 pacing/reshaping <- (conforming incoming from WAN?)	

Video essences

Audio essences

Other essences

Control (IS04/5)

Campus PTP

Other IP data

Composite or essence media

Flow protection #1 - SMPTE2022-7 based

ST2110-WAN: Protection

- Dual path protection will use ST2022-7

- FEC on individual essence flows (all media types) will use bounded ST2022-5
  - Receivers shall support a matrix product of at least 100
  - Transmitters shall be configurable to use a matrix whose product is 100 or less

- Single FEC - 2D column-only (as opposed to 1D which is inherently row based)

- FEC on trunk (the GRE over RTP option) will use the same restrictions as above

- Aim to keep latency as low as possible (important for low bit rate flows)

- RIST for OTT transport could be explored later
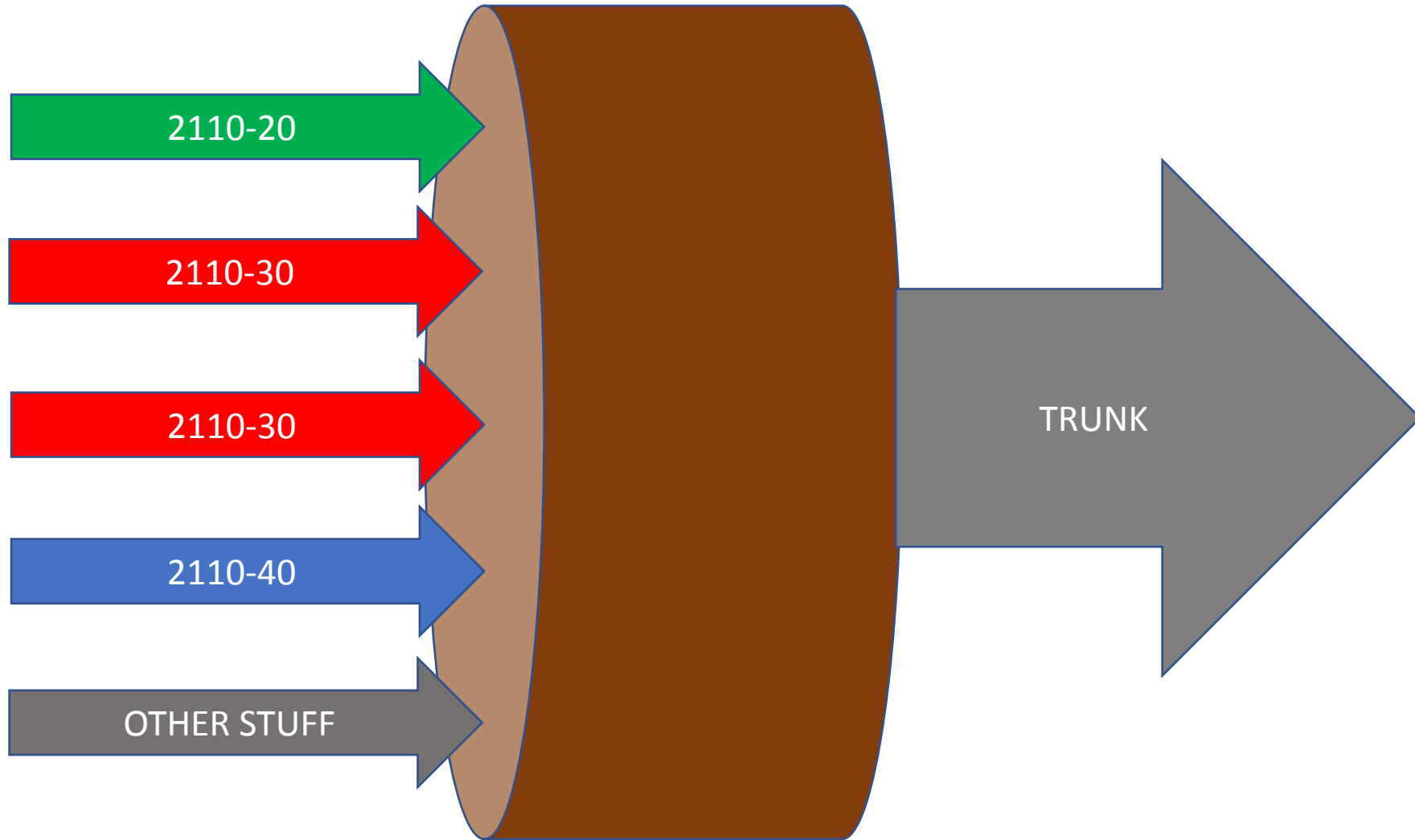
Flow protection #2
FEC – ST2022-5 based
constrained to LxD product of 100 maximum
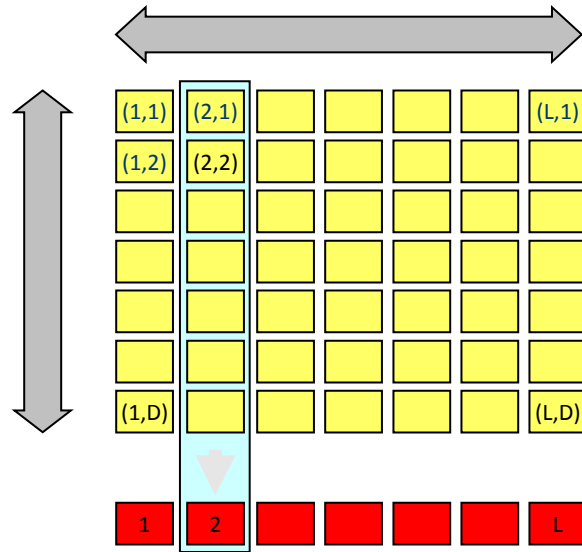
Trunking essences

2110-20

2110-30

2110-30

2110-40

OTHER STUFF
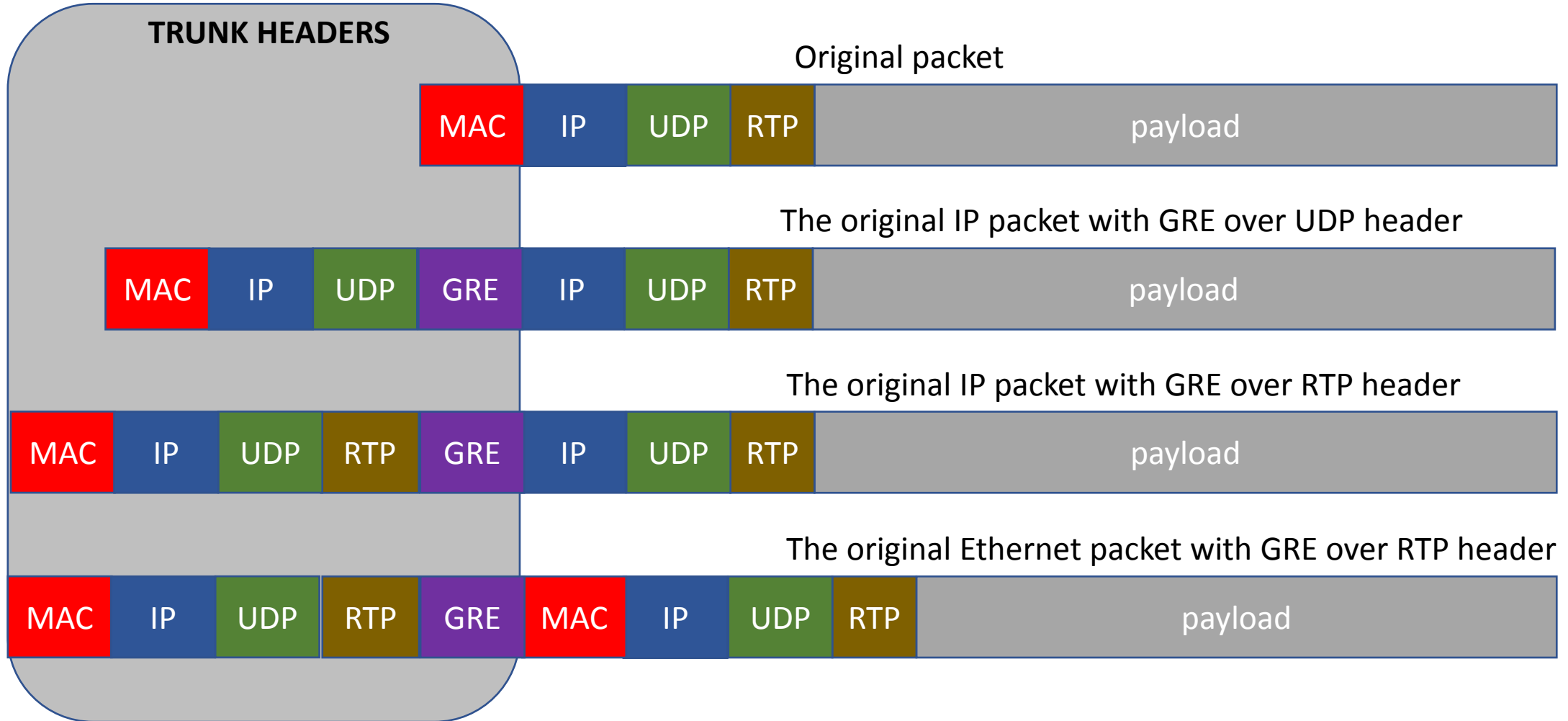
TRUNK

ST2110-WAN: Flow trunking

- Basic trunking option using GRE over UDP(RFC8086) as-is
  - This is to be used in cases when protection of the trunk is not required
  - Protection of the essences (2022-7 RTP merge and 2022-5 FEC) can be applied
  - Mandate use of the 32-bit SN for trunk integrity monitoring
  - *Note that key switch vendors appear to NOT currently support this*
- Trunking using GRE (RFC2784) over RTP (RFC3550) with 2110-style SN extension
  - Use for cases where protection is needed at the trunk layer
  - This needs to be defined (see proposal in subsequent slide)
  - Use 2022-7 for RTP merge and (constrained) 2022-5 for FEC (as per previous slide)
  - Consideration for RFC submission (not necessary – precedent exists)

Trunking encapsulation

TRUNK HEADERS

Original packet

| MAC | IP | UDP | RTP | payload |

The original IP packet with GRE over UDP header

| MAC | IP | UDP | GRE | IP | UDP | RTP | payload |

The original IP packet with GRE over RTP header

| MAC | IP | UDP | RTP | GRE | IP | UDP | RTP | payload |

The original Ethernet packet with GRE over RTP header

| MAC | IP | UDP | RTP | GRE | MAC | IP | UDP | RTP | payload |

2022-7 protection
at essence or trunk

GRE over RTP

RTP HDR	RTP SN	RTP TSTP	RTP SSRC	RTP SNE	RTP ID	GRE HDR	GRE PTY	Payload (IP or Ethernet)

```
                     0                   1                   2                   3
                     0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1
                    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
                    |V=2|P|X|   CC    |M|     PT      |       sequence number         |
                    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
                    |                           timestamp                           |
                    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
                    |            synchronization source (SSRC) identifier           |
                    +=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+
                    |    Sequence Number Extension    |        Flow Identifier       |
                    +=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+
                    |C|   |K|S| Reserved0      | Ver  |       Protocol Type          |
                    +-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+-+
                    |              Encapsulated payload (Ethernet or IP packet)      |
                    |                              ....                              |
                    +=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+=+
```

Protection of other data

LAN data
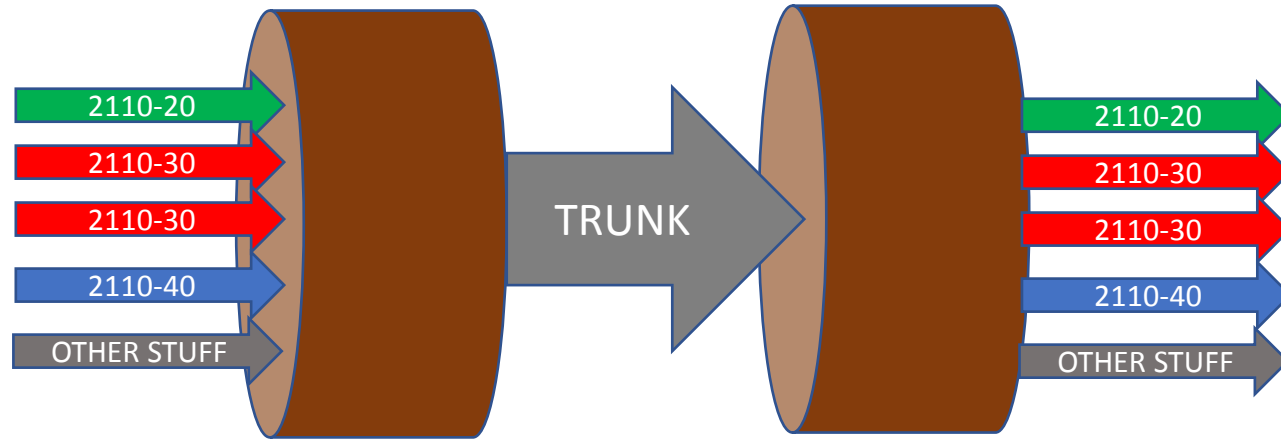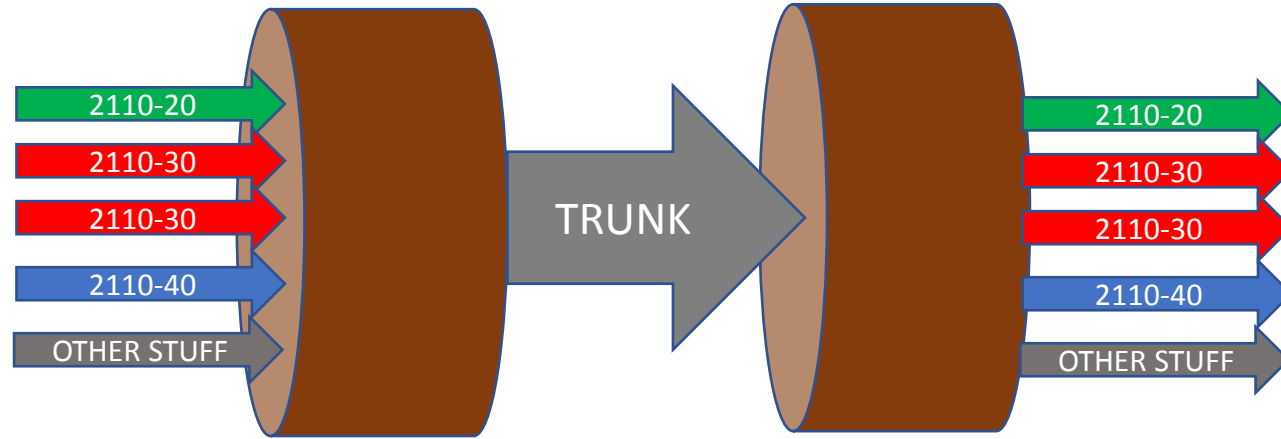
WAN protected

WAN protected

ST2110-WAN:
Protection of other data

- Service providers and broadcasters have desire to trunk other IP data (TCP or UDP) with similar protection (specifically 2022-7 style)

- The GRE over RTP defined previously would allow both RTP merge and FEC to be applied if desired

- Differentiation of non-RTP traffic recommended so it protects optimally i.e. existing 2022-7 dual RTP flow best transported on two independent tunnels

- Broadcasters have other 'stuff' to carry in tunnel – not necessarily ST2110

Reconciling essence timings for WAN
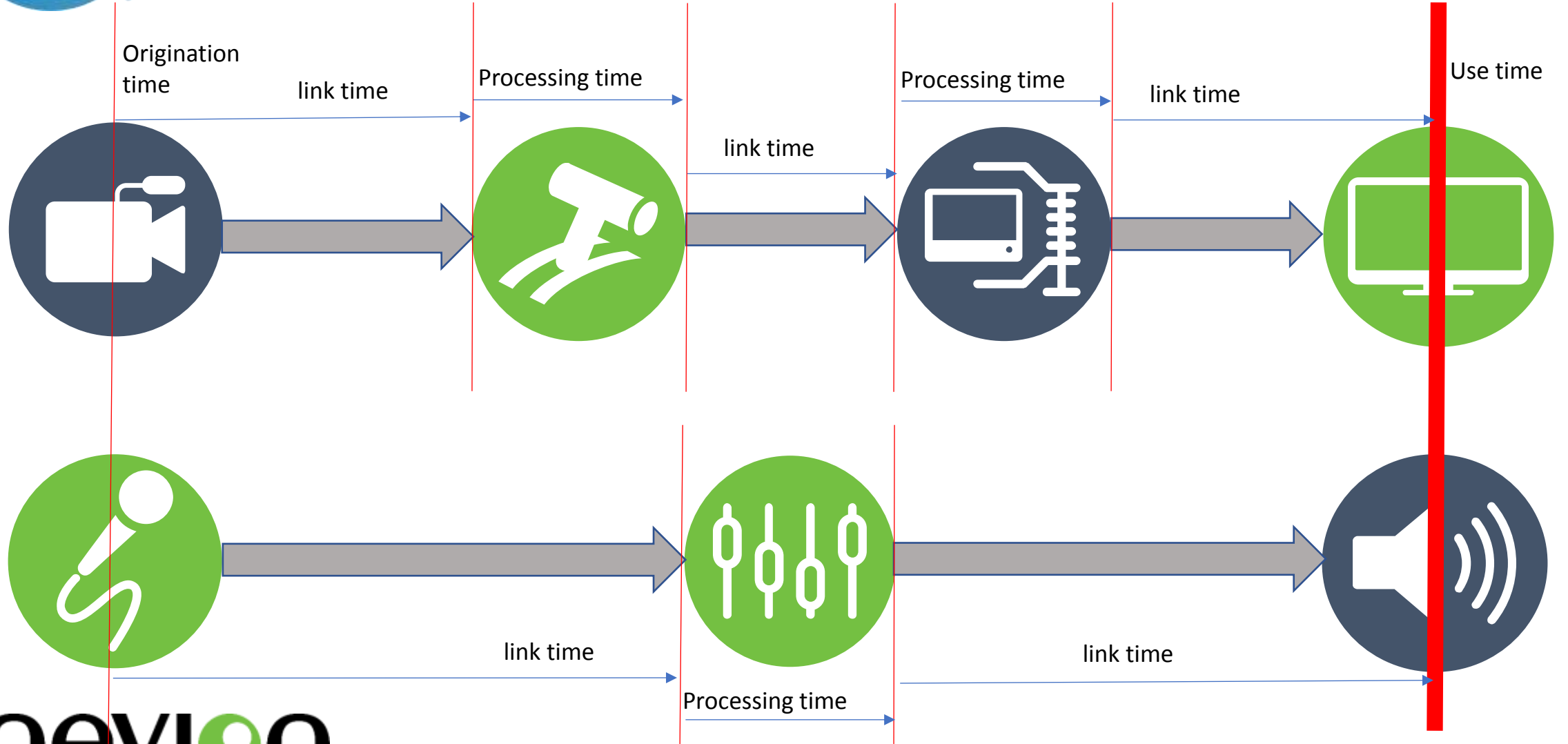
ST2110-WAN:
Essence realignment

- Essence realignment refers to the temporal realignment of the individual essence flows that constitute a wholistic media signal to ensure they are temporally in synchronization.

- Essence alignment consideration:
  - On transit off-campus
  - On transit on-campus

- Signals may be carried as native 2110 or in some other format on WAN

- Alignment is essential when converting to composite flow (e.g. ST2022-6)

- Alignment is optional when transiting WAN as ST2110 essence

- Statement on relative timing of essences being essential …. NEEDS MORE WORK
  - Production intent
  - Presentation time (actual vs presentation)

- RTP should be preserved within WAN transport, to allow for far-end re-alignment

- Look to further work on carrying origination time that may be of use….

Compression

ST2110-WAN: WAN compression

- Recognize that long-haul WAN connectivity can be too costly to use uncompressed in some scenarios

- Define compression type, profile and bit-rate range to be used
    - TR-01 100-200Mbps for 1080i/720p, 150-300Mbps for 1080P
    - TR-01 already has maximum and minimum rates recommended – should they be narrowed?
    - AT&T (Nick) - expand up to 500Mbps for 1080P?

- Do we want to specify TR-01 2018 ULL for some use cases?

- Consideration that JPEG-XS may well be a good candidate for recommendation within the next 12 months

MTU/fragmentation

- GRE over UDP already addresses fragmentation

- The GRE over RTP should adopt the same text/recommendations as GRE over UDP

- Recommend that controllable media flow sources ensure packet lengths sufficiently small to avoid risk of reaching max MTU/fragmentation when wrapped

- For generic TCP data sources industry best practice (e.g. MSS clamping) should be used to minimize likelihood of fragmentation

- Other data sources (e.g. VPN data) may well default to max MTU and will be the likely area of unavoidable fragmentation

Discovery & control - filtering & proxy
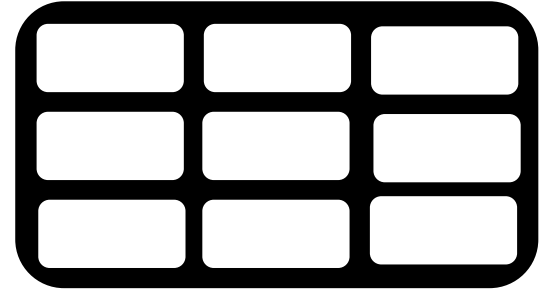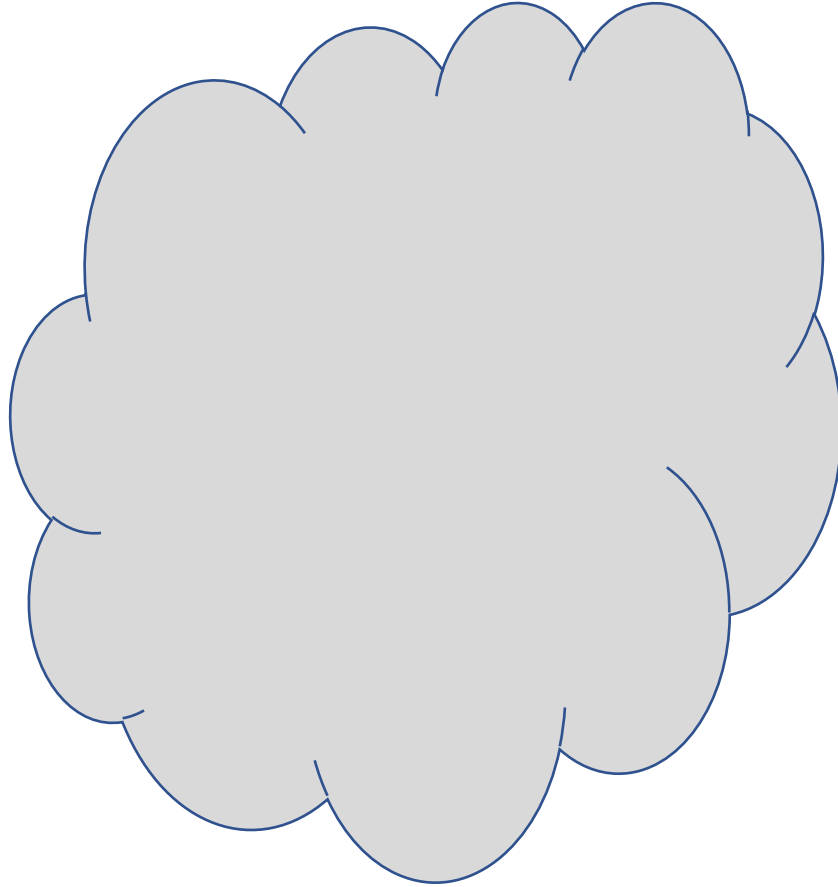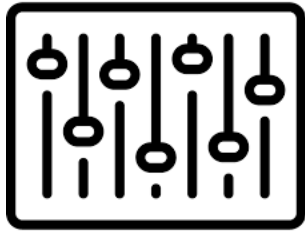
IS-0X discovery/reg/control transport proxy

Campus facility 1 · · · · · · · · · · · · · · · · · Campus facility 2

Other topics -Transcapsulation

ST 2110

ST 2022-6
or ST 2110

Other topics - Security

Connectivity Security

Content Security

Will reference other work on best practice

Other consideration - PTP trunking

Timing domains

ST 2110
LAN

PTP

ST2110
or ST2022-6
or ST2022-8
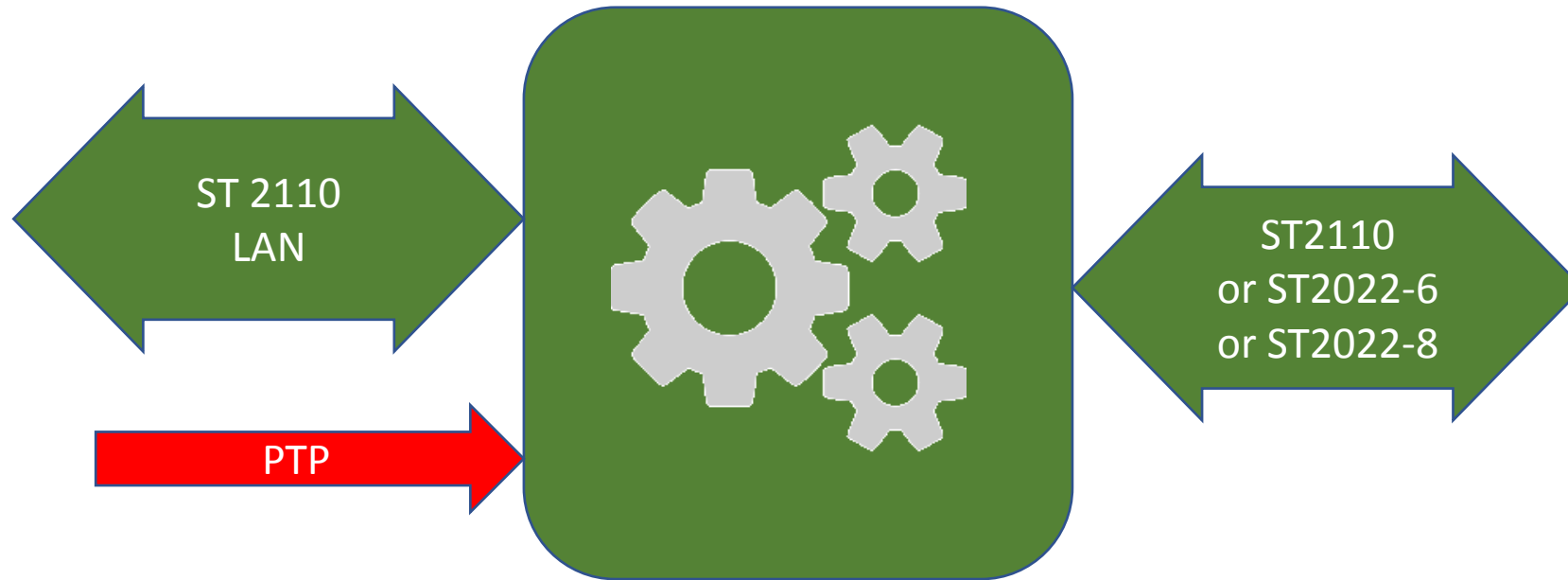
Thank you to those who have been involved
There is still time for other input

vsf.tv

http://vsf.tv/SMPTE_ST_2110_over_WAN.shtml

Thank You
Do come and see us SU5510
We do a nice cup of tea!

Andy Rayner, Chief Technologist

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