An Open-source Software Toolkit for Professional Media over IP (ST 2110 and more)

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- UDP
- Multicast
- Massive bandwidth (min. 1.2 Gb/s)

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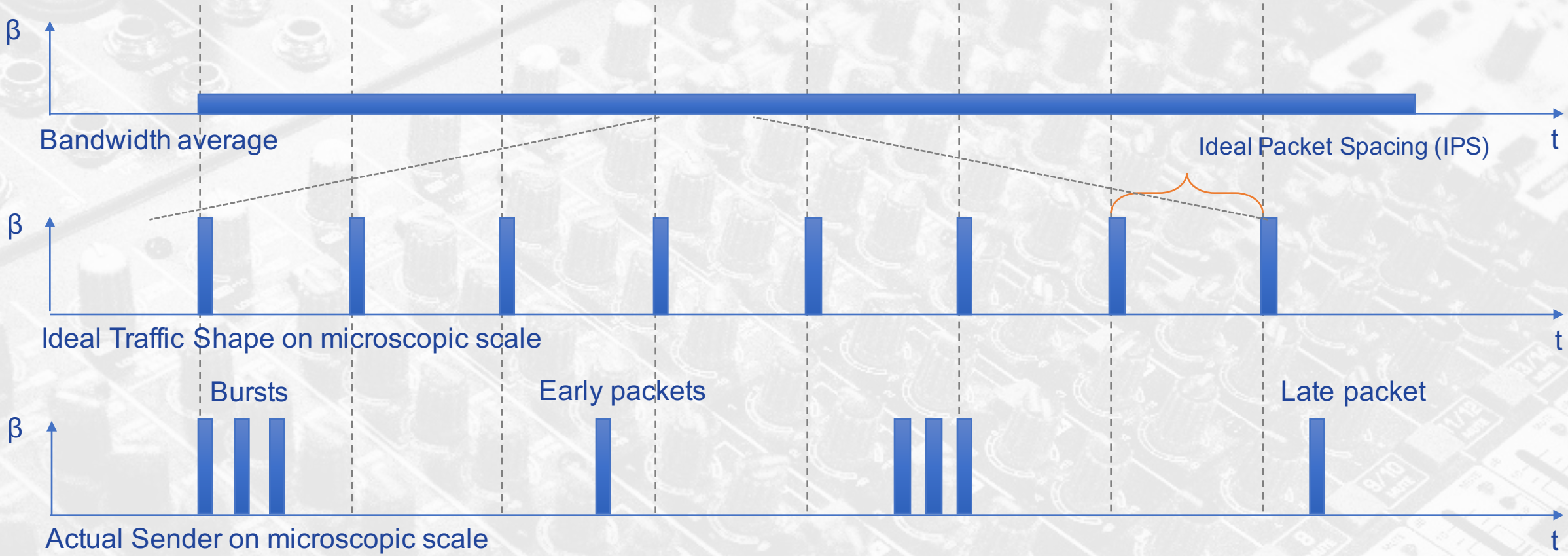
TRAFFIC ON MICROSCOPIC SCALE



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WHAT MAKES IT ALL WORK TOGETHER?

- SMPTE ST2110-10 – timing (SMPTE ST2059) and timestamping
- SMPTE ST2110-21 – buffers and packet pacing models

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ST2110-21

- Constrains the packet delay variation (PDV) of a sender
- Describes two virtual leaky buckets

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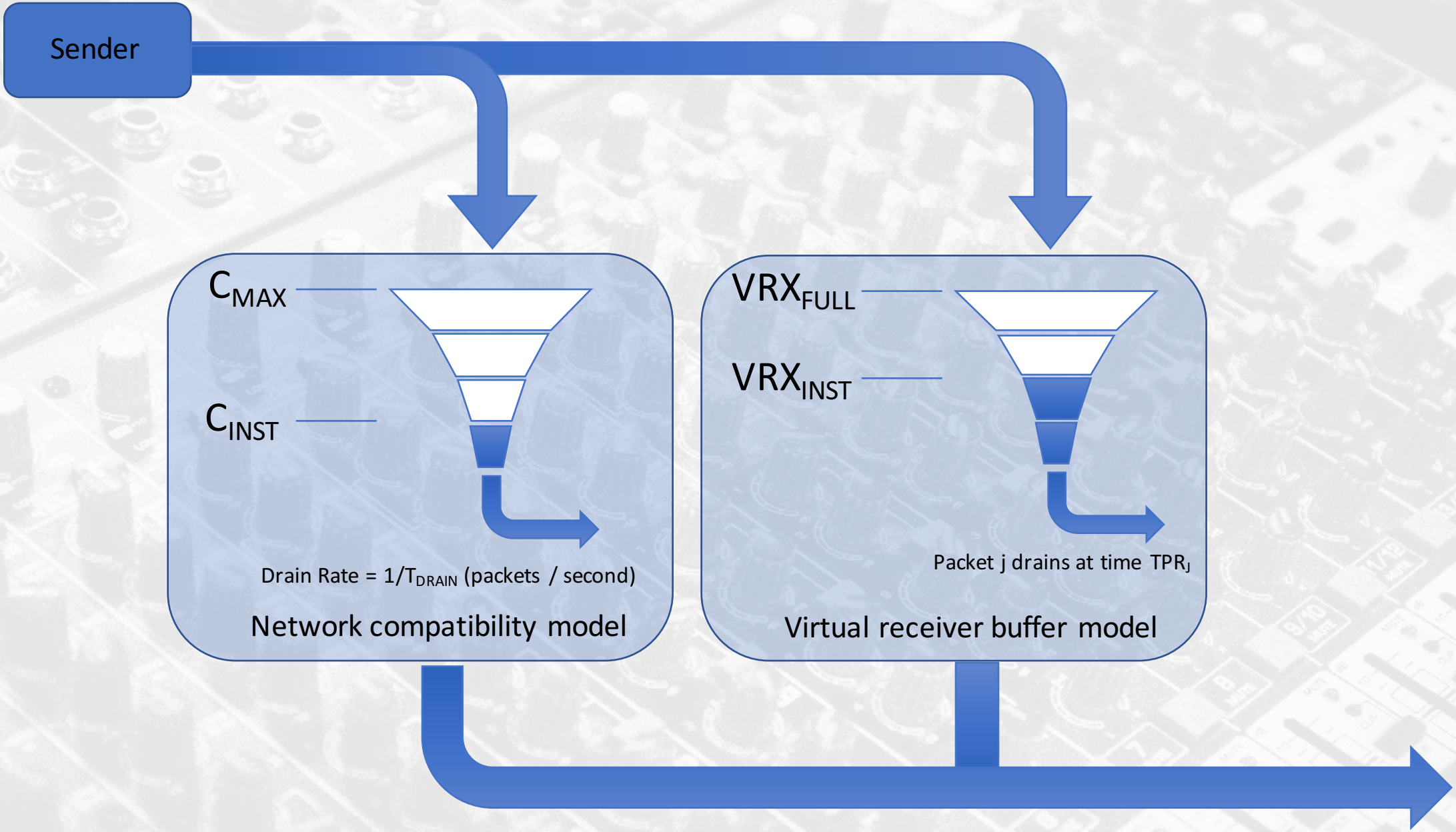

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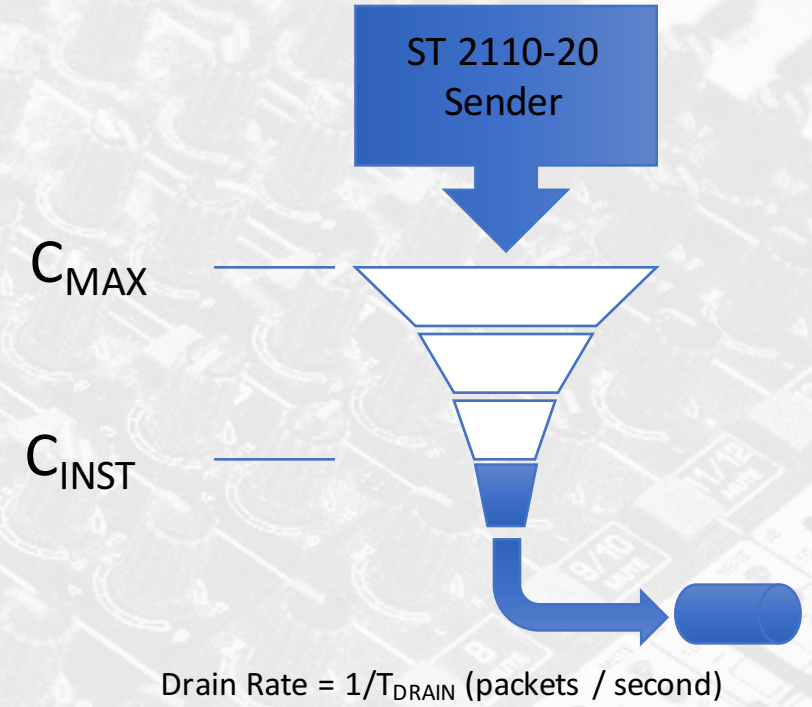
NETWORK COMPATIBILITY MODEL

- Tested at the output of the sender
- Measures PDV introduced by a sender
- Has constant drain rate
- Evaluates sender's compliance with network



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IMPACT OF PACKET BURSTS WITH CORRELATION TO C VALUE

Egress total	3.2	Tbps
Btotal	16	MB
Ractive	96%	
Beta	1.1	

	Cmax	4

Usage of Egress (1/Beta) and 100% of memory								
1/Beta	90%	80%	70%	60%	50%	40%	30%	20%	10%
	4.855E-05	5.461E-05	6.242E-05	7.282E-05	8.738E-05	1.092E-04	1.456E-04	2.185E-04	4.369E-04
	20599.37	18310.55	16021.73	13732.91	11444.09	9155.27	6866.46	4577.64	2288.82

Resolution	Hz	Npackets	Packetrate	C								
720	50	1614	80700	3	4	5	5	7	8	11	17	35
720	60	1614	96840	4	5	6	7	8	10	14	21	42
1080	50	3631	181550	8	9	11	13	15	19	26	39	79
1080	60	3631	217860	10	11	13	15	19	23	31	47	95
2160	50	14522	726100	35	39	45	52	63	79	105	158	317
2160	60	14522	871320	42	47	54	63	76	95	126	190	380
2160	100	14522	1452200	70	79	90	105	126	158	211	317	634
2160	120	14522	1742640	84	95	108	126	152	190	253	380	761

Resolution	Hz	β	βgap	#Streams								
720	50	0.93	0.96	2987	2655	2323	1991	1659	1327	996	664	332
720	60	1.11	1.16	2489	2212	1936	1659	1383	1106	830	553	277
1080	50	2.09	2.17	1328	1180	1033	885	738	590	443	295	148
1080	60	2.50	2.60	1106	983	861	738	615	492	369	246	123
2160	50	8.34	8.68	332	295	258	221	184	148	111	74	37
2160	60	10.01	10.41	277	246	215	184	154	123	92	61	31
2160	100	25.00	26.00	111	98	86	74	62	49	37	25	12
2160	120	48.05	49.97	58	51	45	38	32	26	19	13	6

Courtesy of Willem Vermost (vermost@ebu.ch)

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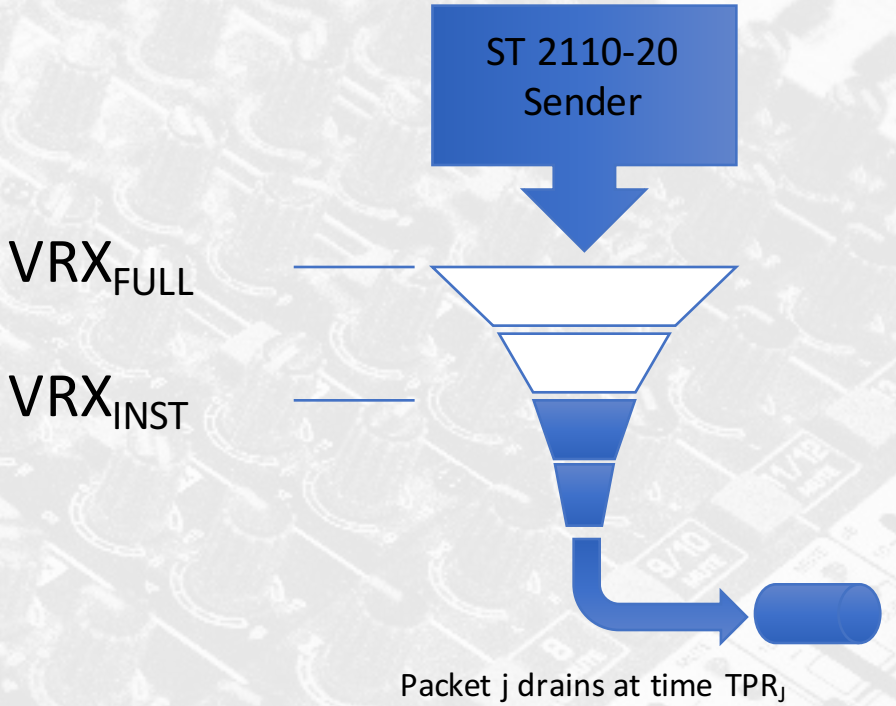
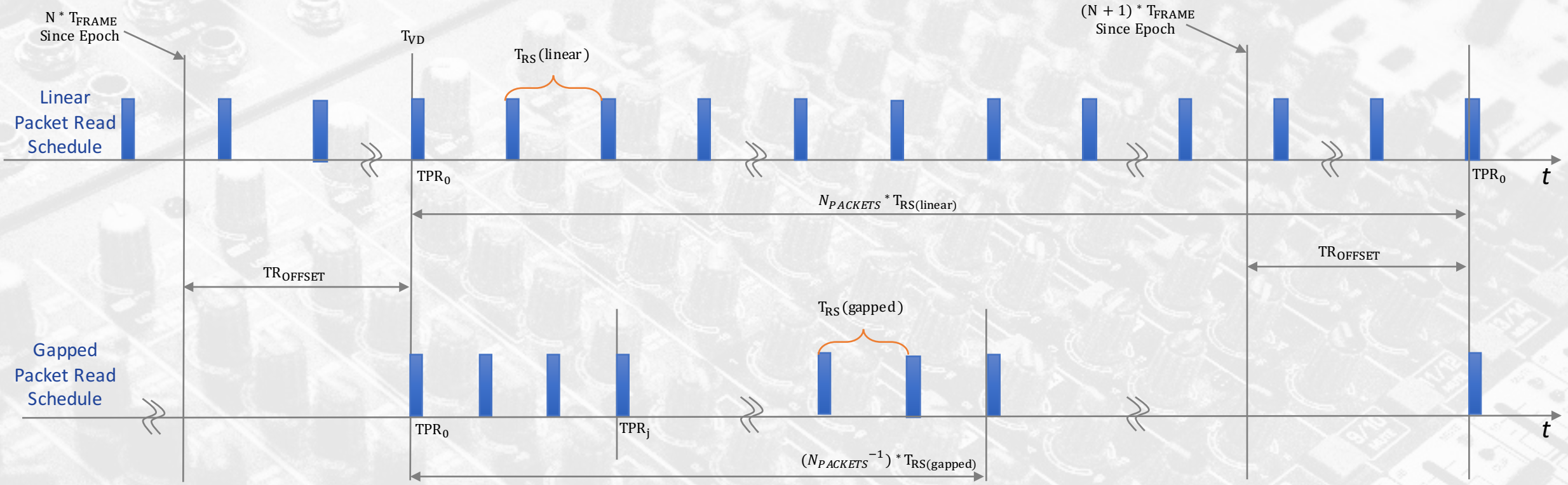
VIRTUAL RECEIVER BUFFER MODEL

- Similar to the *Network Compatibility Model*
- Drain rate is based on a receiver's packet read schedule
- Evaluates sender's compliance with receiver



LINEAR VS GAPPED PACKET READ SCHEDULE (PRS)



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TYPES OF SENDERS

NARROW

Narrow (N) senders:

- Have tight PDV values
- $C_{MAX} = 4$
- $VRX_{FULL} = 8$
- Designed for **gapped** PRS

Narrow Linear (NL) senders:

- Have tight PDV values
- $C_{MAX} = 4$
- $VRX_{FULL} = 8$
- Designed for **linear** PRS

WIDE

Wide senders:

Have loose PDV values

- $C_{MAX} = 16$
- $VRX_{FULL} = 720$

Calculated values are for:
720p60, 1080i50, 1080p50

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TYPES OF RECEIVERS

- Narrow – “constrains” Narrow sender
- Wide – “constrains” Wide sender

- Asynchronous – doesn’t have to be PTP locked

SENDER-RECEIVER COMPATIBILITY

	N	W	A
N	YES	YES	YES
NL	NO	YES	YES
W	NO	YES	YES

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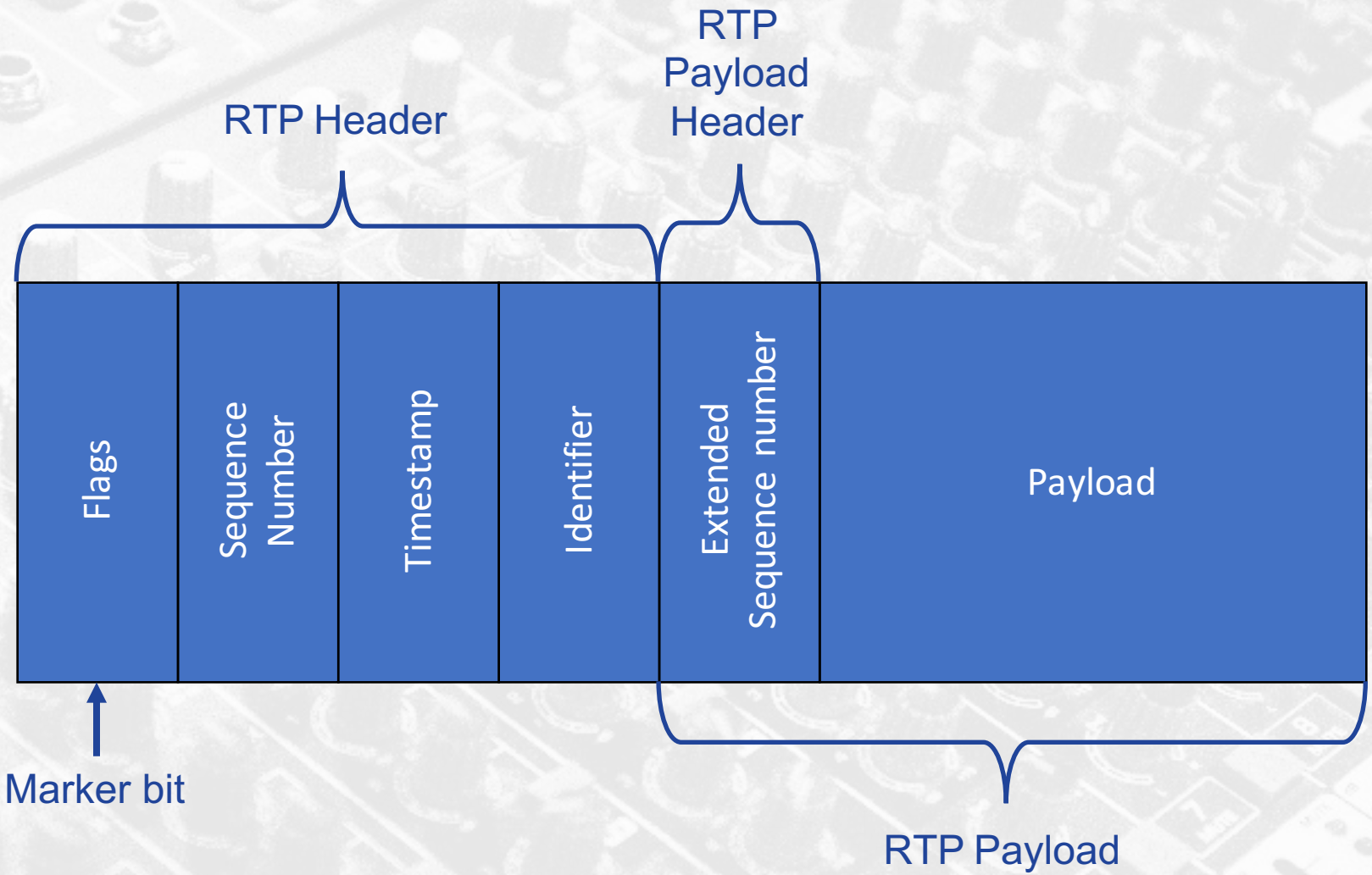
RTP PACKET ANATOMY



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CALCULATIONS BASED ON RTP TIMESTAMP

Having timestamp, sequence number and marker bit values and PTP:

- Exact field/frame arrival time
- PTP time of the packet
- Index of received frame

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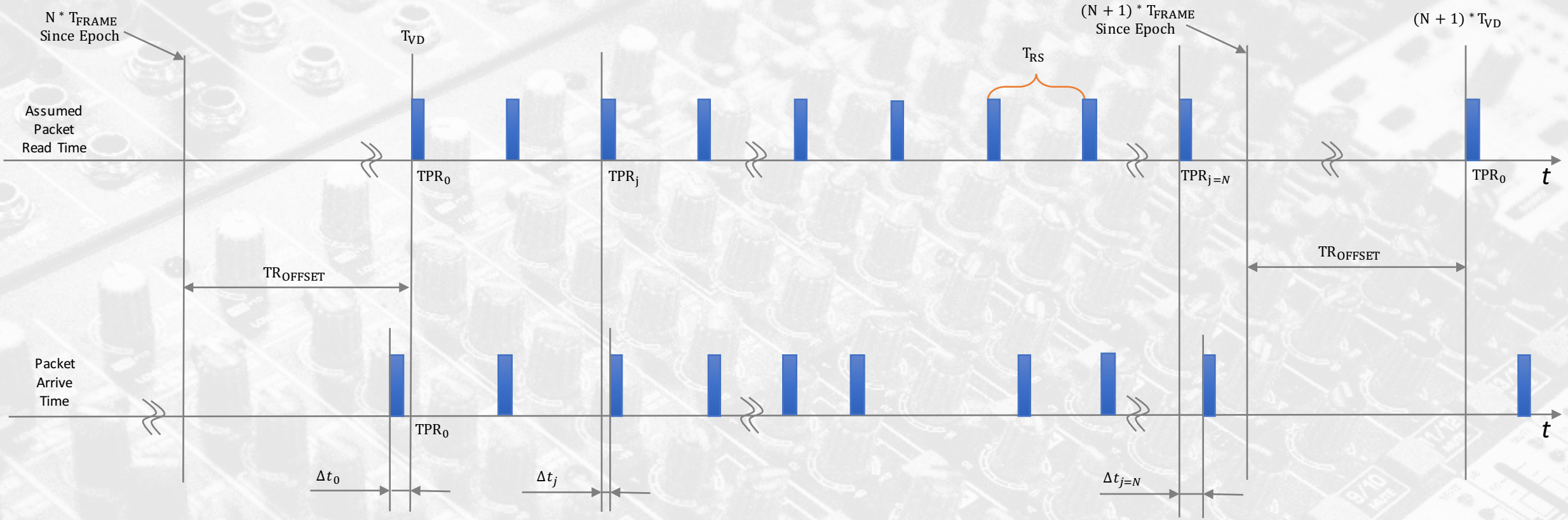

EBU SMPTE ST2110 ANALYZER

- Developed by Willem Vermost
- Offers PTP offset, C and VRX buffers analysis
- Available as open source software
- https://github.com/ebu/smpte2110-analyzer

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LIST - Live IP Software Toolkit

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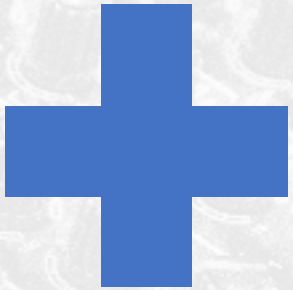
Backend



Frontend

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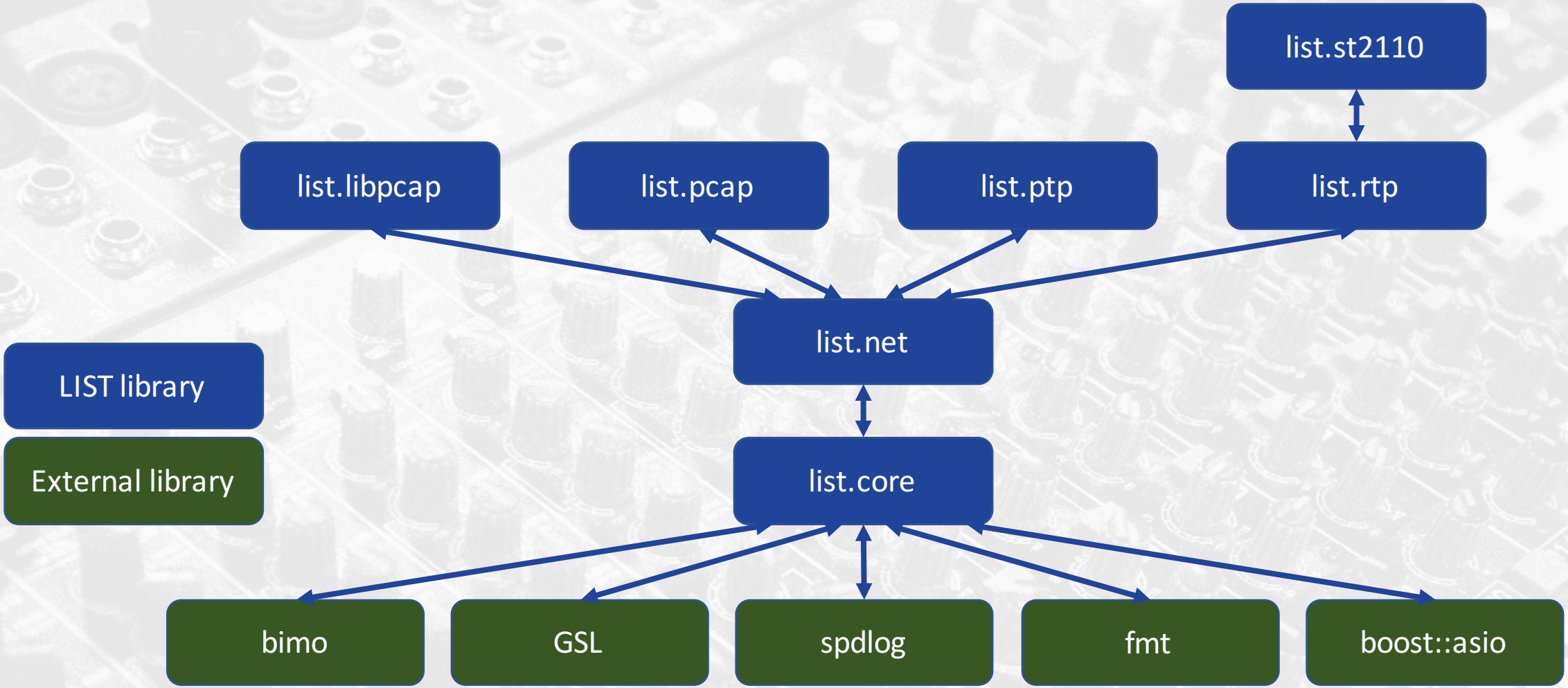

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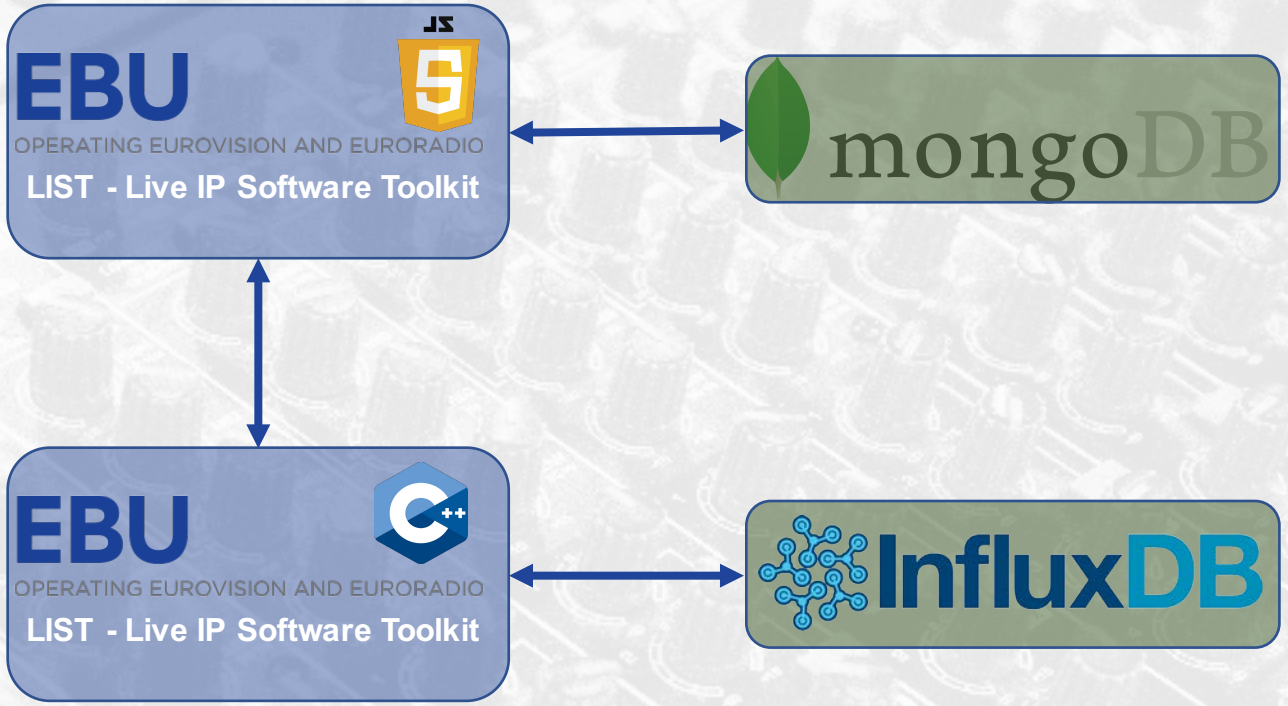

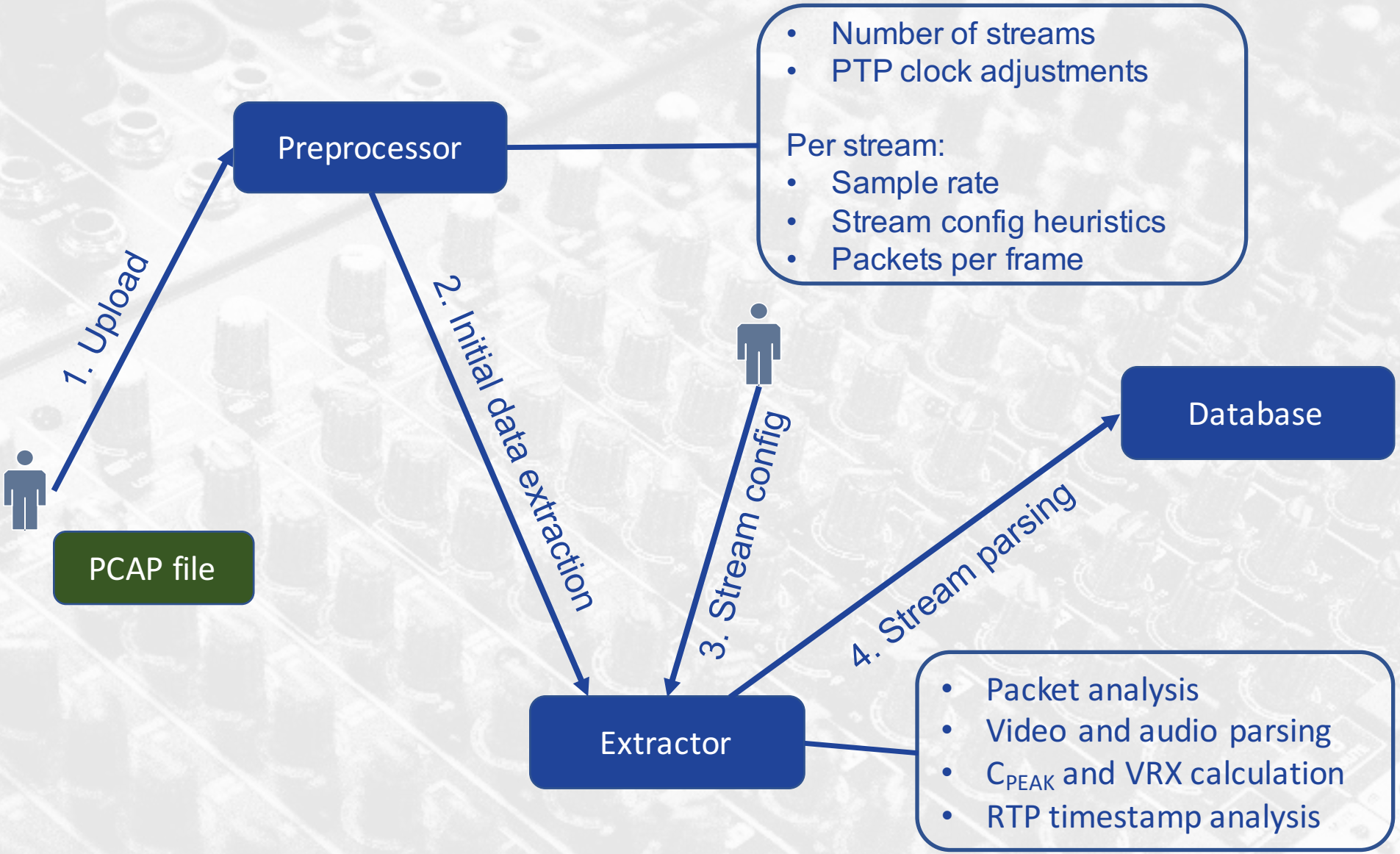

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HIGH PRECISION PTP

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LESS PRECISE PTP

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EXAMPLE OF POLITE SENDER (FOR C BUFFER)

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EXAMPLE OF BURSTY SENDER (FOR C BUFFER)

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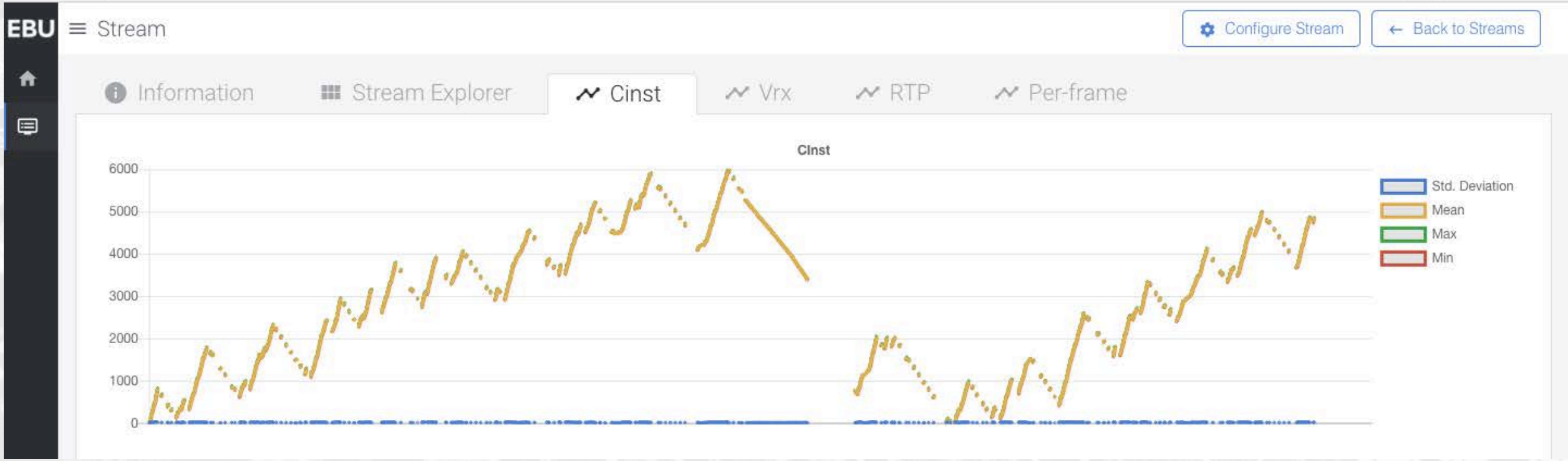

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EXAMPLE OF POLITE SENDER (FOR VRX BUFFER)

EXAMPLE OF UNDERFLOW OF VRX BUFFER

EXAMPLE OF OVERFLOW OF VRX BUFFER

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KEY TAKEAWAY

- Measurements of mission critical parameters in your network are…. mission-critical
- Every parameter of the sender can be extracted from the stream capture and measured
- Compliance to the standards can be evaluated
- Risks can be lowered
- Better view on the devices in the network
- Education and training of staff
- **The tools are there**

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