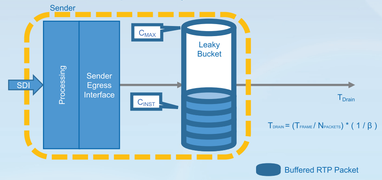
SMPTE ST 2110-21

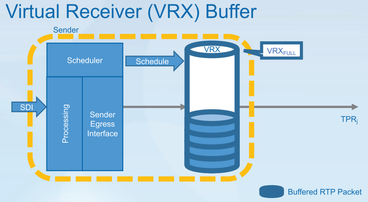
Timing Network Traffic for Low Latency Application

Network Compatibility Model



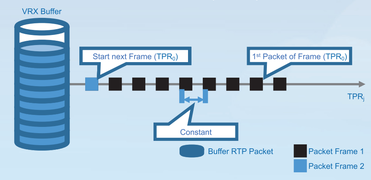
The Network Compatibility Model ensures that the IP network can cope with a large number of simultaneously converging SMPTE ST 2110 streams without switch buffers or queues overflowing. It is based on the leaky bucket algorithm, with packets being drained on a regular basis.

Virtual Receiver (VRX) Buffer



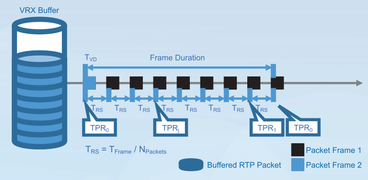
The **Virtual Receiver (VRX) Buffer Model** ensures that the sequence of actual packet transmissions neither underflow nor overflow receiver buffers. The VRX Model is also based on the leaky bucket algorithm.

Packet Read Schedule (PRS)



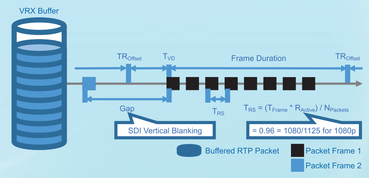
The PRS describes how packets are to be drained from the VRX buffer model by describing the sequence of read times TPR_j of packet j. There are two types of PRS: Linear and Gapped.

Progressive PRS (Linear)



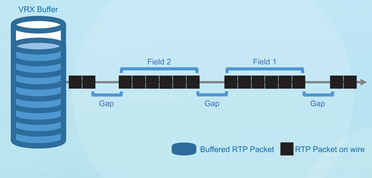
The **Linear PRS** has packet read times that are evenly spaced throughout the frame period.

Progressive PRS (Gapped Timing)



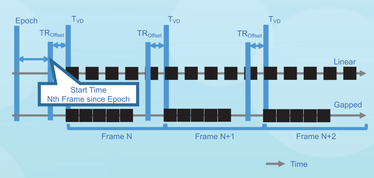
The **Gapped PRS for progressive video** contains a time gap between frames when no packets are sent. This allows delivery of video frames with an approximation of an SDI blanking period. The calculation of the packet spacing T_{RS} changes slightly from the Linear PRS due to the gap.

Interlaced PRS (Gapped)



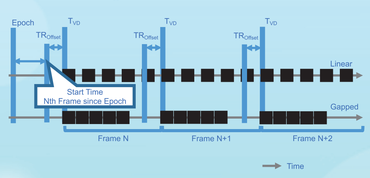
The **Gapped PRS for interlaced video** contains a time gap between each field when no packets are sent, which approximates to an SDI signal with a blanking period.

TR_{OFFSET}



TR_{OFFSET} signals the alignment of a sender to the common clock source for network devices. When expressed in SDP, TR_{OFFSET} is expressed as an integer number of microseconds.

Overall Timing



T_{VD} is the Video Transmission Datum, which is co-incident with TPR_0, the read schedule of the first packet of a frame.

System	R_{ACTIVE}	$TRO_{DEFAULT}$
525 line interlaced system as specified in Recommendation ITU-R BT.656-5	(487/525)	(20/525) x T_{FRAME}
625 line interlaced system as specified in Recommendation ITU-R BT.656-5	(576/625)	(26/625) x T_{FRAME}
1125 line interlaced system and Progressive segmented Frame (PsF) systems as specified in Recommendation ITU-R BT.709-6	(1080/1125)	(22/1125) x T_{FRAME}

This table shows the **ratio of active time for interlaced systems** when using the Gapped PRS, and also provides the default TR_{OFFSET} known as $TRO_{DEFAULT}$.

Sender Compliance

Sender Type	PRS	Minimal C_{MAX}	VRX_{FULL}	β
Narrow (N)	Gapped	8 Packets	Calculate	1.1
Narrow Linear (NL)	Linear	4 Packets	Calculate	1.1
Wide (W)	Linear	16 Packets	720 Packets	1.1

ST 2110-21 defines the sender compliance to the ST 2110-21 timing model through certain parameters, based on a sender type of Narrow (N), Narrow Linear (NL), or Wide (W). The parameters are the PRS, the C_{MAX} value, the VRX_{FULL} value and the scaling factor β.

Receiver Compliance

Receiver Type	N Sender Support	NL Sender Support	W Sender Support	Locked to Sender Clock
Synchronous Narrow (N Type)	Mandatory	Optional	N/A	Yes
Synchronous Wide (W Type)	Mandatory	Mandatory	Mandatory	Yes
Asynchronous (A Type)	Mandatory	Mandatory	Mandatory	No

ST 2110-21 defines receiver types listed here with their compliance criteria. There are two main types of receivers: synchronous and asynchronous receivers. There are two types of synchronous receivers: narrow or “N type” and wide or “W type.”

SDP Parameter

a=fmtp …	
SDP Attribute	**Value**
TP	Sender Type: 2110TPN, 2110TPNL, 2110TPW
TROFF	Sender Type N, NL: Default TR_{OFFSET} Sender Type W: Alternate TR_{OFFSET}
CMAX	Sender Type specific C_{MAX} value

ST 2110-21 specifies SDP attributes, which are added to the format field indicated by the “a=fmtp” line of an SDP document and signaled from a sender to a receiver. These attributes inform the receiver about the type of sender, what buffer size was used at the sender for network compatibility and TR_{Offset} was used.

SMPTE ST 2110-21 describes the traffic shaping and delivery timing of ST 2110 professional media over managed IP networks. It ensures that ST 2110 streams are able to be reliably transported over IP networks at scale and provides expectations for receiver manufacturers regarding buffer requirements while maintaining low latency. It also has options that can support both FPGA hardware-based solutions that interface with SDI, as well as software or virtualized solutions that may never interface with SDI.