# Service Level Agreements for Frame Relay

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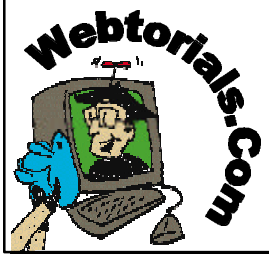
Distributed Networking




## Service Level Agreements For Frame Relay

- Background and Technology
- What to Look For in a Service Level Agreement
- Measuring your SLA

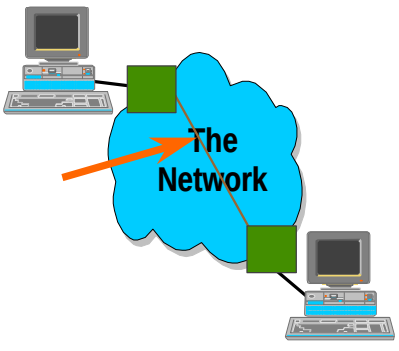
## What is a Service Level Agreement?

- An agreement between the Carrier and the Customer that specifies more precisely what level of service the customer should expect to receive…
- Augments specifications in tariffs
- Two primary functions:
  - Pricing
  - Performance

## Frame Relay Pricing Elements

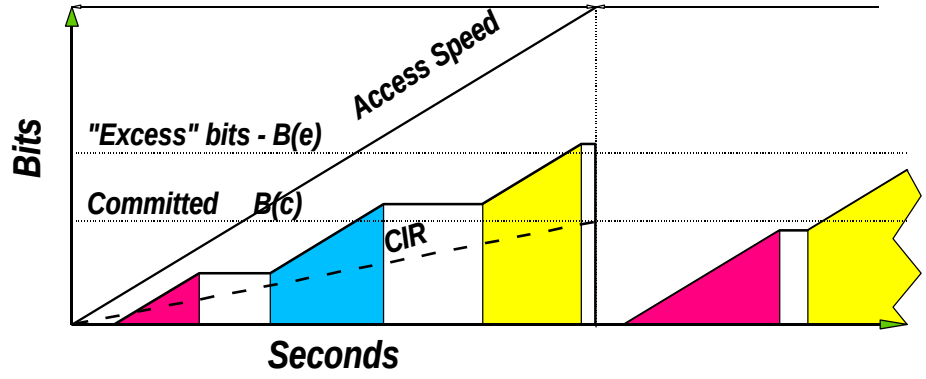
- Access local loops from standard tariffs
- Port Charge based on access speed

➔ **PVC Charge**



## Committed Information Rate

- CIR is designed to guarantee a certain expectation of performance

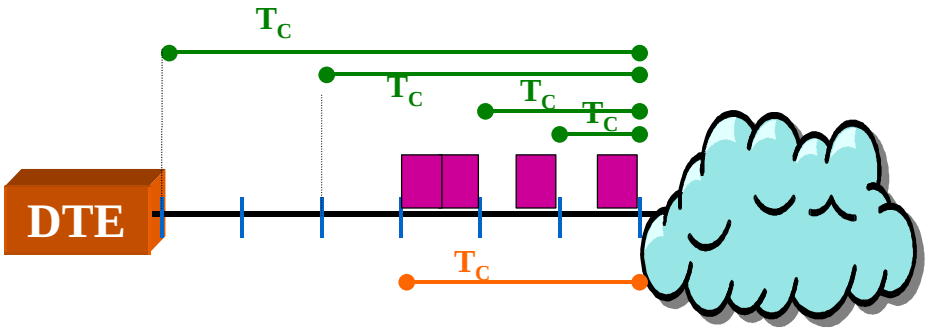



## Computing an Appropriate CIR

- Key parameter is measurement interval for CIR
- Not defined literally in specifications
  - Other than as a $T_C = B_C/(\text{Access Speed})$
  - NOT useful from a practical perspective
- This leaves at least two open issues…
  - Periodicity
  - Synchronization

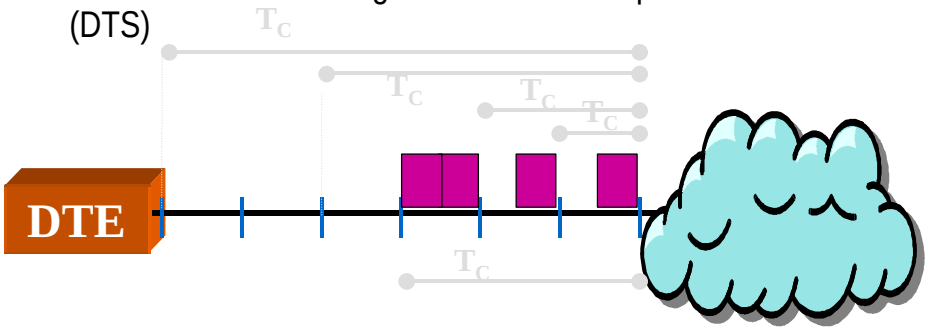
## CIR Measurement Interval: Periodicity

- Assume CIR is 50% of access speed
- Is this example within the CIR?



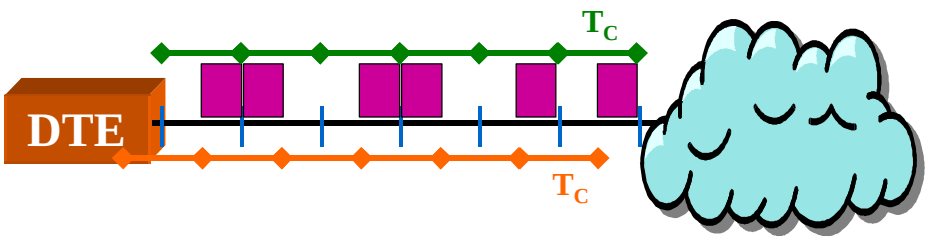

## CIR Measurement Interval: Periodicity

- Usually VERY short due to buffers, etc.
  - Much shorter than periodicity of information
- Should be order of magnitude needed for private line (DTS)



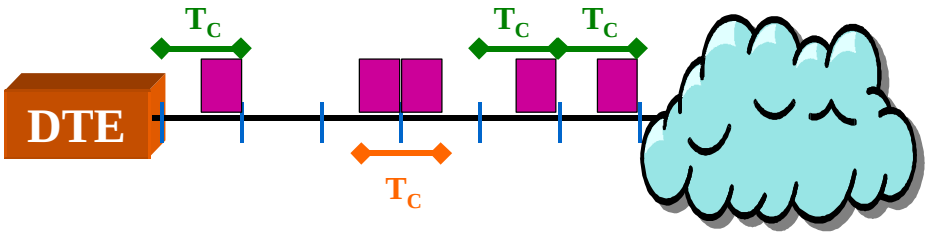
## CIR Measurement Interval: Synchronization

- Question is when to start counting the CIR
- Assuming 50% of access speed, is this in CIR?
  - Problem is no “Sync” to start counting from...




## CIR Measurement Interval: Synchronization

- Question is when to start counting the CIR
- “Asynchronous model” starts from the first bit
  - User loses any unused bandwidth
- Bottom line - 2 models but neither is precise

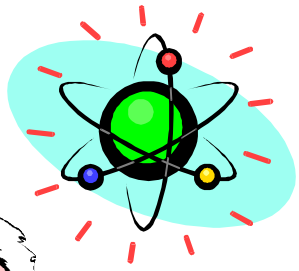


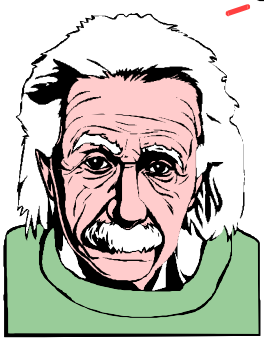
## Bottom Line on CIR...

- Great concept
- Especially for conceptual discussions and relating to a private line environment

## Bottom Line on CIR...

- Falls apart if measured too closely
- Report intervals, especially if measured on a macro level, may show much lower utilization than is needed for performance





## Service Level Agreements For Frame Relay and ATM

- Background and Technology
- ➔ What to Look For in a Service Level Agreement
- Measuring your SLA

## SLAs and SLDs

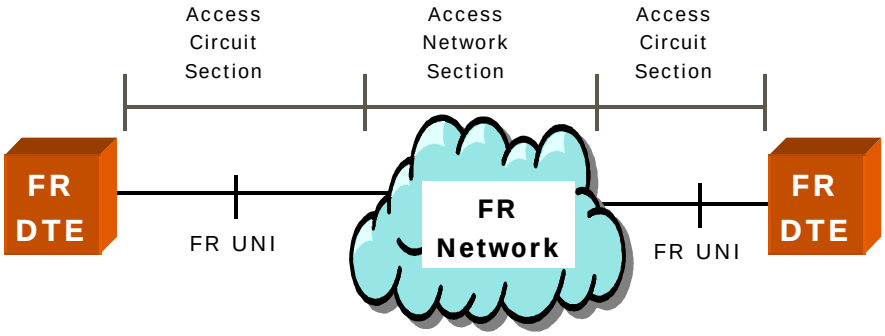
- Frame Relay Forum "Service Level Definition" Implementation Agreement is in "Letter Ballot"
  - Forms a common vocabulary for SLAs
    - Also should help with marketing issues
  - Defines "what to measure" but not "how to measure it"
    - "OA&M" IA is following
  - Ballots due on June 23
    - ***NO predictions of final outcome***, but concepts are worth considering regardless...

## Technical Parameters for your SLA/SLD

- Define Reference Models
- Delay
- Frame Delivery Ratio
- Data Delivery Ratio
- Service Availability
- Plus “business considerations”
  - Mean Time to Respond; Mean Time to Repair, etc.

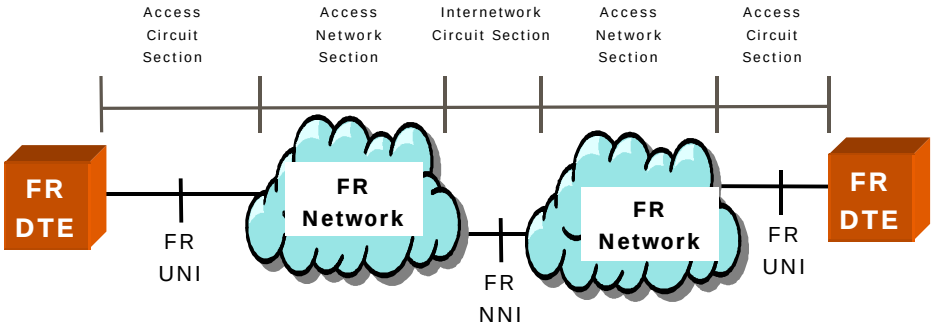
## SLA Reference Models

- Connection Components: Single Public Network



## SLA Reference Models

- Connection Components: Two Public Networks

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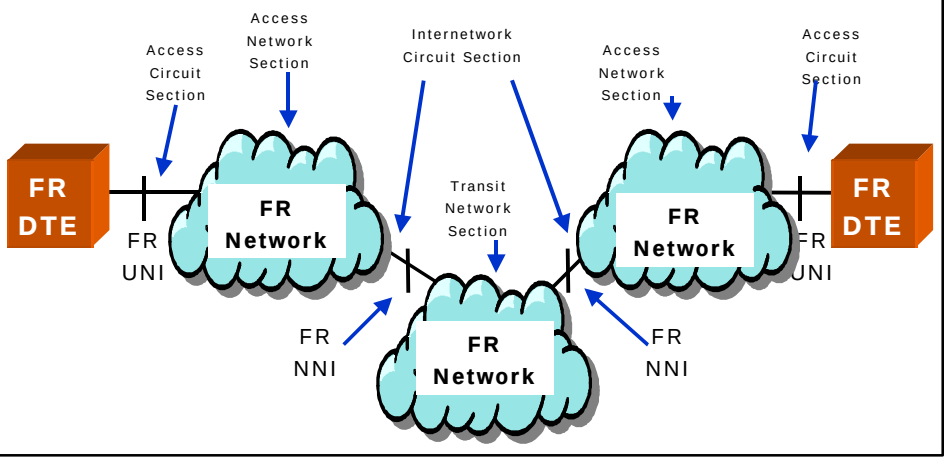
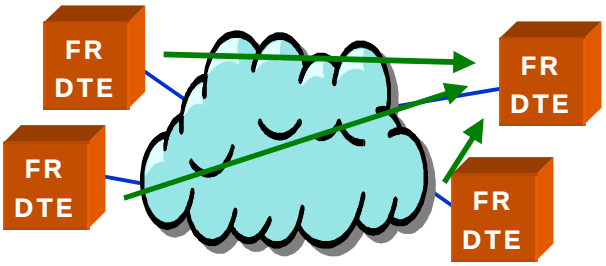


## Egress Queuing & Committed Traffic Oversubscription

- Key to efficiency and cost-effectiveness
- May "violate" CIR agreements
  - But well worth it!

64 kbps links
32 kbps CIR per PVC

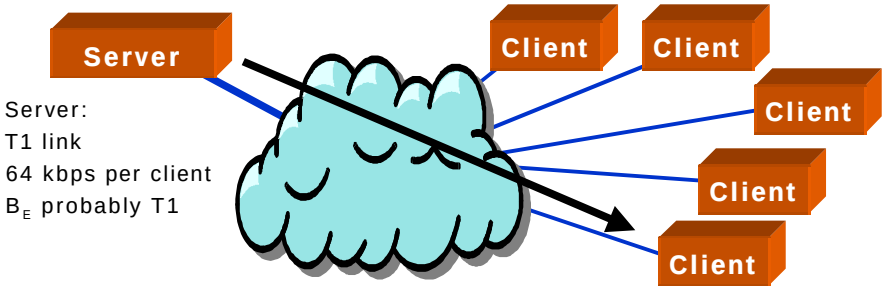



Situation #1: Multiple Connections

## Egress Queuing & Excess Traffic Oversubscription

- Uses speed conversion for better performance
- May cause queuing at egress

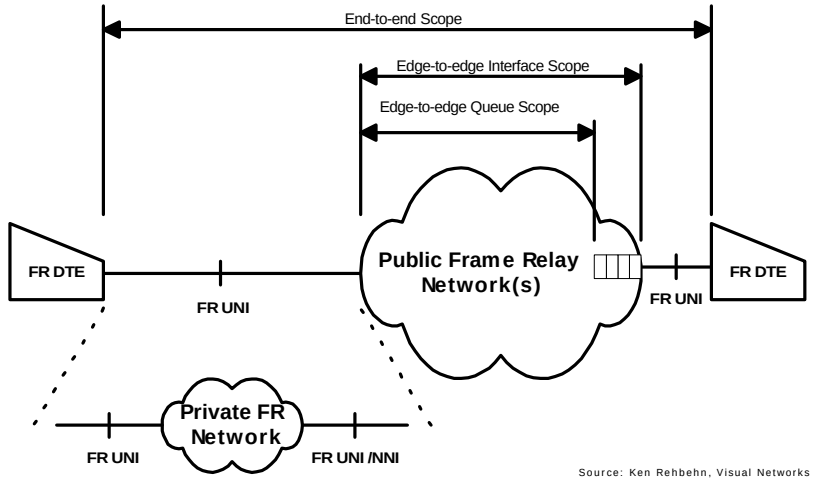
64 kbps links to clients
64 kbps CIR to clients




Server:
T1 link
64 kbps per client
$B_E$ probably T1

Situation #2: Speed Conversion

## Service Level Reference Model




## Delay

- Delay to transport frames through the network
  - default is 128 byte payload
  - Three types: End-to-End, Edge-to-Edge Interface, Edge-to-Egress Queue
- Frame Transfer Delay = $t_2 - t_1$
  - $t_1$ is time (msec) when frame left the source
  - $t_2$ is time when the frame arrives at the destination

## Frame Delivery Ratio

- For all frames:

$$FDR = \frac{(FramesDelivered_c + FramesDelivered_e)}{(FramesOffered_c + FramesOffered_e)}$$

- Where:
  - ***FramesDelivered*$_c$** - Successfully delivered frames in $B_c$
  - ***FramesDelivered*$_e$** - Successfully delivered frames in $B_e$
  - ***FramesOffered*$_c$** - Submitted frame transmissions in $B_c$
  - ***FramesOffered*$_e$** - Submitted frame transmissions in $B_e$

## Frame Delivery Ratio for CIR

- For frames within the CIR:

$$FDR_C = \frac{(FramesDelivered_c)}{(FramesOffered_c)}$$

- Where:
  - ***FramesDelivered*$_c$** - Successfully delivered frames in $B_c$
  - ***FramesOffered*$_c$** - Submitted frame transmissions in $B_c$

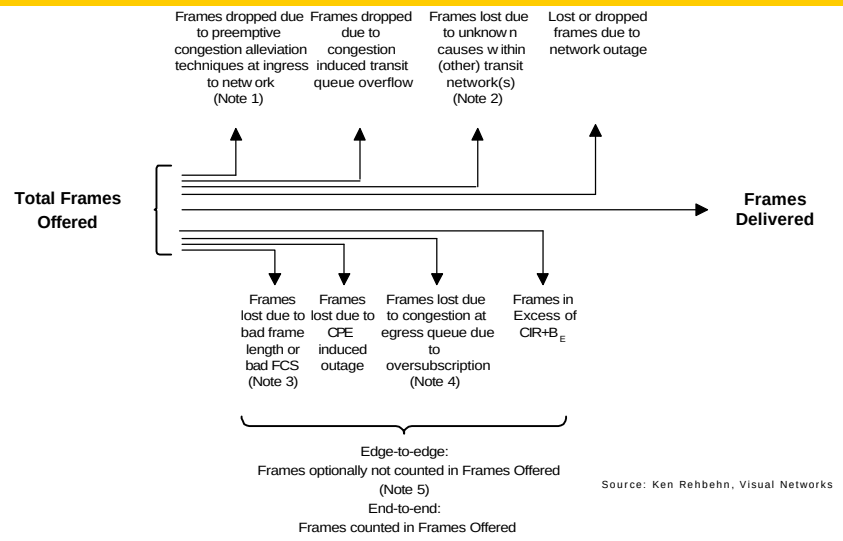
## Frame Delivery Ratio for Excess Frames

- For frames above $B_C$ but within $B_E$:

$$FDR_e = \frac{(FramesDelivered_e)}{(FramesOffered_e)}$$

- Where:
  - ***FramesDelivered*$_e$** - Successfully delivered frames in $B_e$
  - ***FramesOffered*$_e$** - Submitted frame transmissions in $B_e$

## Frame Delivery Adjustments




Source: Ken Rehbehn, Visual Networks

## Data Delivery Ratio

- Similar to FDR, but counts octets rather than frames

$$DDR = \frac{(DataDelivered_c + DataDelivered_e)}{(DataOffered_c + DataOffered_e)}$$

$$DDR_C = \frac{(DataDelivered_c)}{(DataOffered_c)}$$

$$DDR_e = \frac{(DataDelivered_e)}{(DataOffered_e)}$$

## Service Availability

- Operational Readiness, affected by:
  - Fault Outages (network faults)
  - Excluded Outages (scheduled maintenance, etc.)

$$FRVCA = \frac{IntervalTime - ExcludedOutageTime - Outagetime}{IntervalTime - ExcludedOutageTime} * 100$$

- FRVCA: Frame Relay virtual connection availability
- Possible Excluded Outage Examples
  - Scheduled Maintenance; Local loop (Edge-to-Edge vs. End-to-End)

## Availability Definition

- Measurement interval is a key to extended outages
  - Assume 99.5% availability
    - If one month, allows a failure within the month of > 3.5 hours
    - If one day, less than 8 minutes per day
  - Go for the nines!
    - 99.95% allows 22 minutes per month outage
    - 99.995 allows about 2 minutes per month

## Additional Parameters

- FRF-SLD also addresses
  - MTTR - Mean Time To Repair
  - MTBSO - Mean Time Between Service Outages
  - "Suggestions" for aggregation
    - For example, is the reported (and contracted) FDR per site or per PVC?
      - How is it calculated?
    - Be sure to define in your SLA

## You may also address (among other issues)

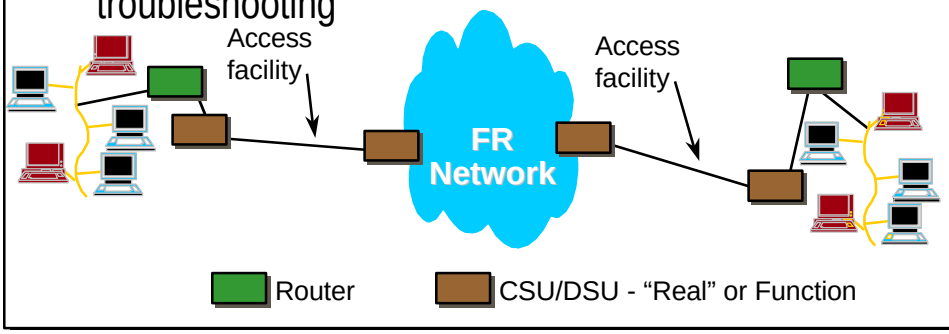
- Trouble escalation procedures
- Performance penalties (beyond credits)
- Mean Time to Respond (vs. Repair)
- Measurement interval for CIR
- Reporting mechanism
  - Web based?
  - Reported interval vs measured interval ($T_C$, etc.)

## Service Level Agreements For Frame Relay and ATM

- Background and Technology
- What to Look For in a Service Level Agreement
- ➔ Measuring your SLA

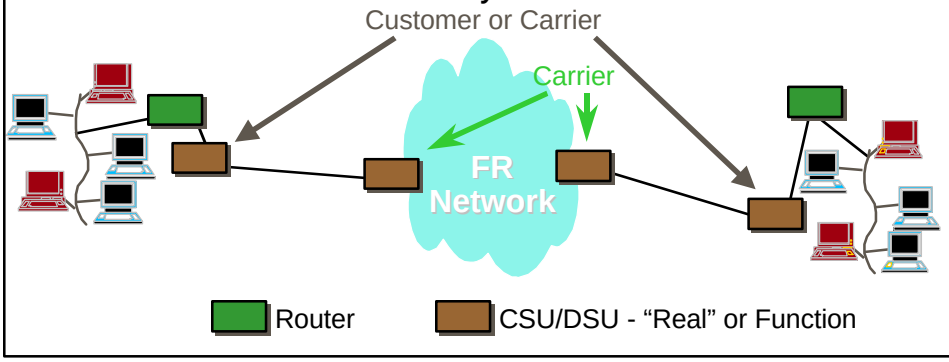
## CSU/DSU-Based Management Tools

- CSU/DSU is the common element in all Frame Relay UNIs (at least to T1/E1 speeds)
- Excellent “demarcation point” for statistics and troubleshooting




## Who owns the CSU/DSU?

- The “Network Side” CSU/DSU is always owned by the carrier
- The “Customer Side” may be CPE or CLE



## Economics

- Assume start with bidirectional 512 kbps PVCs
- Detailed analysis shows real need for 384 kbps for the “heavy” traffic direction & 128 kbps in the other
- Representative* monthly pricing for PVCs drops from $1550 to $800. Lower port speed saves another $160.
- ***Total savings are $11,000 per year on this single PVC.***

***Specific savings may vary...**

## Status of CSU/DSU Management

- Several products are on the market
- Proprietary and standardized statistical output
- Software to “fine tune” CIRs, etc.
- Can pay for itself quickly in reduced costs
- Provides “independent” point of view for troubleshooting
- Can be CPE or CLE as part of a “managed service”

## CDU/DSU Future

- Adds value to an already valuable service
  - Also “keeps the service provider honest”
  - Helps alleviate historical mistrust of carriers
- Can be deployed equally well as CPE or CLE
- Large installed customer base
- Domestic and international markets
  - Internationally and at higher speeds, a “probe” model may be used