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# Multi-Stream Traffic Generator and Analyzer (1 Gbps)

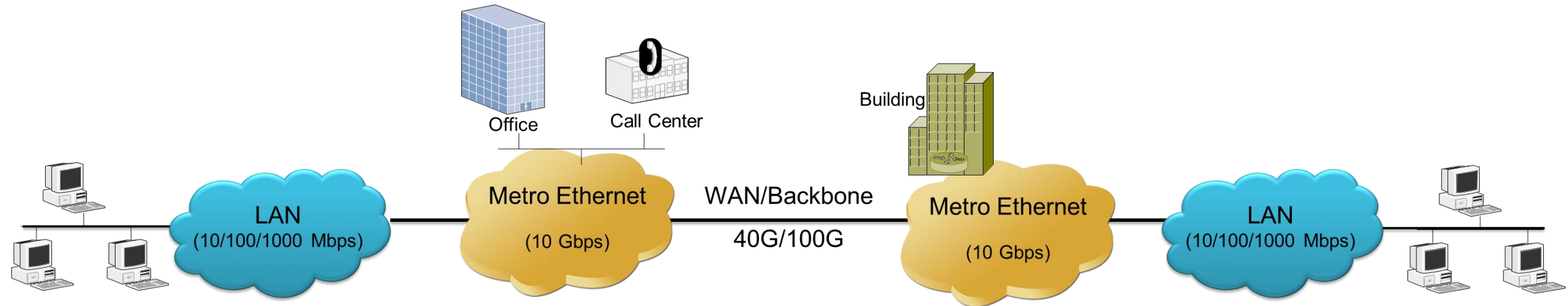
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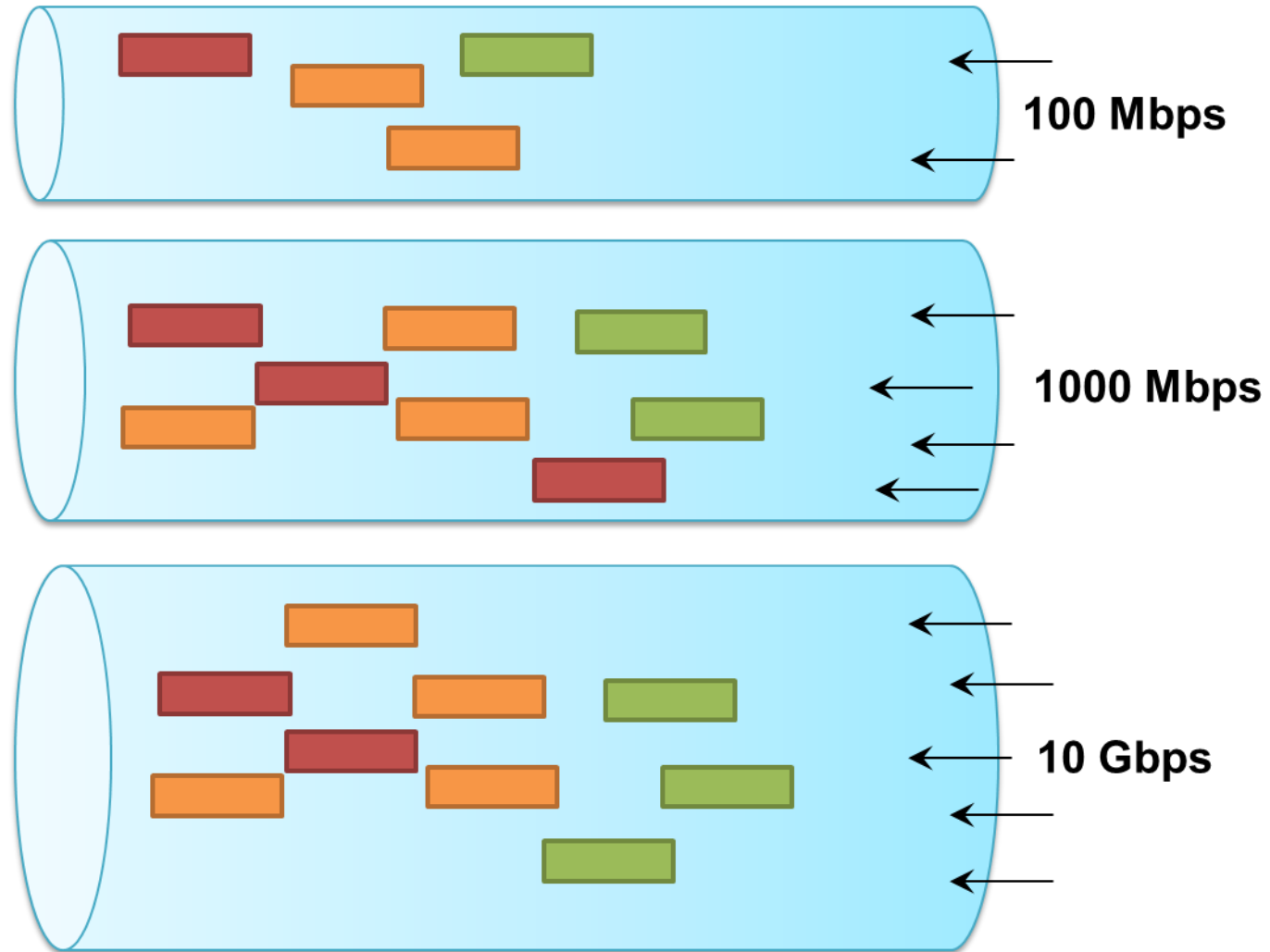


818 West Diamond Avenue - Third Floor, Gaithersburg, MD 20878  
Phone: (301) 670-4784 Fax: (301) 670-9187 Email: [info@gl.com](mailto:info@gl.com)  
Website: <https://www.gl.com>

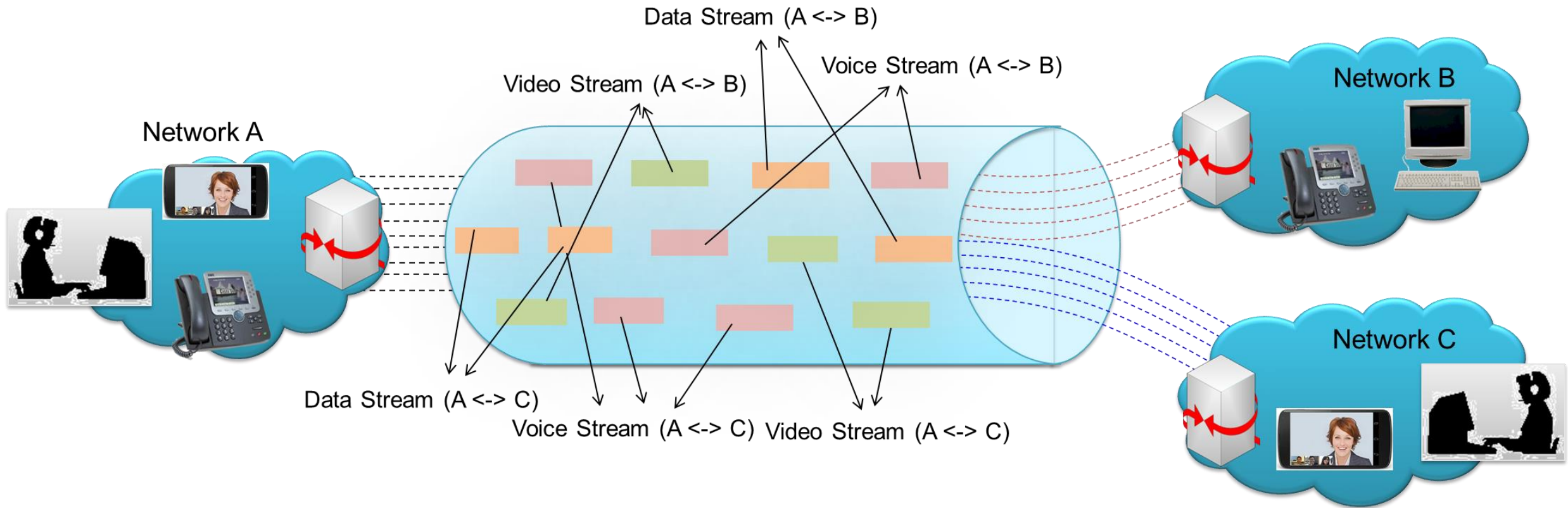
# Ethernet Technology



# Just bigger Pipes, but same Ethernet/IP Packets

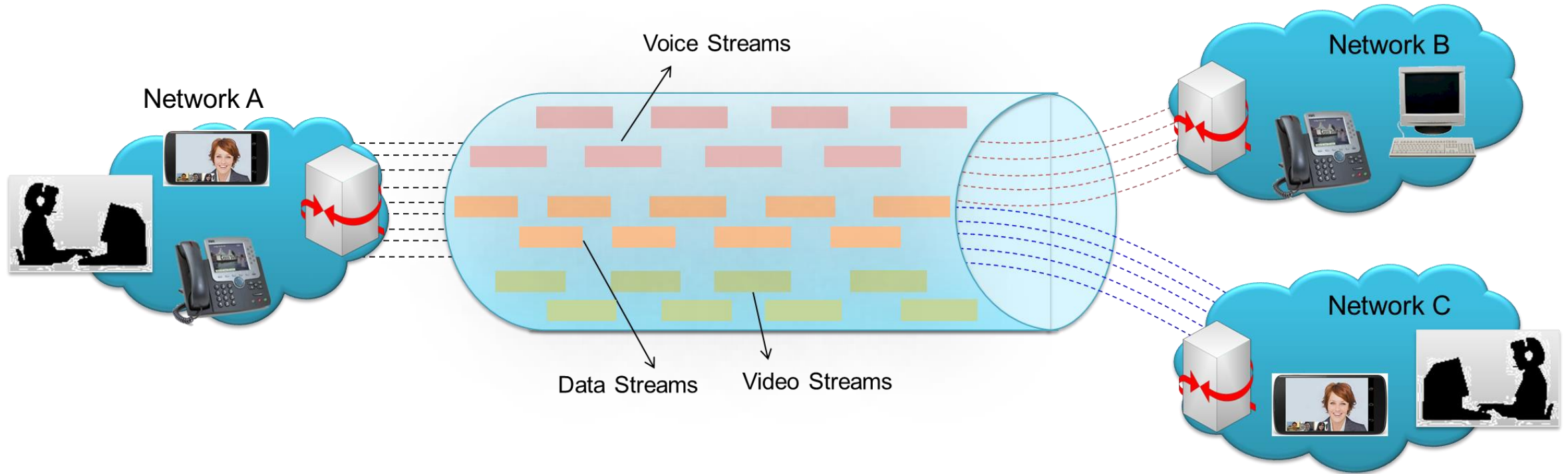


# Multi Stream Traffic

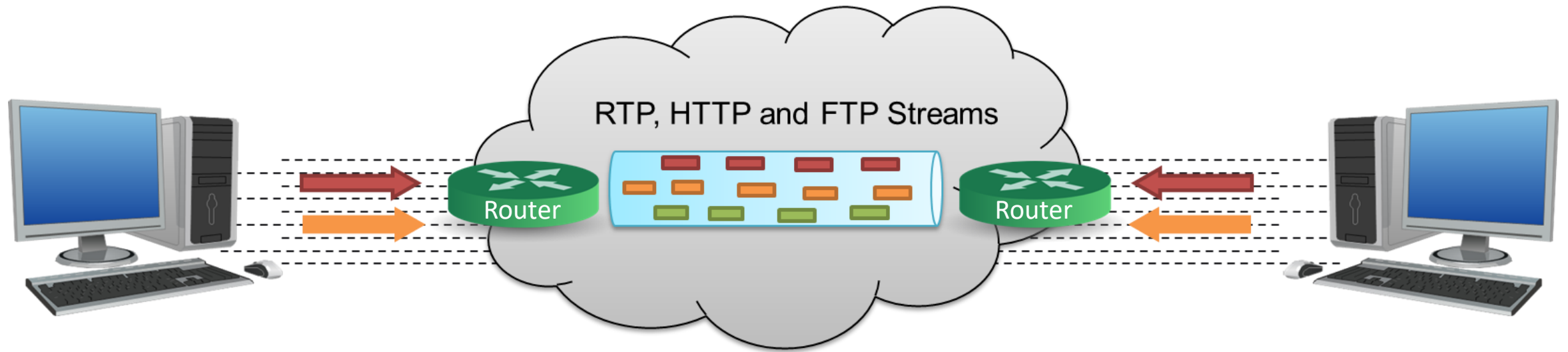


- A traffic “**Stream**” or “**Flow**” can be defined as a set of packets flowing across the DUT/Network, who are logically connected to each other

# Multiple "Stream" or "Flow" in Ethernet/IP Traffic



# Multi-Stream Traffic between 2 End Points



# Identifying Streams

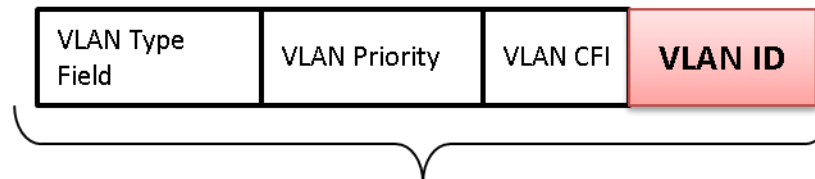
UDP headers

<b>UDP Source Port</b>	<b>UDP Destination Port</b>
UDP Length	UDP Checksum
Data	

IP header

Version	Header Length	Service Type	Total Length	
Identification		Flags	Fragment Offset	
TTL	Protocol	Header Checksum		
<b>Source IP Address</b>				
<b>Destination IP Address</b>				
Options			Padding	

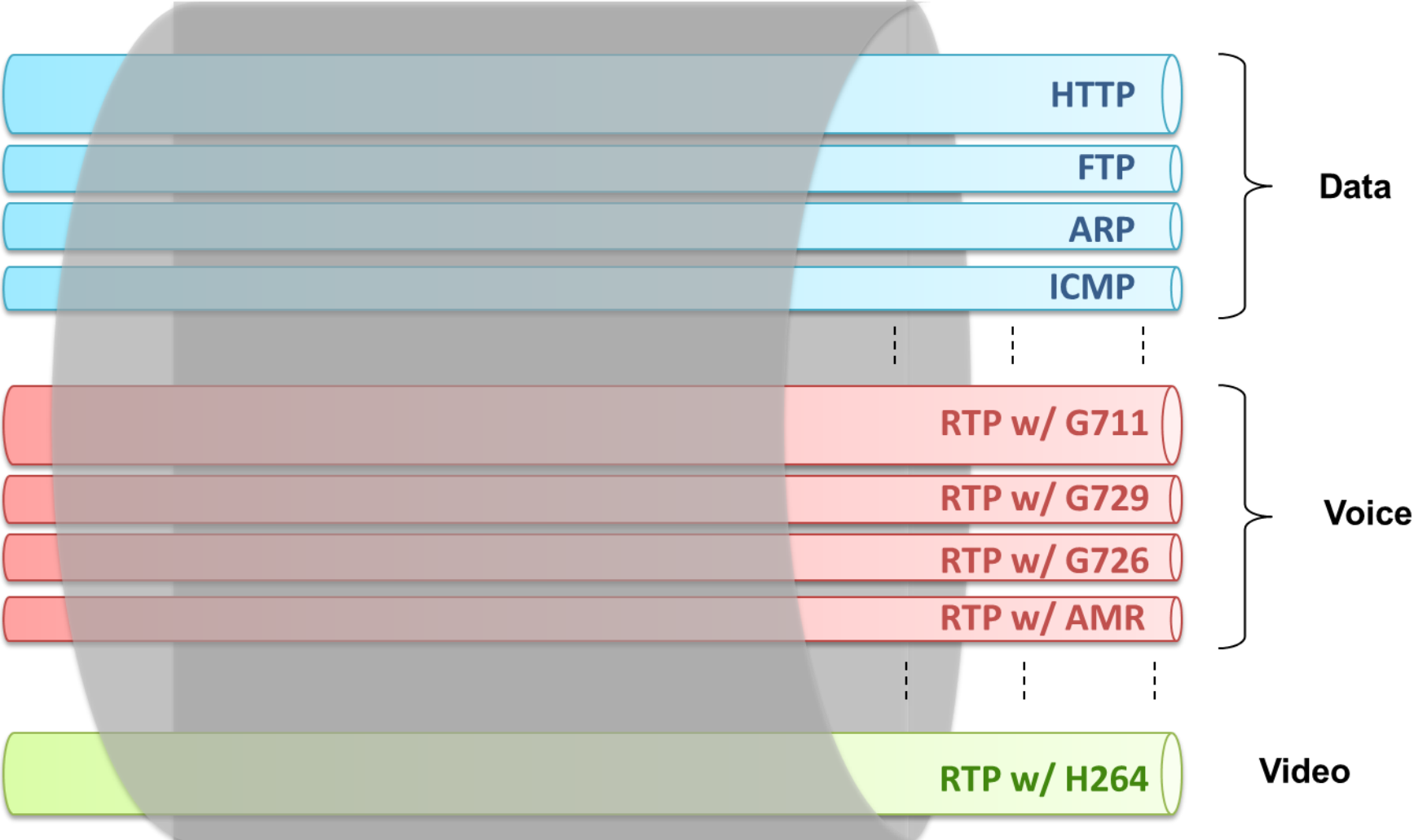
VLAN header



MAC header

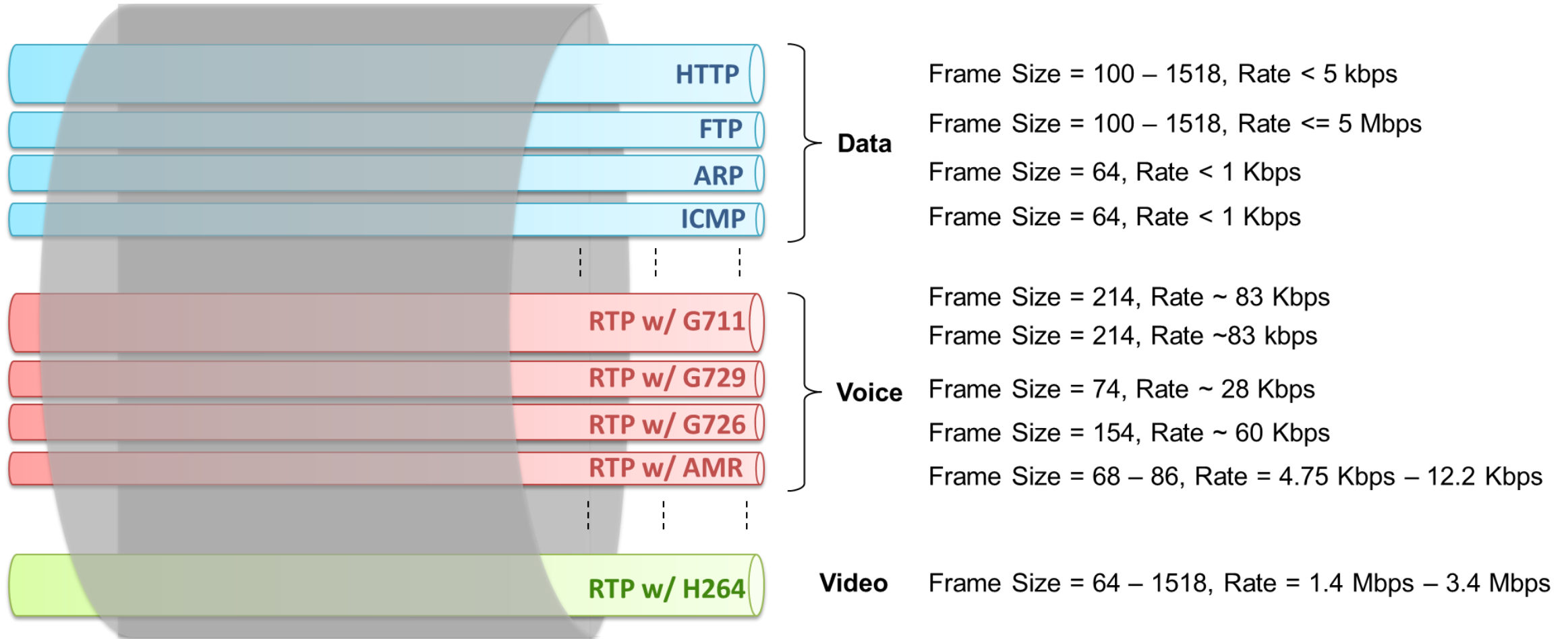
<b>Destination Address</b>	<b>Source Address</b>	VLAN Tag	Type/Len	Payload	FCS
----------------------------	-----------------------	----------	----------	---------	-----

# Application-wise Streams

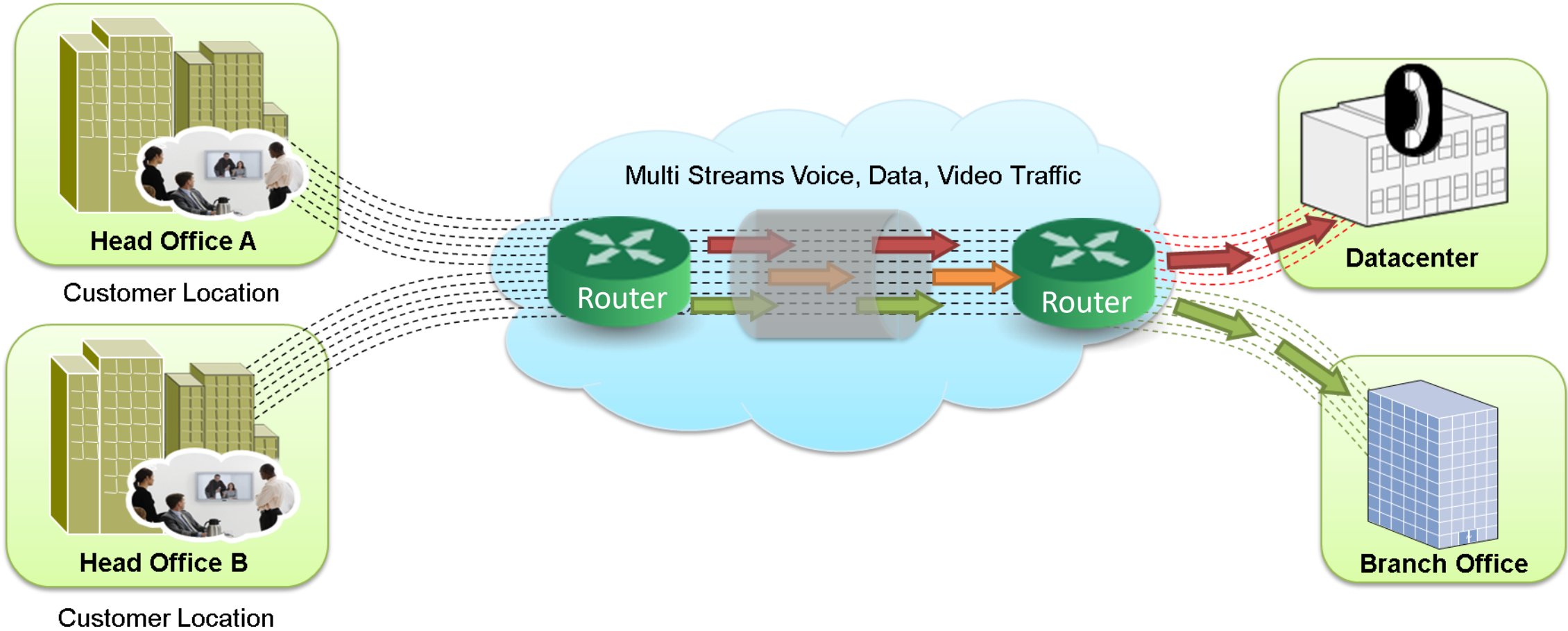




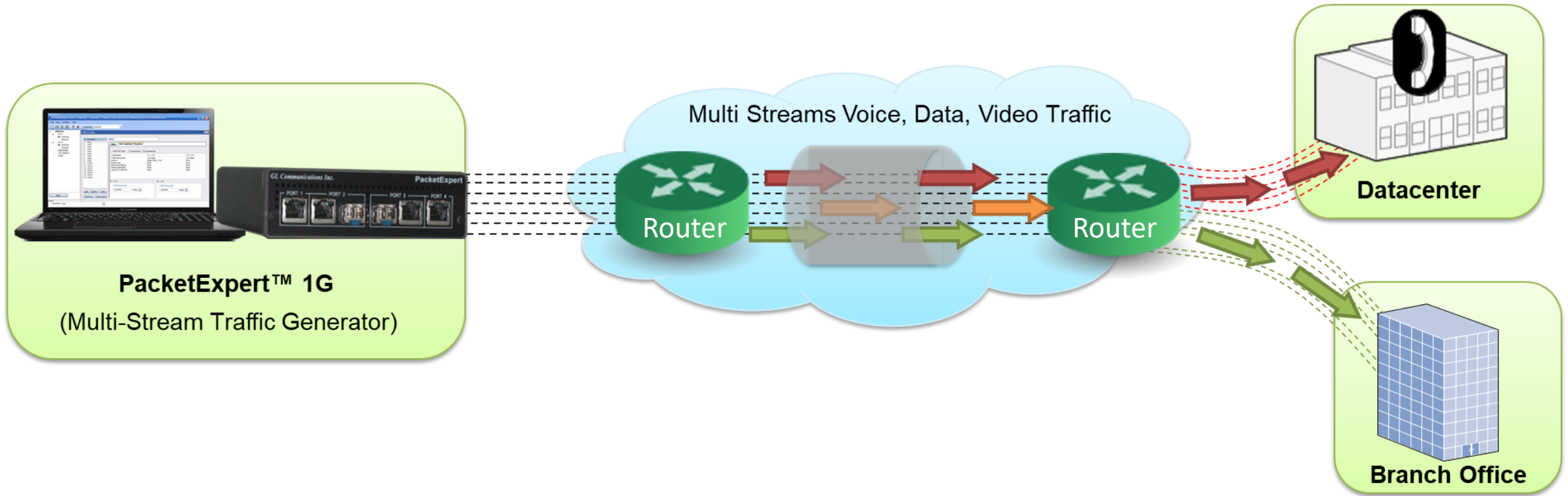
# Stream Characteristics



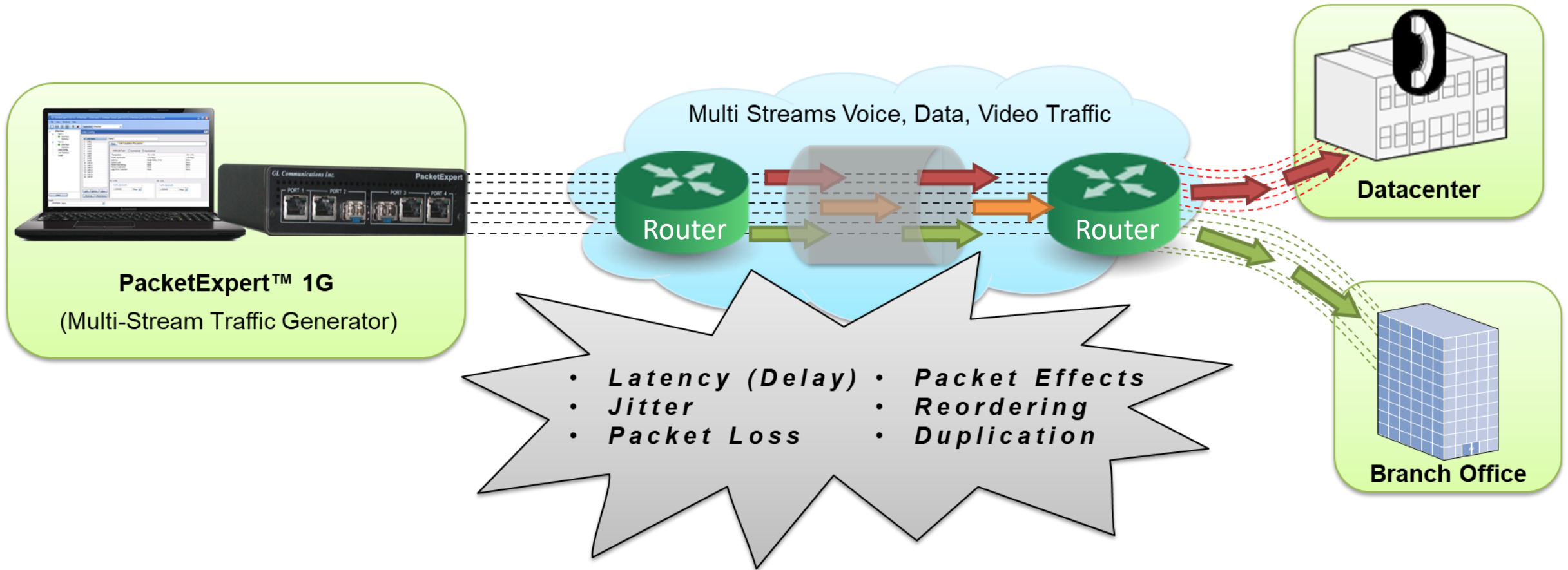
# All Streams Carried over Single Pipe



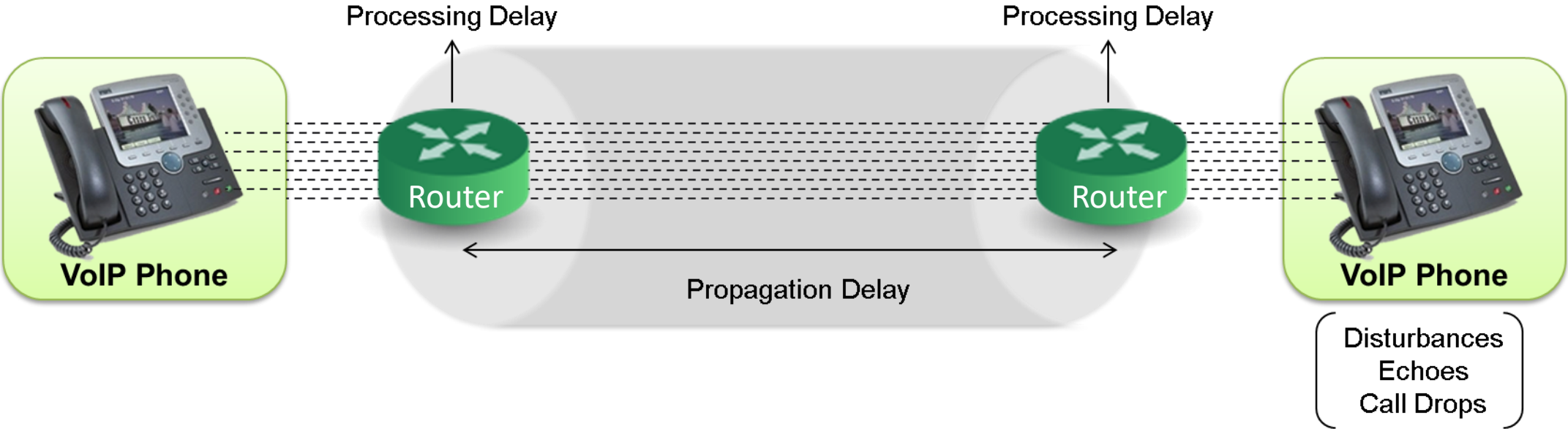
# Multi Stream Traffic Generator



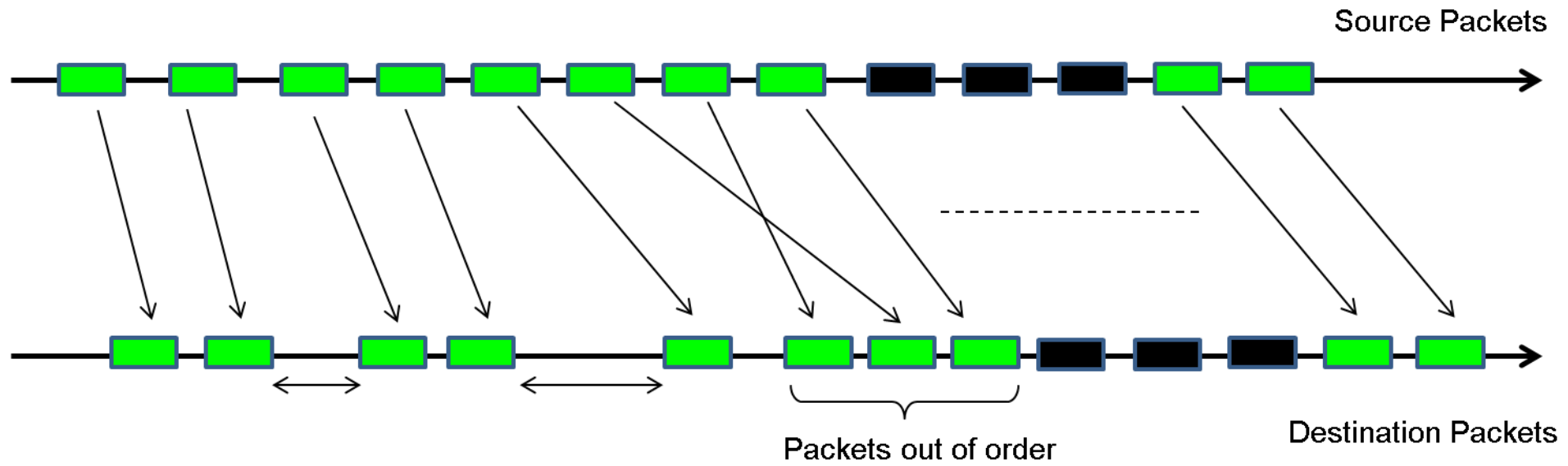
# Impairments Introduced by Packet Switching Networks



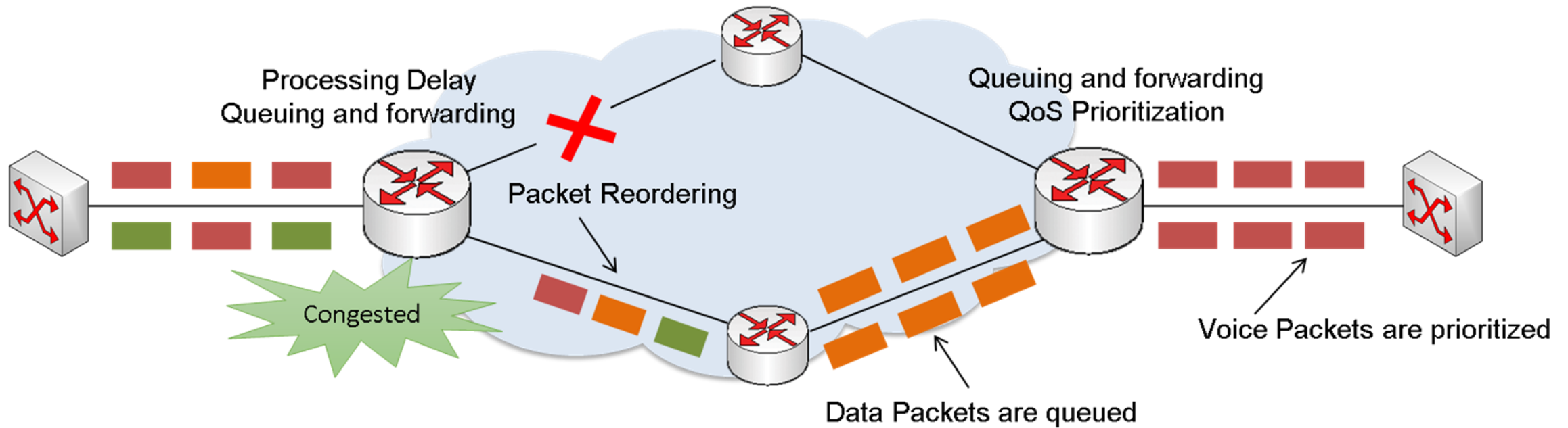
# Latency or Frame Transfer Delay



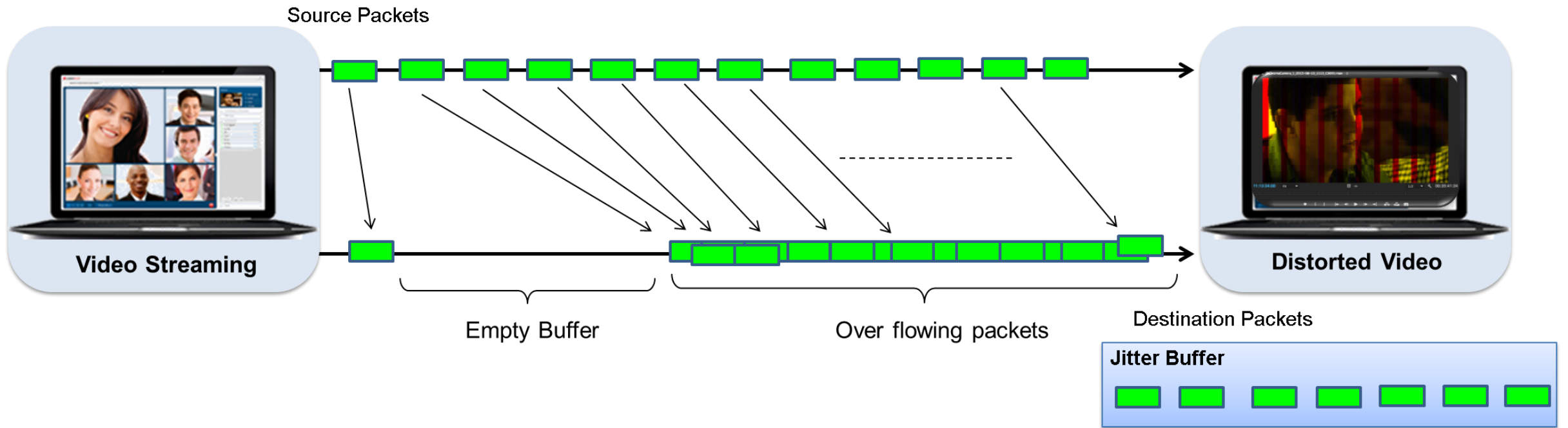
# Jitter



# Jitter Introduced in Various Ways

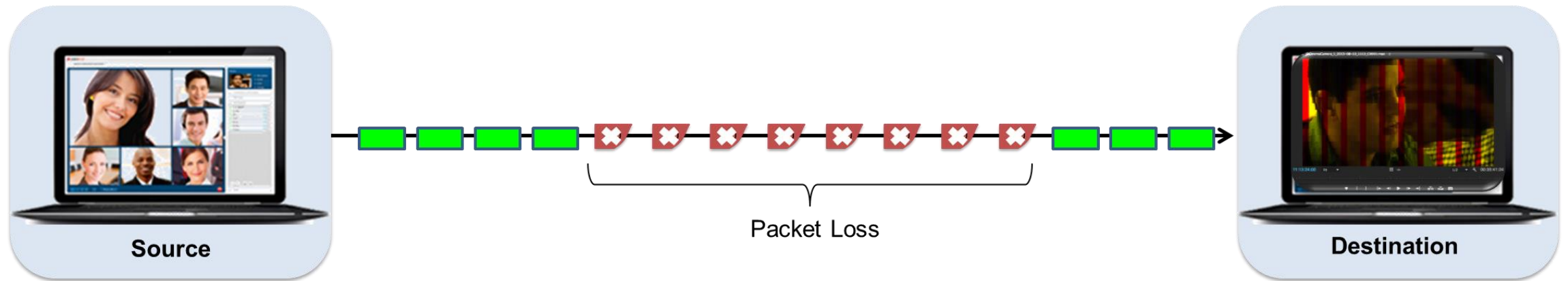


# Effects of Jitter on Video Playback

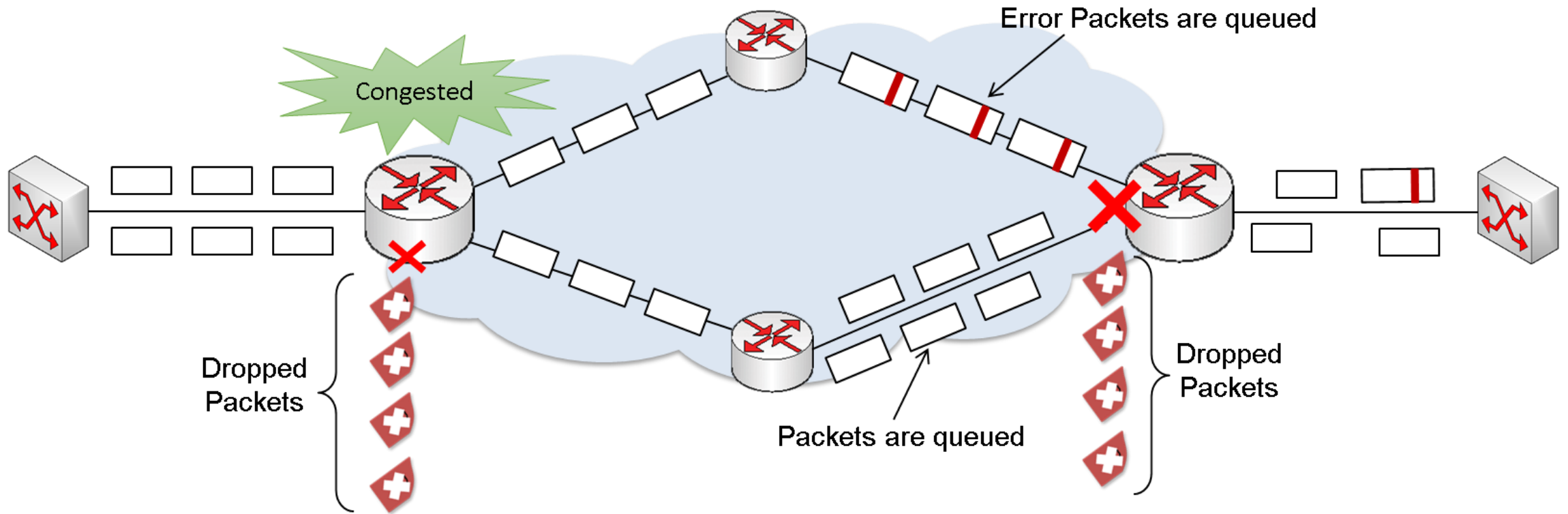




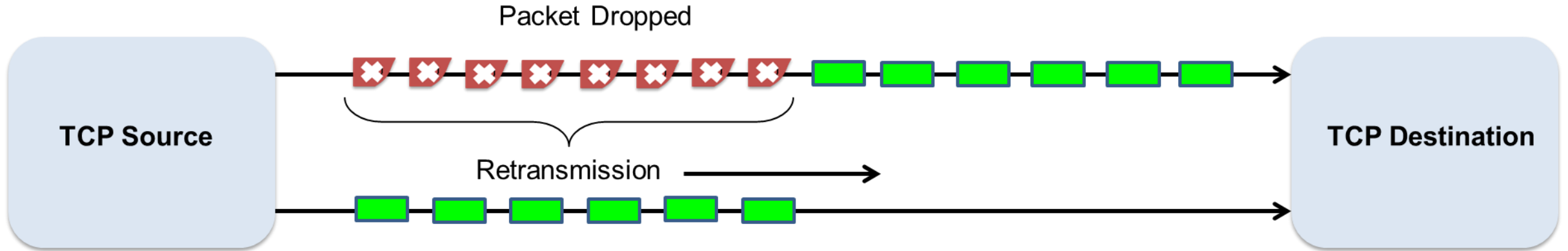
# Packet Loss



# Packet Loss Introduced in Different Ways



# Effects of Packet Loss

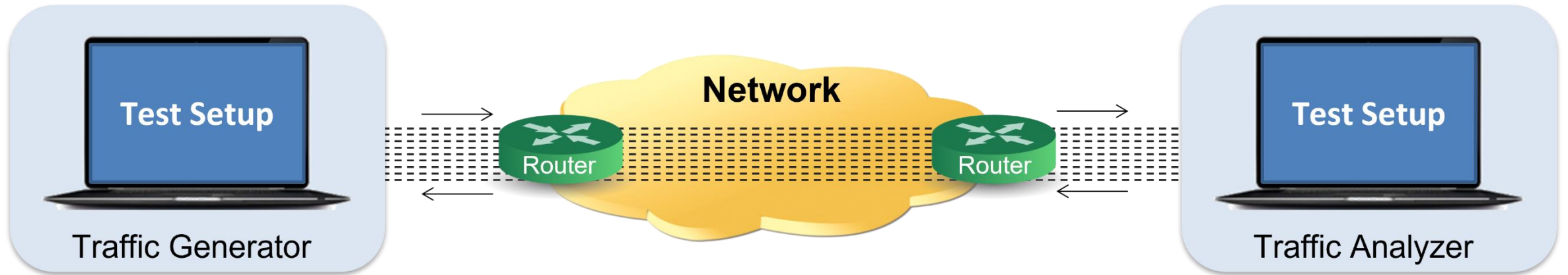


# IP Measurements

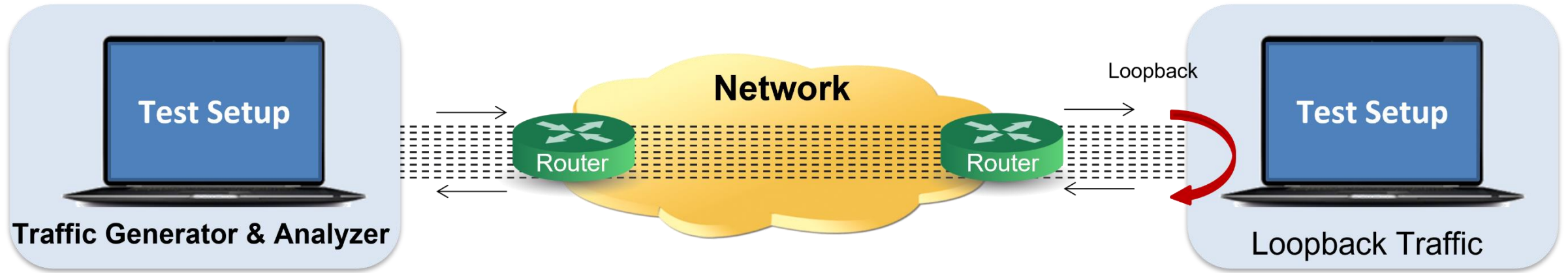
Need to measure these IP Metrics:

- Throughput/Bandwidth
- Latency/Frame Transfer Delay (FTD)
- Jitter/Frame Delay Variation (FDV)
- Packet Loss/Frame Loss (FL)

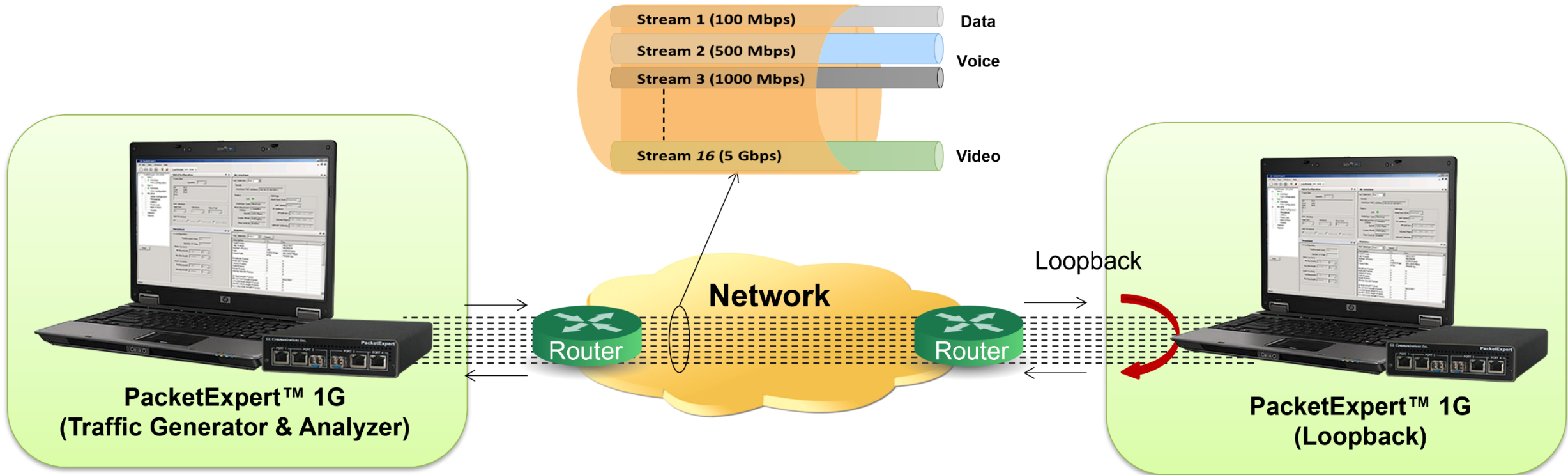
# End-to-End Test Setup



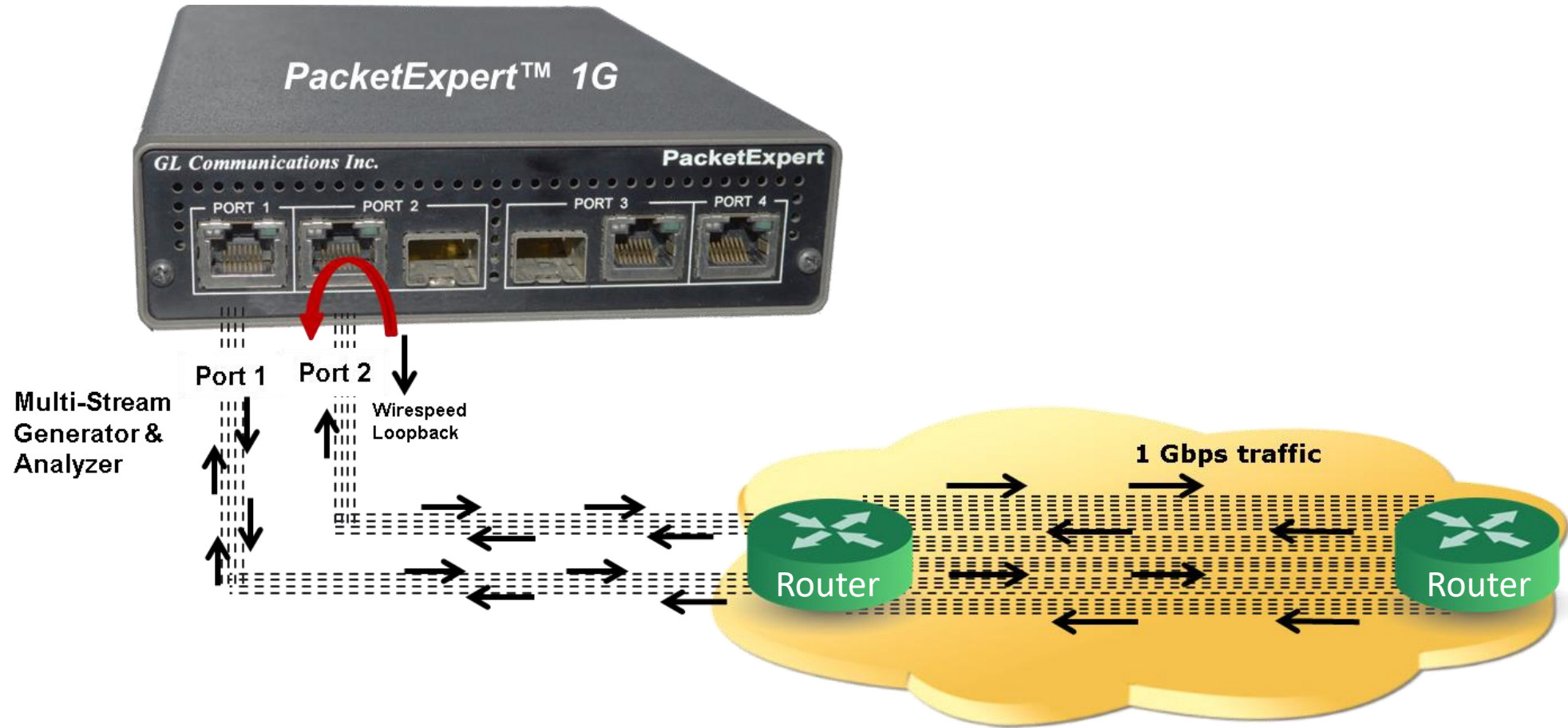
# Test Setup Remote Loopback



# Multi Stream Generator and Analyzer



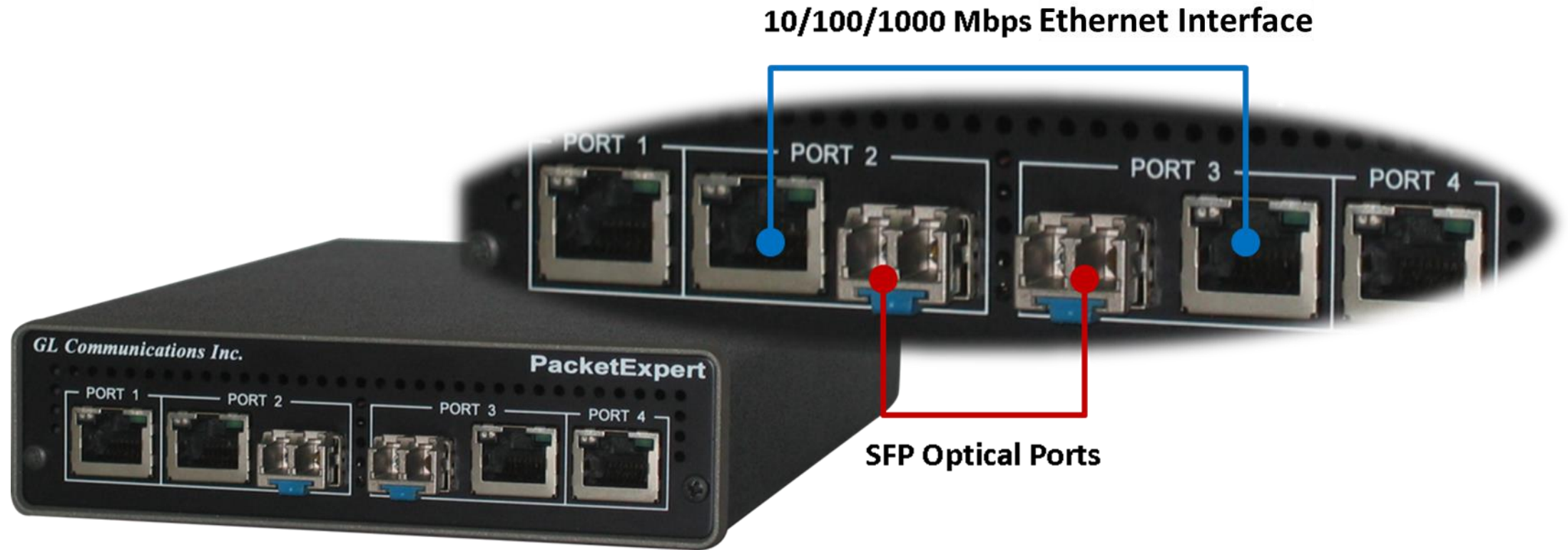
# Local Loopback for Convenience





# Hardware

# Expert Analyzer 1G Ports

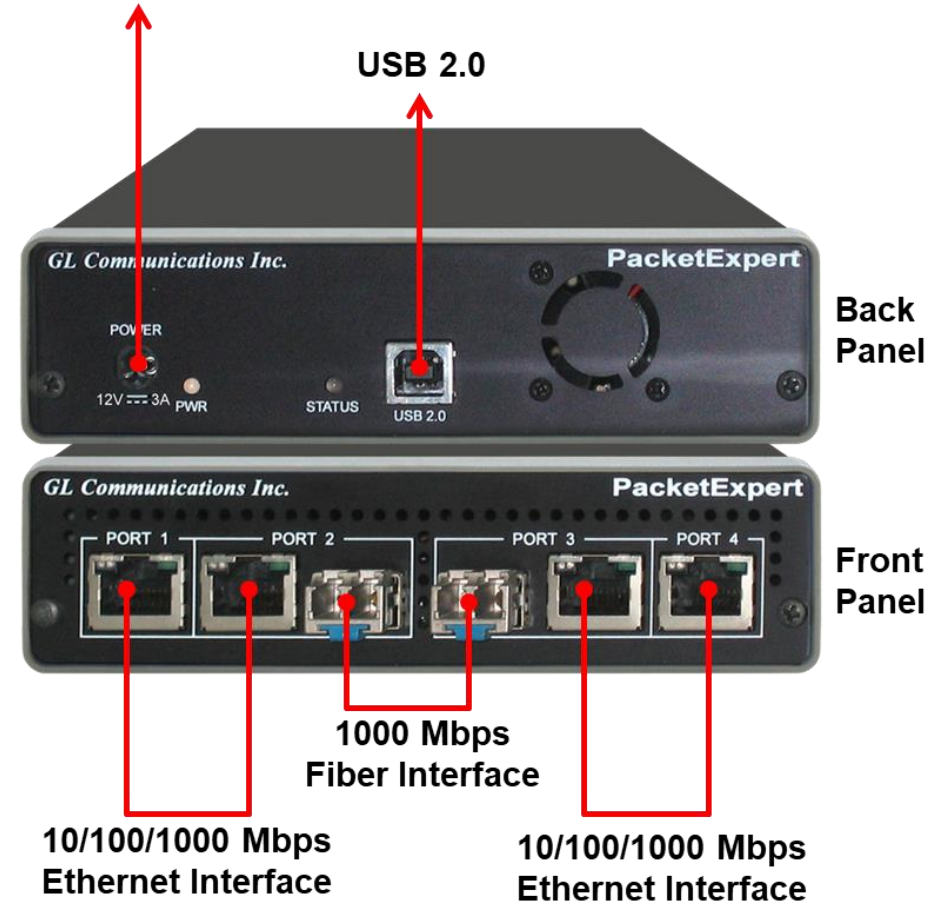


**PacketExpert™ 1G**

# PacketExpert™ 1G Portable Unit

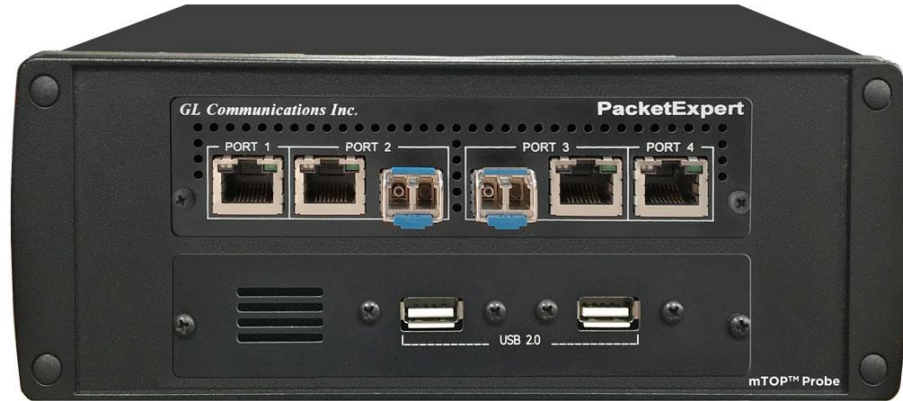
- Interfaces
  - 2 x 10/100/1000 Base-T Electrical only
  - 2 x 1000 Base-X Optical OR 10/100/1000 Base-T Electrical
  - Single Mode or Multi Mode Fiber SFP support with LC connector
  - Optional 4-Port SMA Jack Trigger Board (TTL Input/Output)
- Protocols:
  - RFC 2544 compliance
  - ITU-T Y.1564 (ExpertSAM)
- Power:
  - +12 Volts (Medical Grade), 3 Amps
- Bus Interface:
  - USB 2.0

Power: 12V (Medical Grade), 3A



# PacketExpert™ mTOP™ Probe

## Front Panel View



## Rear Panel View



- Portable Quad Port Ethernet/VLAN/MPLS/IP/UDP Tester with 4 Electrical Ethernet Ports (10/100/1000 Mbps) and 2 Optical Ports (100/1000 Mbps). Embedded with Single Board Computer (SBC).
- **SBC Specs:** Intel Core i3 or optional i7 NUC Equivalent, Windows® 11 64-bit Pro Operating System, USB 3.0 and USB 2.0 Ports, 12V/3A Power Supply, USB Type C Ports, Ethernet 2.5GigE port, 256 GB Hard drive, 8G Memory (Min), Two HDMI ports
- Each GigE port provides independent Ethernet/VLAN/MPLS/IP/UDP testing at wire speed for applications such as BERT, RFC 2544, and Loopback. BERT is implemented for all layers.
- RFC 2544 is applicable for Layers 2, 2.5, and 3, and Loopback is applicable for Layers 2, 3, and 4.

# PacketExpert™ High-Density 12/24 GigE Ports mTOP™ Rack

**PacketExpert™ SA (PXE112)** is a 12-Port PacketExpert™ w/ Embedded Single Board Computer (SBC)

**SBC Specs:** Intel Core i3 or optional i7 NUC Equivalent, Windows® 11 64-bit Pro Operating System, USB 3.0 and USB 2.0 Ports, ATX Power Supply, USB Type C Ports, Ethernet 2.5GigE port, 256 GB Hard drive, 8G Memory (Min), Two HDMI ports

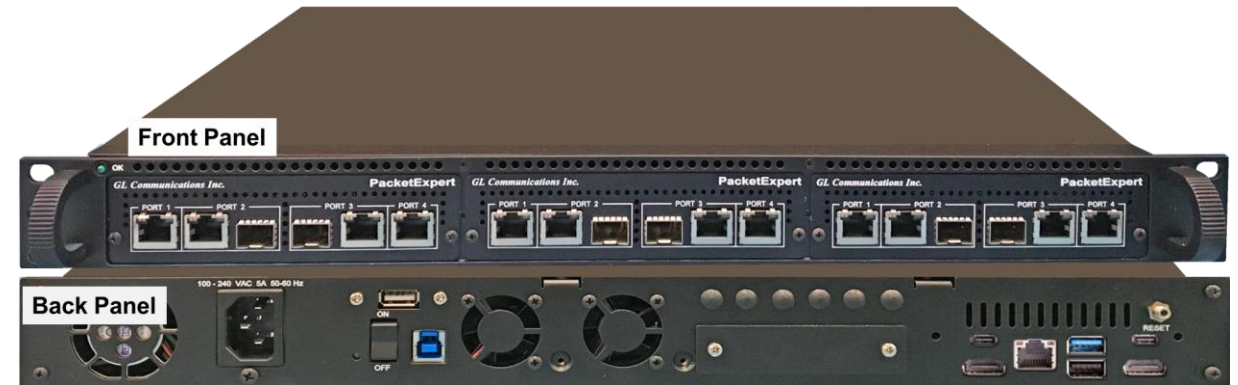
19" 1U Rackmount Enclosure (If options, then x 3)

**PacketExpert™ SA (PXE124)** is a 24-Port PacketExpert™ w/ Embedded Single Board Computer (SBC)

**SBC Specs:** Intel Core i3 or optional i7 NUC Equivalent, Windows® 11 64-bit Pro Operating System, USB 3.0 and USB 2.0 Ports, ATX Power Supply, USB Type C Ports, Ethernet 2.5GigE port, 256 GB Hard drive, 8G Memory (Min), Two HDMI ports

19" stacked 1U Rackmount Enclosure (If options, then x 6)

## PacketExpert™ SA (PXE112)

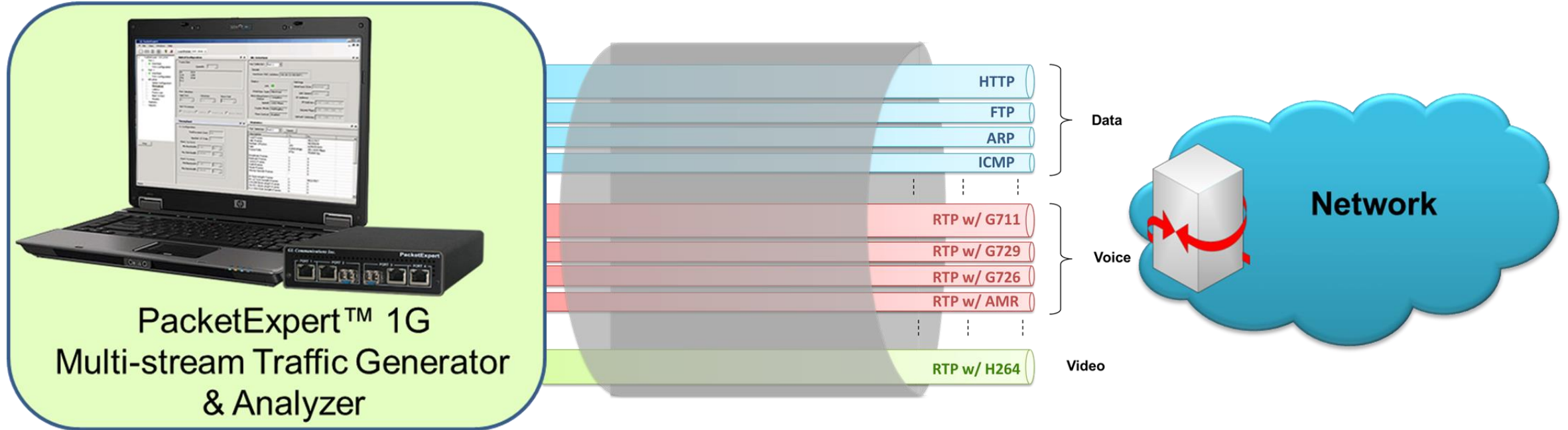


## PacketExpert™ SA (PXE124)

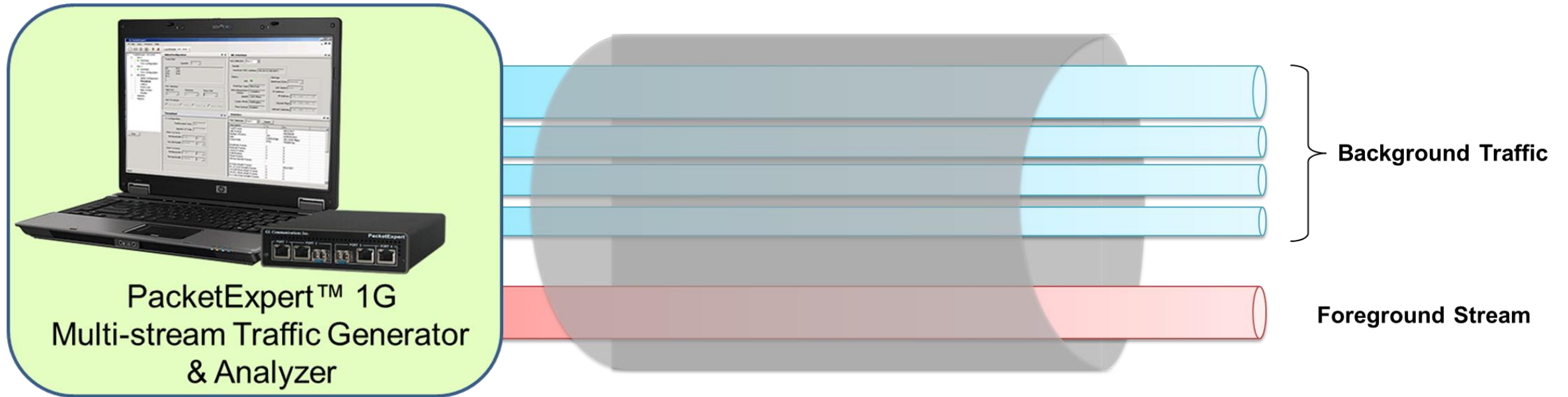


# Application Examples

# PacketExpert™ in the Network

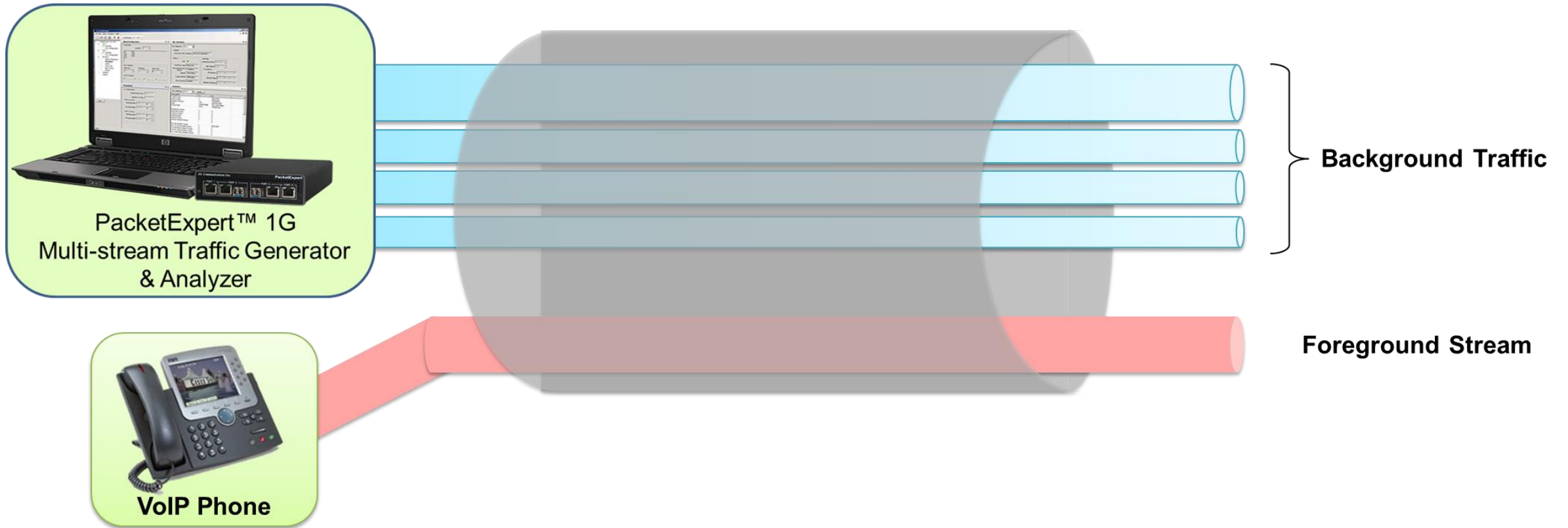


# Stress Testing

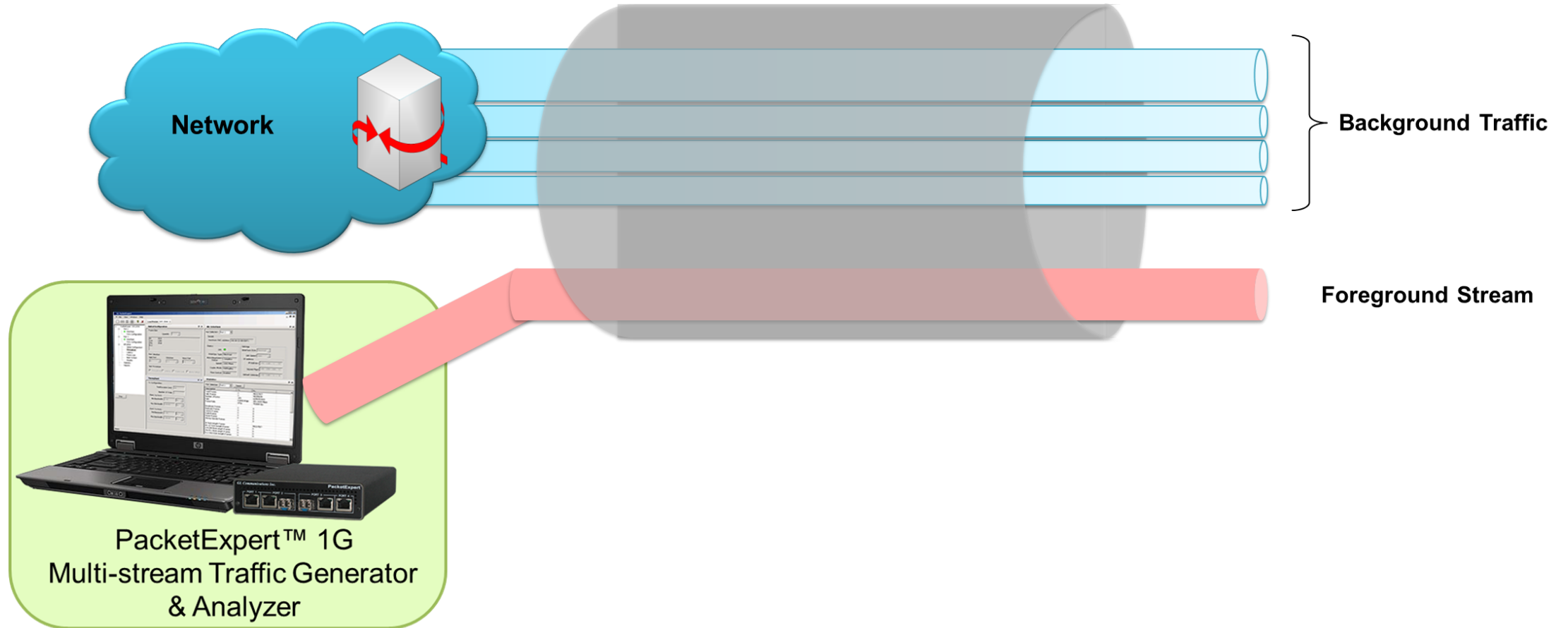




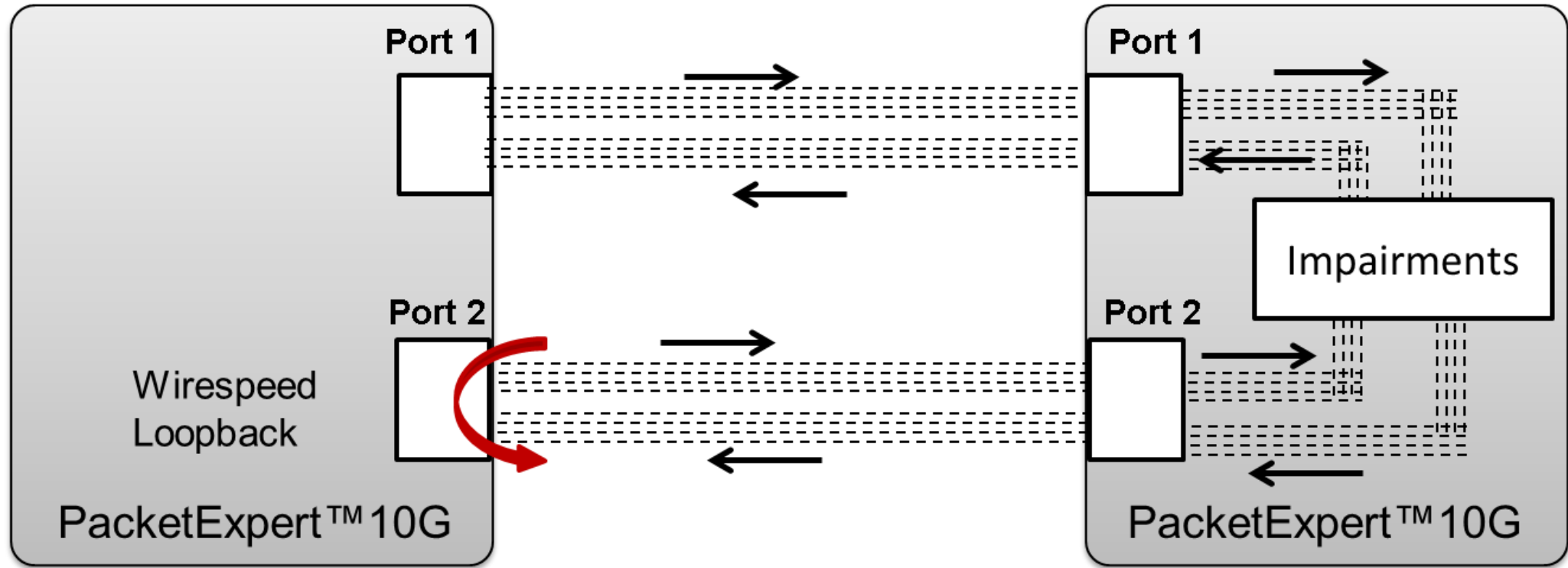
# Background Traffic Generator for Stress Testing



# Foreground Traffic Generator and Analyzer



# Traffic Generator and Analyzer Contd.)



Multi-Stream Generator & Analyzer

IPNetSim

# Stream Statistics and Results

Stream Statistics includes:

- Stream Name
- Test duration in secs
- TxRx Frames
- Rx Bytes
- Frame Loss - FL Count, Frame Loss Ratio - FLR (%)
- Information Rate - IR (Mbps)
- Frame Transfer Delay - FTD (msec)
- Frame Delay Variations - FDV (msec)

## Vertical View of Stream Results

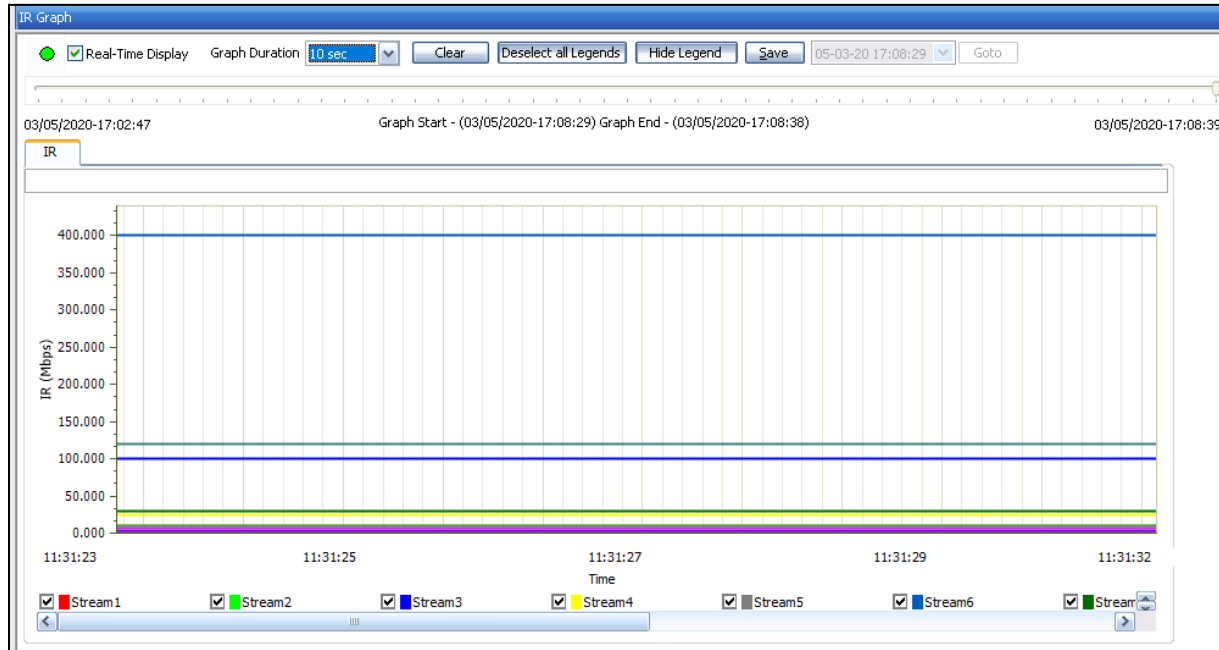
Multi-Stream Traffic Generator & Analyzer Results																			
IR(Mbps), FLR(%), FTD(msec), FDV(msec)		Test Time 00:55:10		Vertical		FTD Unit msec		FDV Unit msec		Activate All		DeActivate All							
Stream No	Sec...	TxFrames	RxFrames	RxBytes	FL Count	FLR	IR (Curr)	IR (Min)	IR (Max)	IR (Avg)	FTD	FTD	FTD	FTD	FDV	FDV	FDV	FDV	
<input checked="" type="checkbox"/>	1	3313	6 637 224	6 637 224	4 005 728 896	0	0.000	10.00	9.98	10.00	9.99	0.014	0.014	0.014	0.014	< 1us	< 1us	0.010	< 1us
<input checked="" type="checkbox"/>	2	3313	7 780 867	7 780 867	3 983 803 904	0	0.000	10.00	9.99	10.00	10.00	0.014	0.014	0.014	0.014	< 1us	< 1us	0.001	< 1us
<input checked="" type="checkbox"/>	3	3313	29 579 548	29 579 548	40 819 776 240	0	0.000	100.01	99.99	100.01	100.00	0.014	0.014	0.014	0.014	< 1us	< 1us	0.001	< 1us
<input checked="" type="checkbox"/>	4	3313	7 392 845	7 392 844	10 202 124 720	1	0.000	24.99	24.99	25.00	24.99	0.014	0.014	0.014	0.014	< 1us	< 1us	0.001	< 1us
<input checked="" type="checkbox"/>	5	3313	78 584 714	78 584 714	81 256 594 276	0	0.000	200.01	200.00	200.01	200.01	0.014	0.014	0.014	0.014	< 1us	< 1us	0.003	< 1us
<input checked="" type="checkbox"/>	6	3313	1 104 397 060	1 104 397 057	143 571 617 410	3	0.000	400.02	400.00	400.05	400.02	0.014	0.014	0.014	0.014	< 1us	< 1us	0.004	< 1us
<input checked="" type="checkbox"/>	7	3313	8 871 414	8 871 413	12 242 549 940	1	0.000	29.98	29.98	29.99	29.99	0.014	0.014	0.014	0.014	< 1us	< 1us	0.001	< 1us
<input checked="" type="checkbox"/>	8	3313	3 169 529	3 169 529	3 245 597 696	0	0.000	7.99	7.98	7.99	7.99	0.014	0.014	0.014	0.014	< 1us	< 1us	0.001	< 1us
<input checked="" type="checkbox"/>	9	3313	93 415 332	93 415 332	47 828 649 984	0	0.000	120.00	120.00	120.01	120.01	0.014	0.014	0.014	0.014	< 1us	< 1us	0.004	< 1us
<input checked="" type="checkbox"/>	10	3313	131 776 436	131 776 436	26 355 287 200	0	0.000	70.01	70.00	70.01	70.00	0.014	0.014	0.014	0.014	< 1us	< 1us	0.007	< 1us
<input checked="" type="checkbox"/>	11	3313	46 934 353	46 934 353	6 101 465 890	0	0.000	17.00	17.00	17.00	17.00	0.014	0.014	0.014	0.014	< 1us	< 1us	0.003	< 1us
<input checked="" type="checkbox"/>	12	3313	27 606 761	27 606 761	3 588 878 930	0	0.000	10.00	10.00	10.00	10.00	0.014	0.014	0.014	0.014	< 1us	< 1us	0.001	< 1us

## Horizontal View of Stream Results

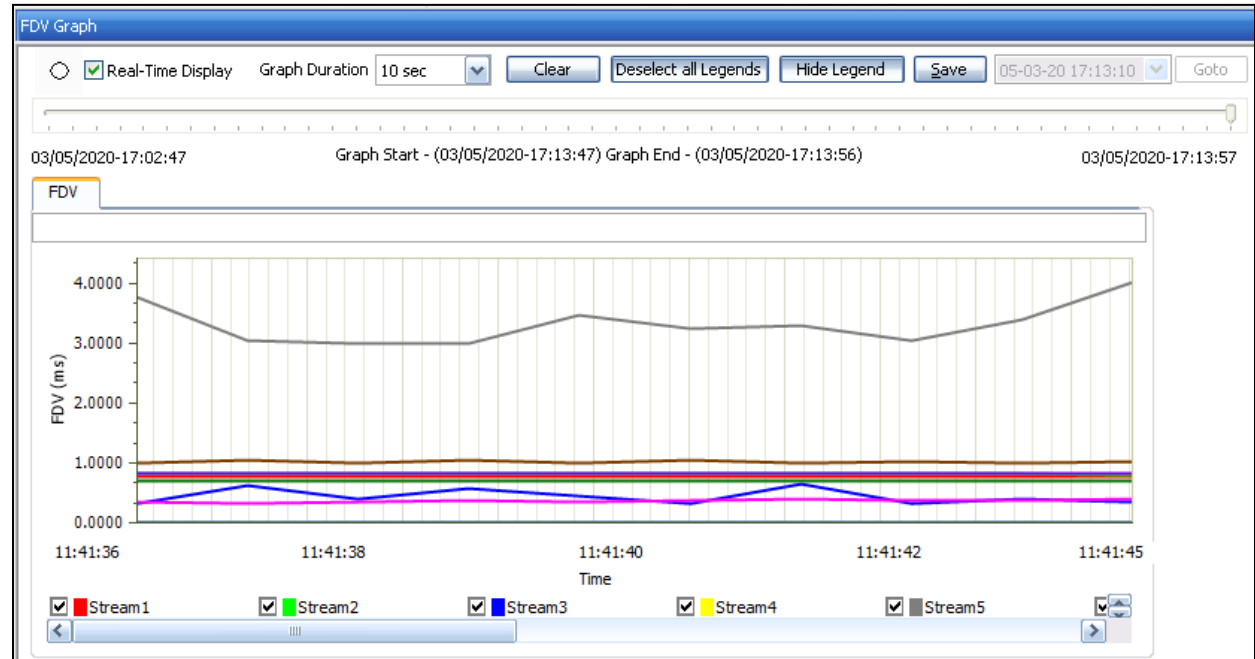
Multi-Stream Traffic Generator & Analyzer Results													
IR(Mbps), FLR(%), FTD(msec), FDV(msec)		Test Time 00:55:56		Horizontal		FTD Unit msec		FDV Unit msec		Activate All		DeActivate All	
Stream No.	1	2	3	4	5	6	7	8	9	10	11	12	
Stream Sele...	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	
Seconds	3358	3358	3358	3358	3358	3358	3358	3358	3358	3358	3358	3358	
TxFrames	6 727 375	7 886 554	29 981 322	7 493 261	79 652 119	1 119 397 920	8 991 913	3 212 581	94 684 179	133 566 336	47 571 855	27 981 740	
RxFrames	6 727 375	7 886 554	29 981 322	7 493 261	79 652 118	1 119 397 916	8 991 913	3 212 581	94 684 179	133 566 335	47 571 855	27 981 740	
RxBytes	4 060 138 370	4 037 915 648	41 374 224 360	10 340 700 180	82 360 290 012	145 521 729...	12 408 839 940	3 289 682 944	48 478 299 648	26 713 267 000	6 184 341 150	3 637 626 200	
FL Count	0	0	0	0	1	4	0	0	0	1	0	0	
FLR	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	
IR (Curr)	9.99	10.00	99.99	25.00	200.01	400.02	29.99	7.99	120.01	70.00	17.00	10.00	
IR (Min)	9.98	9.99	99.99	24.99	200.00	400.00	29.98	7.98	120.00	70.00	17.00	10.00	
IR (Max)	10.00	10.00	100.01	25.00	200.01	400.05	29.99	7.99	120.01	70.01	17.00	10.00	
IR (Avg)	9.99	10.00	100.00	24.99	200.01	400.02	29.99	7.99	120.01	70.00	17.00	10.00	
FTD (Curr)	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	
FTD (Min)	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	
FTD (Max)	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	
FTD (Avg)	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	0.014	
FDV (Curr)	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	
FDV (Min)	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	
FDV (Max)	0.010	0.001	0.001	0.001	0.003	0.004	0.001	0.001	0.004	0.007	0.003	0.001	
FDV (Avg)	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	< 1us	

# Stream-wise Graphs

## Throughput (IR) Graph: Information Rate (Mbps) Vs Time (Sec)

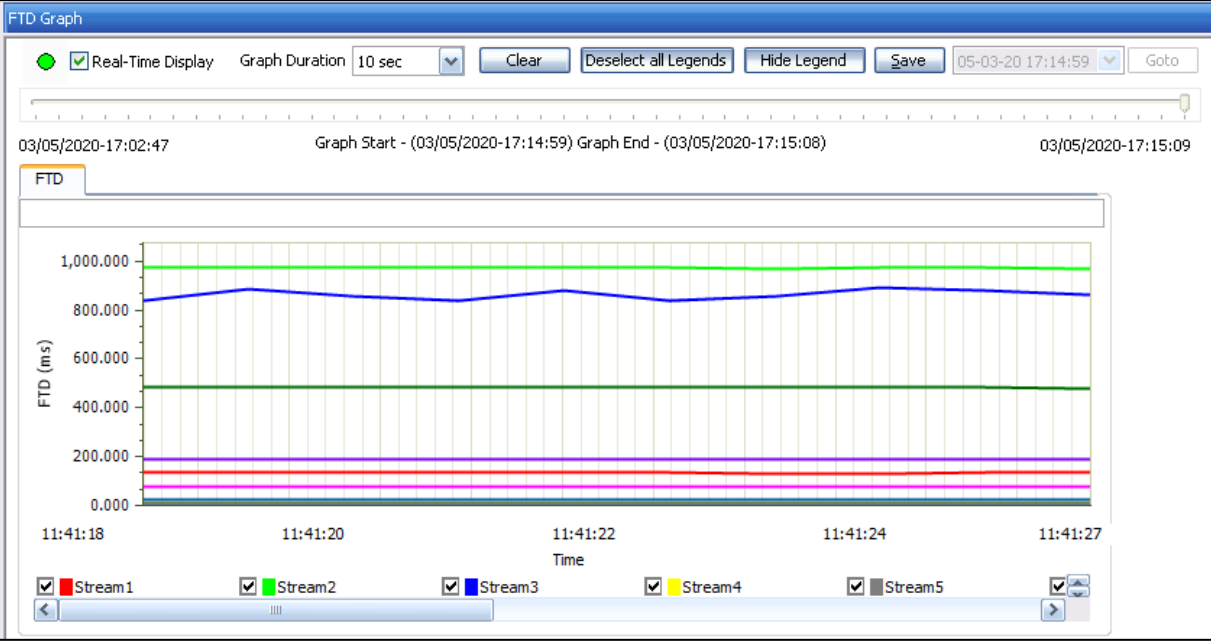


## FDV Graph: Frame Delay Variation (Msec) against Time (Sec)

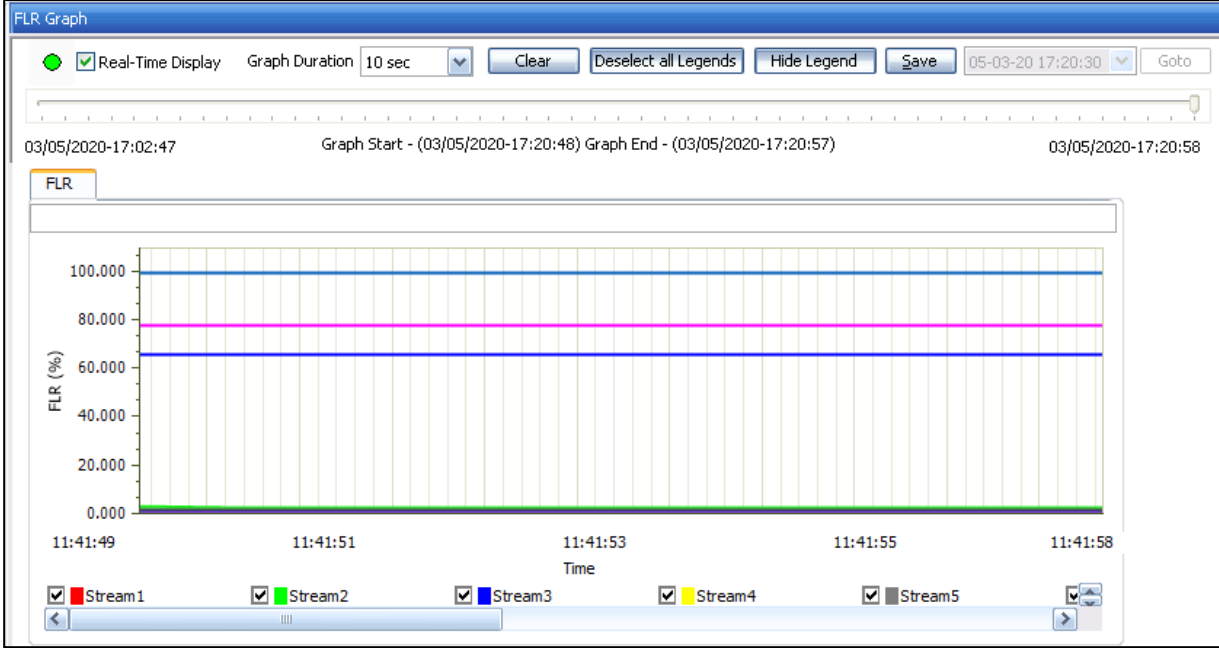


# Stream-wise Graphs (Contd.)

### FTD Graph: Frame Transfer Delay (Msec) against Time



### FLR Graph: Frame Loss Ratio (%) against Time (Sec)



Thank you