TOW2023 Operational Data Transport in the IVS (part 1)

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Outline – Part 1

- Overview of data transport
- Networks
  - Topology
  - Performance
  - Network stack and protocols
  - Software tools
  - Operational data transport procedure – e-Transfer

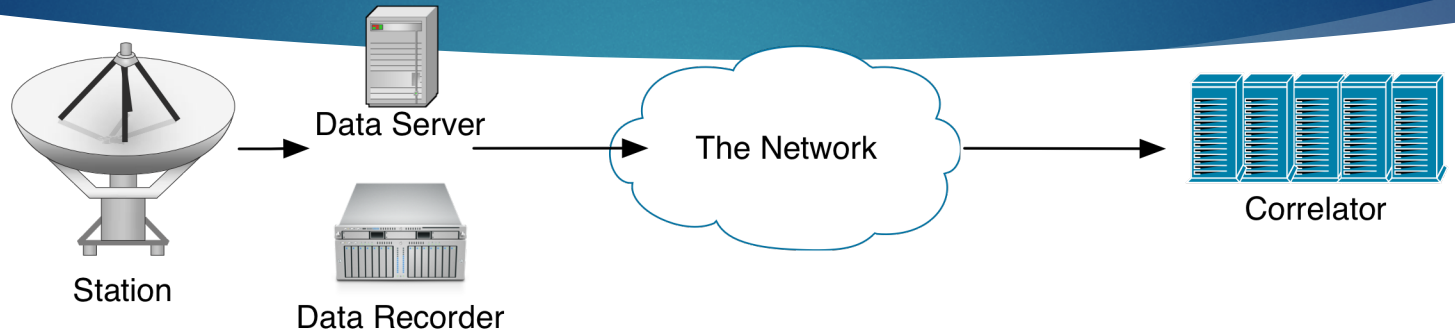
Overview

With IVS operations how do we get the data from our stations to the Correlators for processing?

Overview – Shipping Data

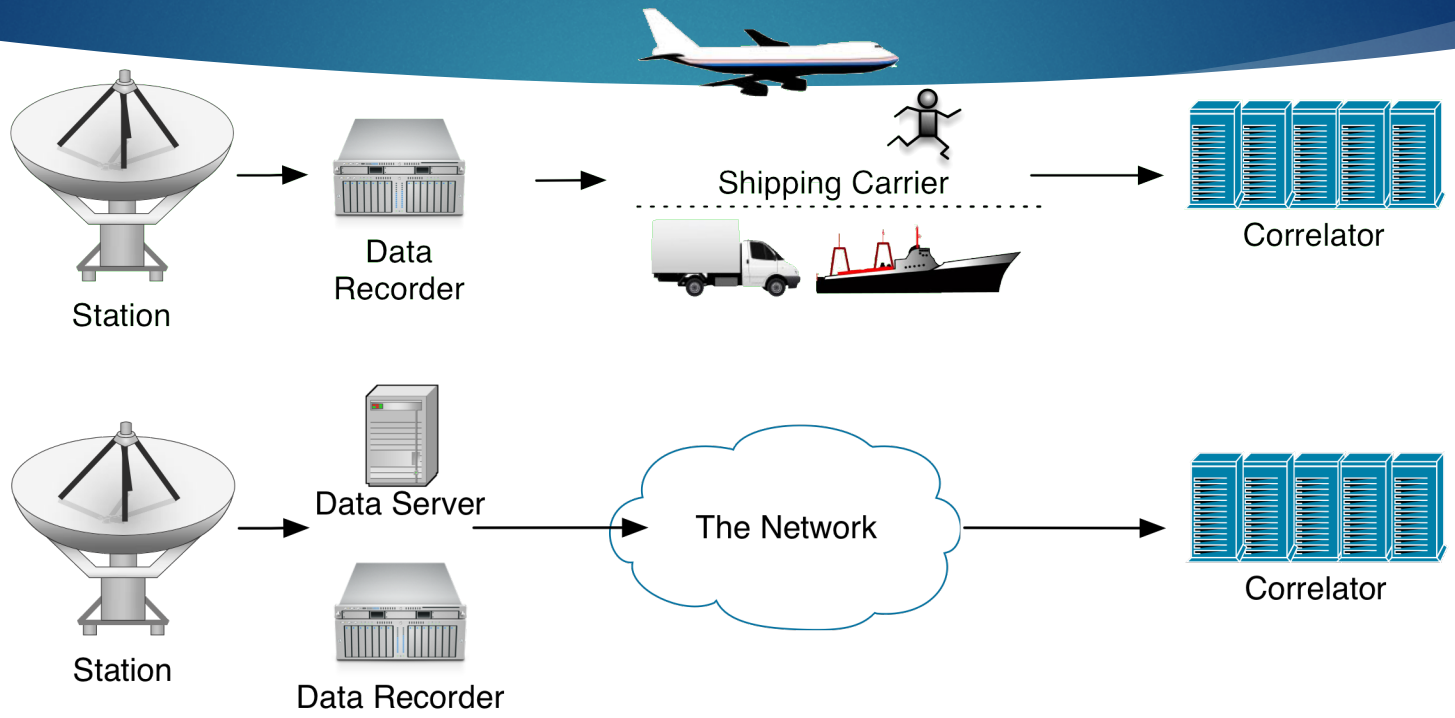
- Data recorded to Data Recorder unit
- Modules are pulled from the recorder and brought to shipping
- Shipments can take days/weeks to arrive
- Correlator centers then process the modules

Overview – e-Transfer data

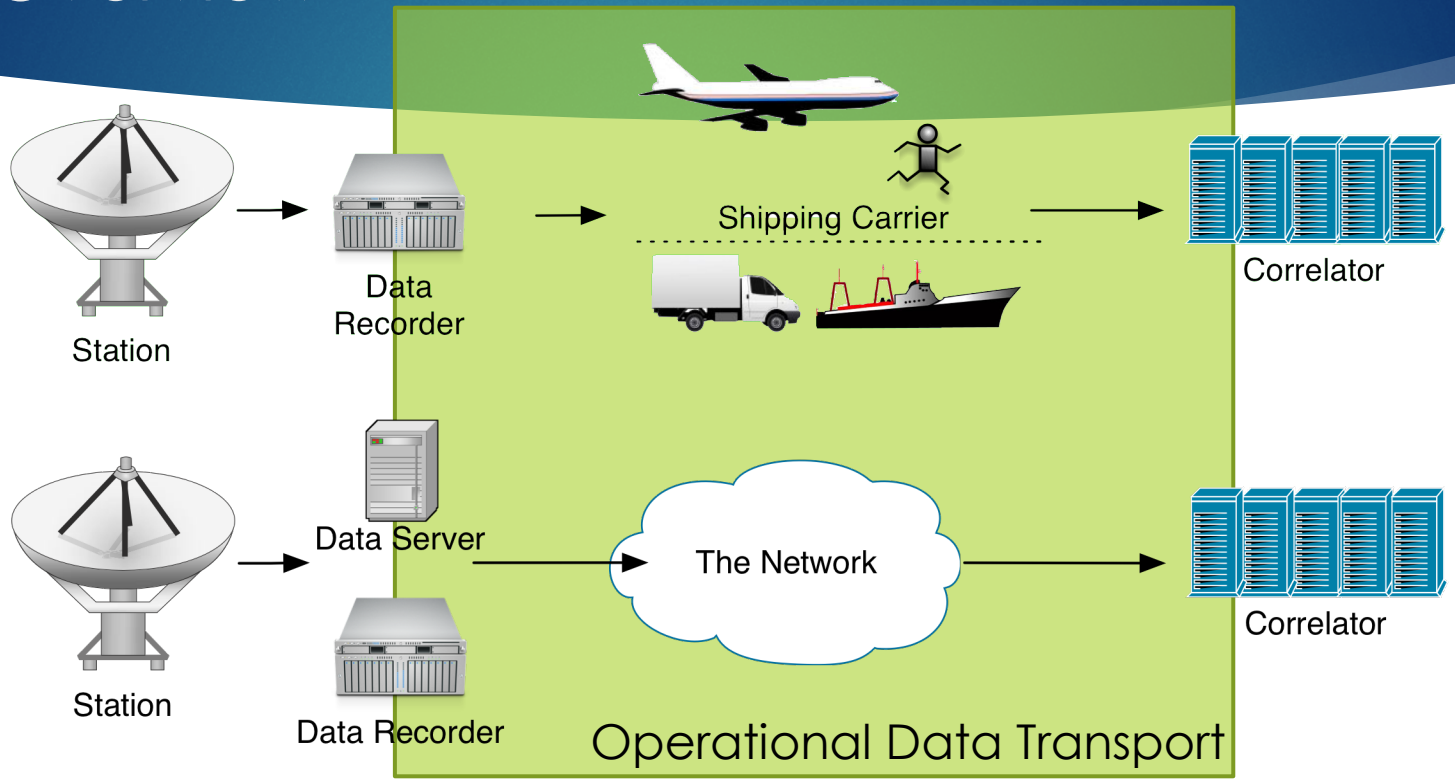


- Data recorded to Data recording unit
- The data on the recorder or server are prepared for network transfers
- Transfer of data is initiated and sent to Correlator data servers over the network
  - Transfer rates will vary (discussed later on)
- Correlator centers then process the files

Overview


Station
Data Recorder
Shipping Carrier
Correlator
Station
Data Server
Data Recorder
The Network
Correlator

Overview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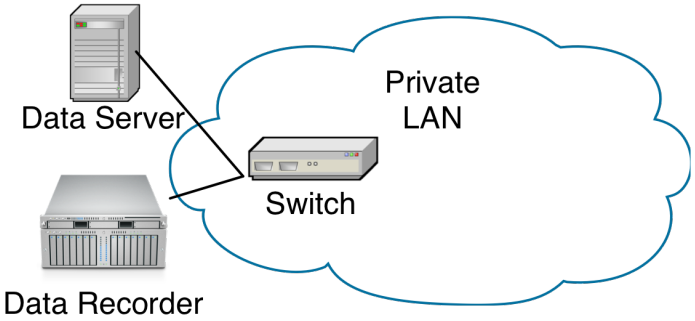
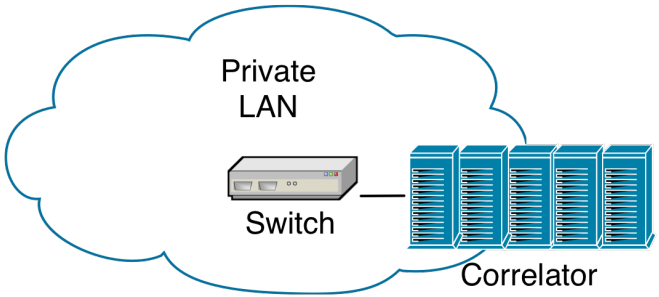
Correlator
Data Recorder
Operational Data Transport

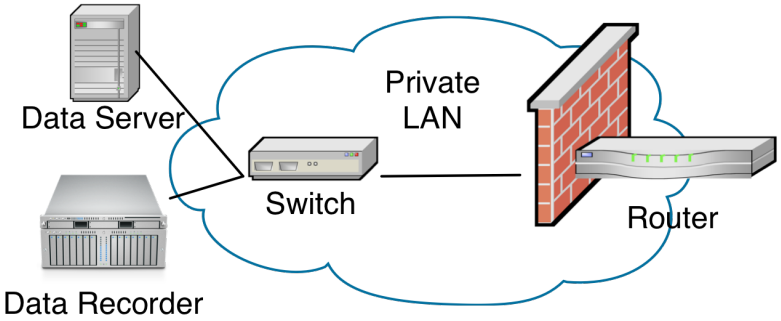
Networks

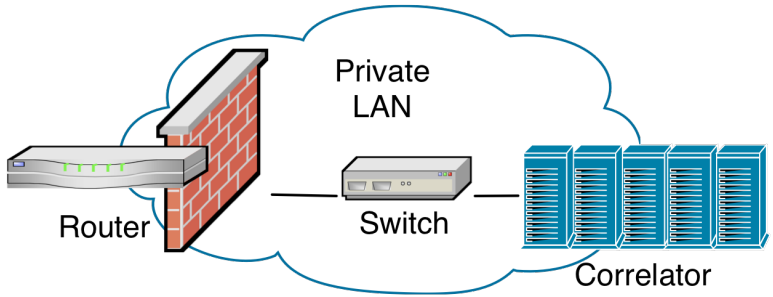
Network Topology



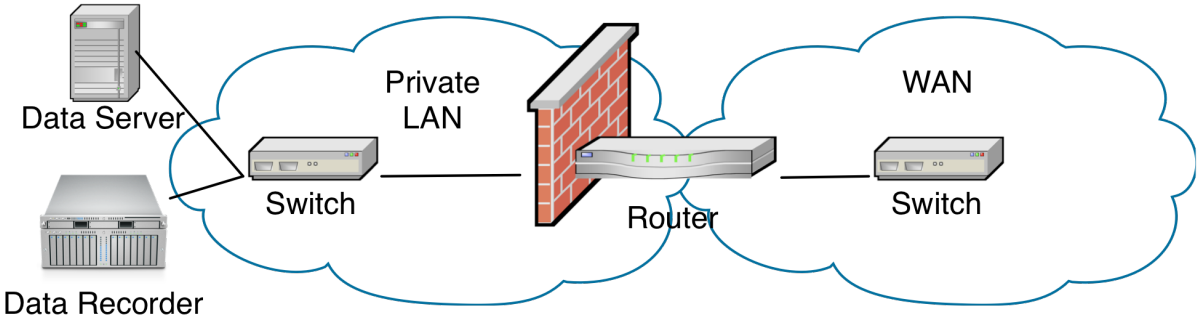


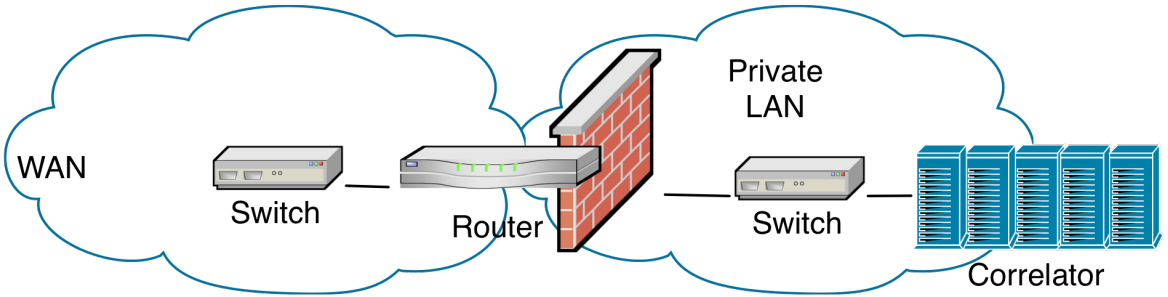
Local network



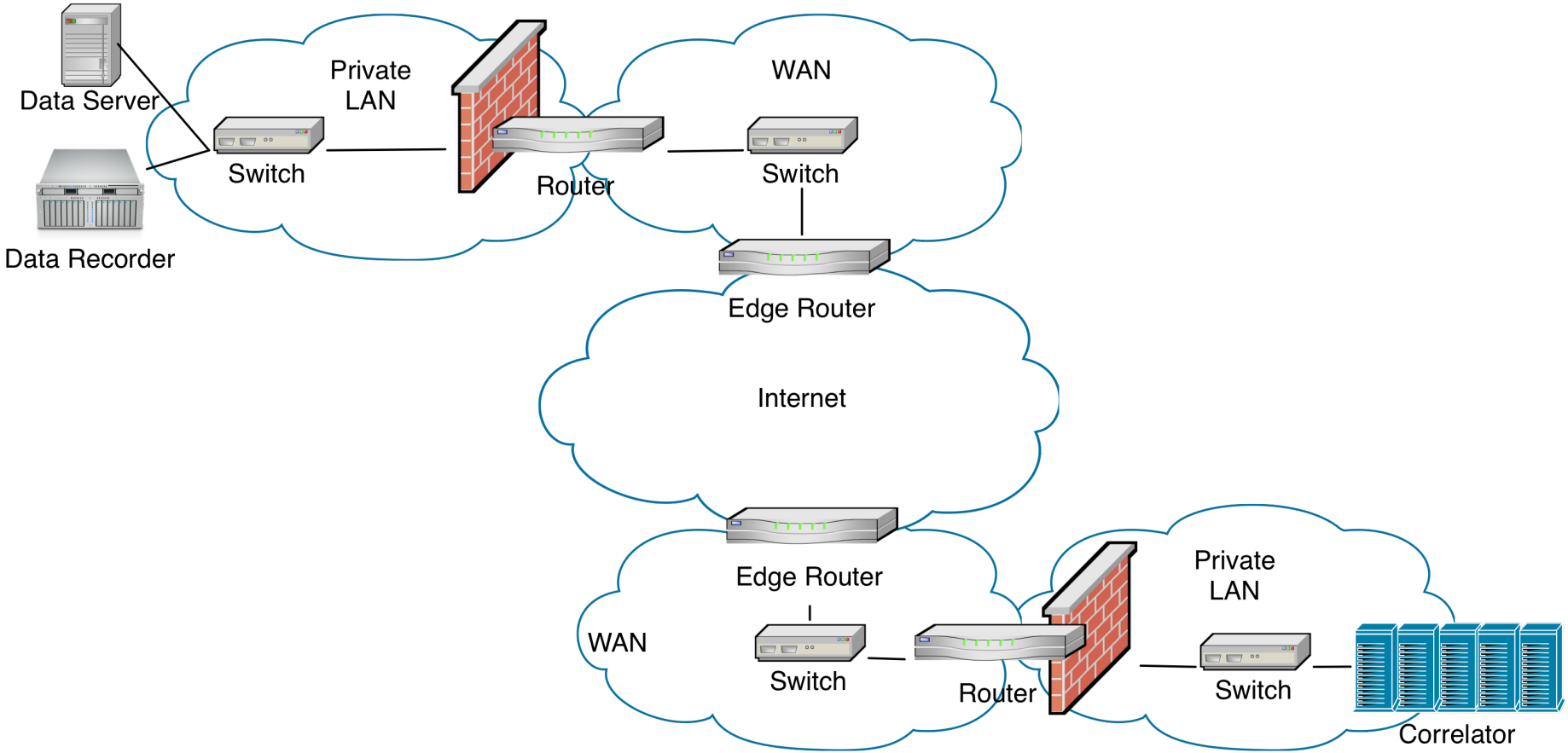


Local router and firewall

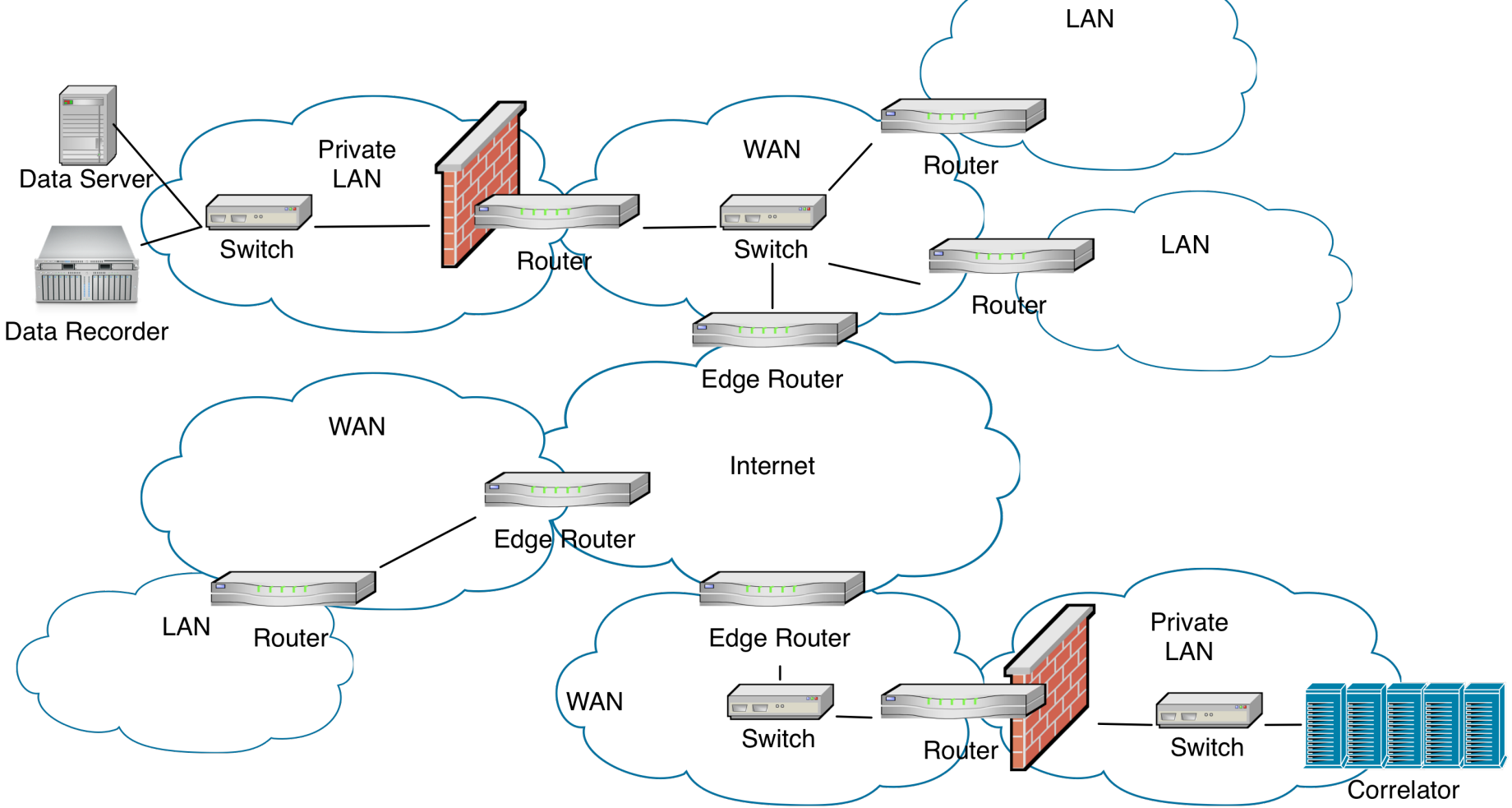




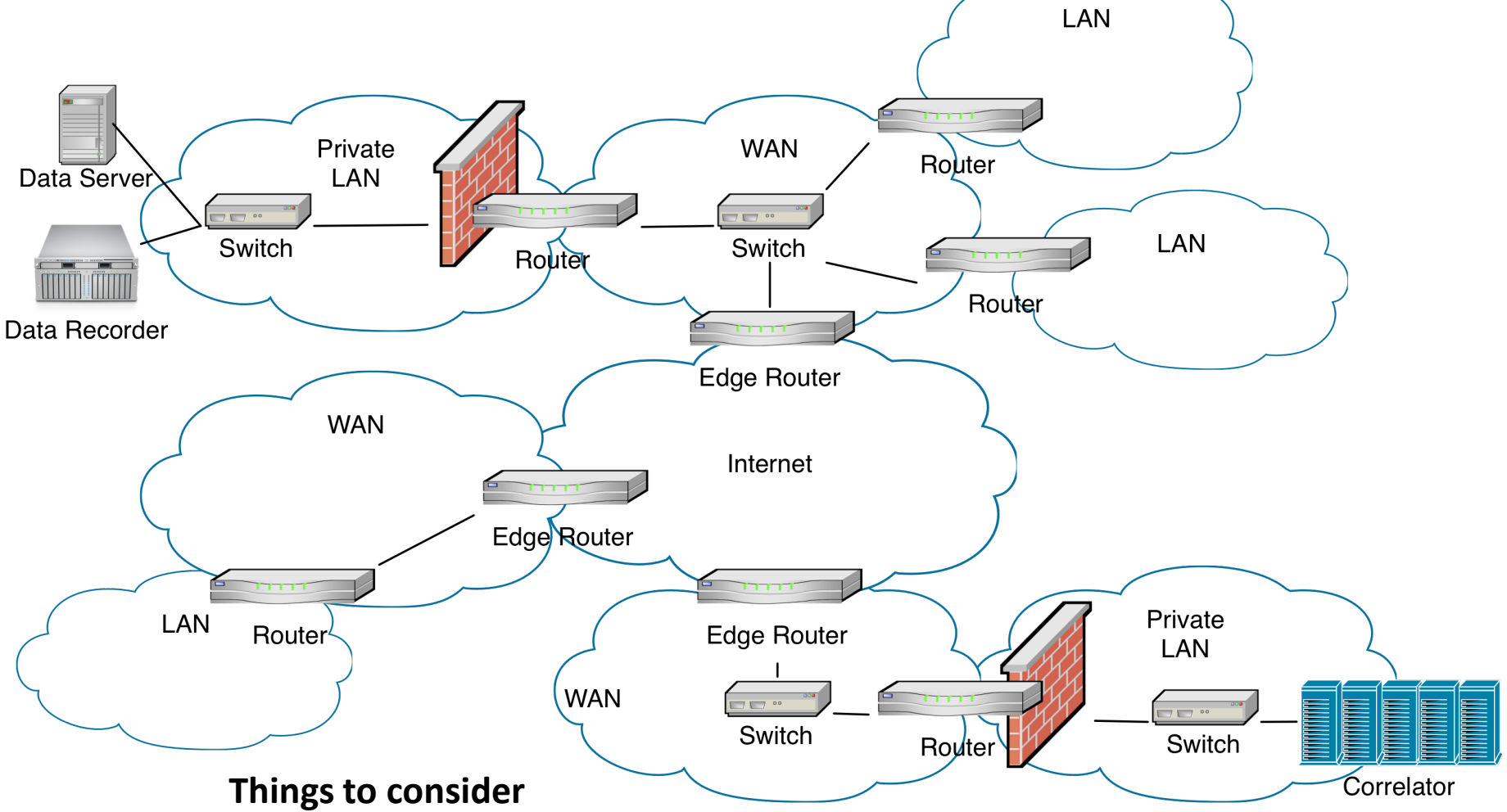
Uplink to edge network



Edge network to Internet backbone



Everyone Else!



Things to consider

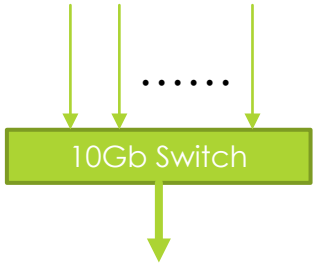
- Resource availability and bottlenecks!

Networks

Resource availability and bottlenecks

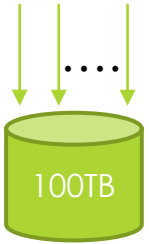
- Networks are a shared resource, using more than available will impact performance creating a bottle across the network for everyone using it.
- Correlator data volumes are shared with other stations. We need to be sure there is enough data resources available for your data.

Input streams <= total throughput



10Gbps total throughput

session data size <= data resource available



Total data volume 100TB

Networks

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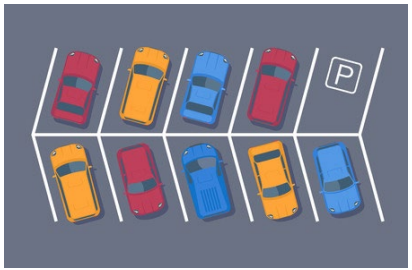
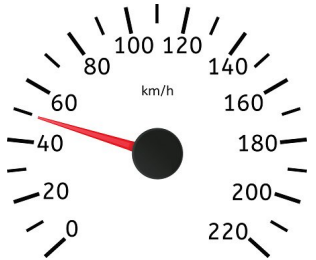


Total data volume 100TB

Network Speed vs Transfer Time

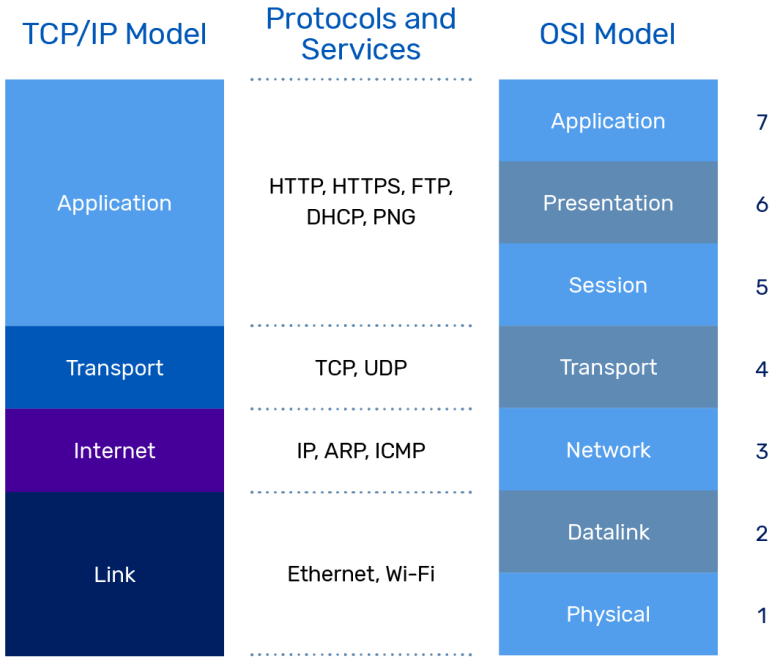
Network Speed	T2/OHIG Session 900GBytes	R1/R4 Session ~2 TeraBytes	RDV/R&D Session ~4 TeraBytes
100Mbps	~20hrs	~45hrs	~55.5hrs
1Gbps	~2hrs	~4.5hrs	~5.5hrs
10Gbps	~12min	~26min	~53min

However network speeds will vary depending on factors of optimization.
(Transport protocol, frame size, routing, etc.)



Network/Protocol Stack

The network/protocol stack is a conceptual model for splitting up the communication over a network into layers.



Network Transport Protocols

TCP – Transmission **C**ontrol **P**rotocol
- Established connection/handshaking
- Data sequenced
- Data retransmission/ Successful delivery
- Slow but complete data transmitted
- Information/File application where all bits matter

UDP – User **D**atagram **P**rotocol
- Connection not needed
- Does not sequence data
- No retransmission of data
- Fast but with risk
- Streaming application where loss is acceptable

UDT – UDP-based **D**ata **T**ransfer Protocol
- Application layer over UDP
- Connection oriented
- Data sequenced
- Data retransmitted
- Faster than TCP and more reliable than UDP alone

Software

Data Transferring Tools

- **Linux utilities**
  - ftp/sftp, rsync, scp, etc.
- **Tsunami transfer software**
  - http://tsunami-udp.sourceforge.net/
- **jive5AB/m5copy**
  - https://github.com/jive-vlbi/jive5ab
- **etransfer server/client system**
  - https://github.com/jive-vlbi/etransfer

Network Testing Tools

- **Linux utilities**
  - ping, traceroute, etc
- **Iperf**
  - https://iperf.fr

Operational Data Transport Procedure – e-Transfer

1. **Data preparation**
2. **Verify Correlator destination on IVS schedule**
   - https://ivscc.gsfc.nasa.gov/sessions/2023/
3. **Verify disk space bandwidth availability**
   - http://www3.mpifr-bonn.mpg.de/cgi-bin/showtransfers.cgi
4. **Update e-transfer active transfers site**
   - Send start message to Transfer folder
5. **Begin data transfers**
6. **Complete data transfers**
   - Send stop message to Transfer folder
7. **WAIT! – Please hold data until Correlator**
8. **Release data after Correlator center releases its report**