

IEN – Another Perspective

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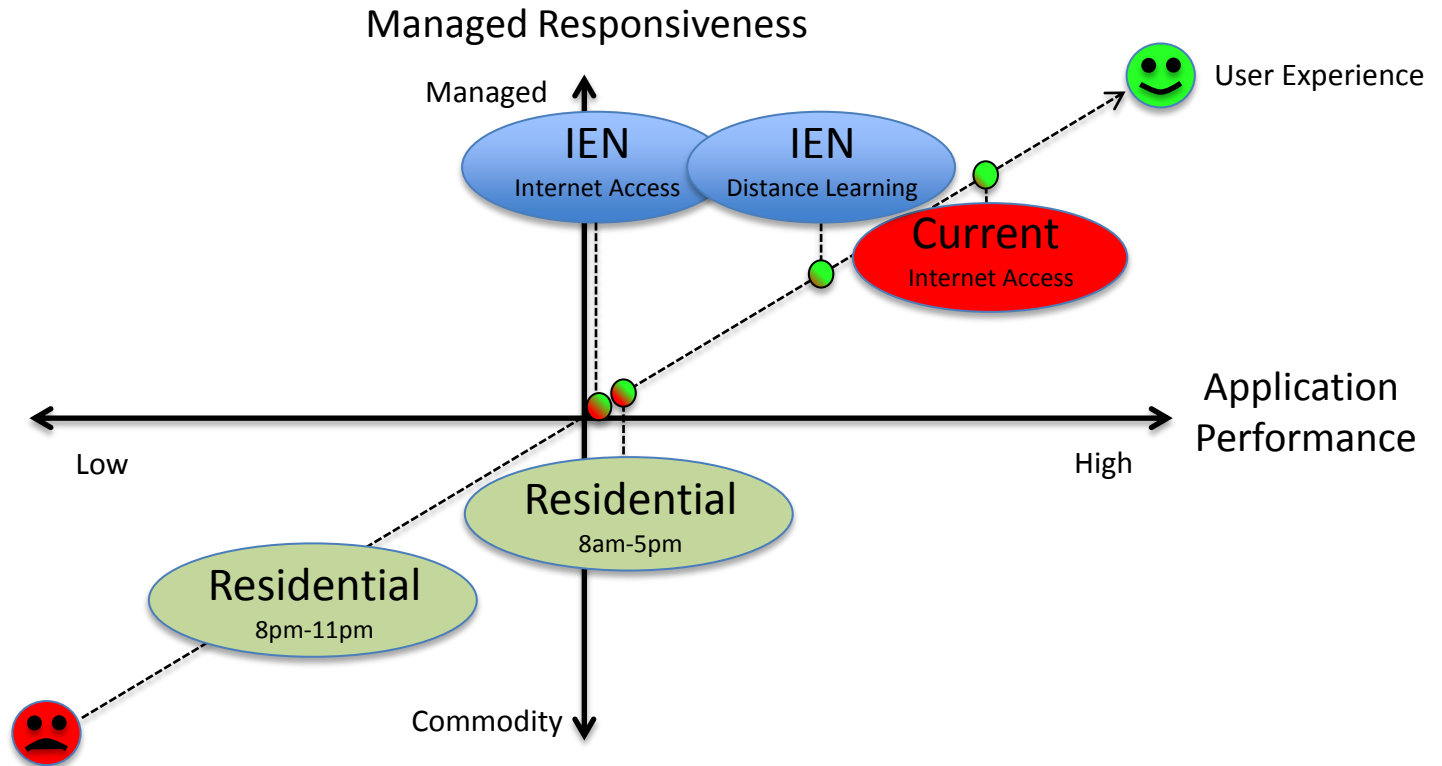
Discussion Points

- Managed Vs. Commodity Internet
- The User Experience
- Can The Current Prices Remain?
- IEN Architecture Lessons Learned

Managed vs. Commodity Internet

- Managed
 - 24x7x365 NOC and Engineering support in house
 - Network grooming against growth
 - Performance monitoring per circuit
 - SLA guarantees - $\geq 99.99\%$ uptime/month or ≤ 4.4 minutes downtime/month
 - Core network maintenance done 1am to 5am with 3 day notice
 - negotiable to 15 days notice
 - This **IS** the internet being sold to the schools that Syringa Networks serves
- Commodity
 - Limited customer service
 - Customer must return device to service center after they find its not working
 - Ratio of Call center and Tech personnel to customers in market is low
 - No scheduled maintenance times or notice

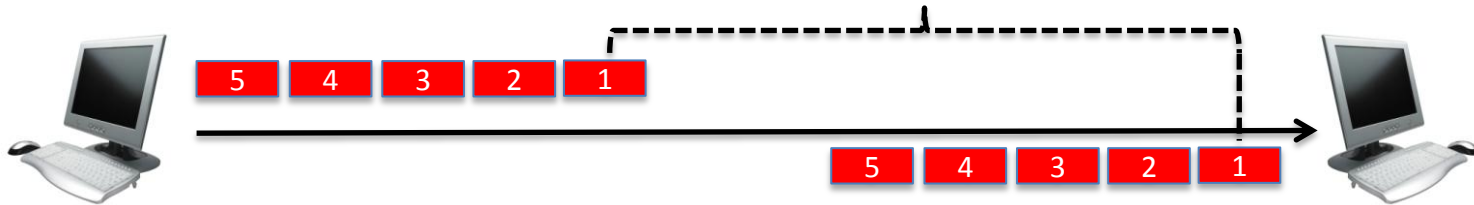
The User Experience



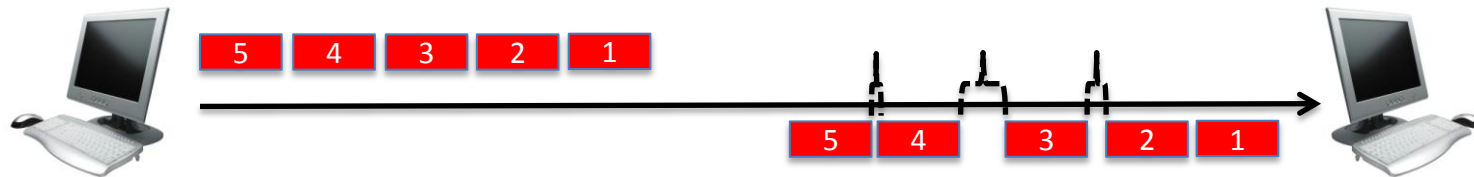
$$\text{User Experience} = f(\text{Managed Responsiveness, Application Performance})$$

Application Performance – The Rest Of The Story

- Network Availability – more is better
 - Network topology, managed responsiveness, redundancy
- Latency – less is better for selected applications



- Jitter – less is better for selected applications



- Bandwidth – more is better generally



Can The Current Prices Remain?

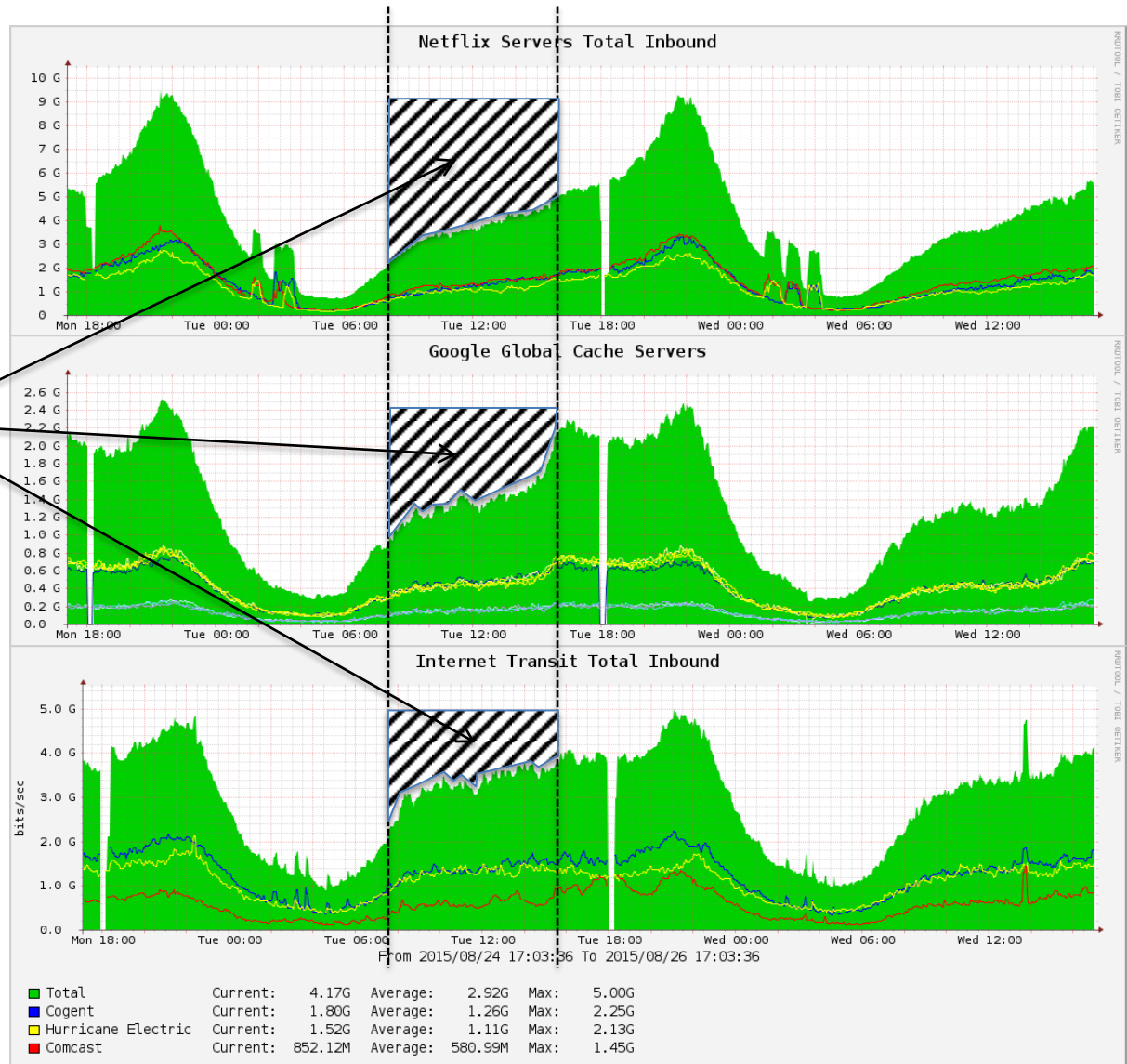
- Yes if;
 - The next IEN architecture is designed to leverage application needs against purchased bandwidth
 - Purchasing decisions do not limit competition
- Yes; because the cost of internet has dropped significantly
 - Peering, pricing, volume have dropped costs dramatically in 5 years
- Yes; because schools often use **excess** Internet bandwidth, making the real cost of their bandwidth marginal

Can The Current Prices Remain?

- Excess Bandwidth
 - Peak internet consumption occurs during the evening hours for many carriers
 - Network operators scale their networks and set oversubscription levels against **peak** usage
 - Therefore, excess capacity (Application Bandwidth) exists during schools hours for many carriers
 - This bandwidth has marginal cost at the network operators Central Office
 - If the excess bandwidth can be delivered locally, it can be at significant savings

Excess Bandwidth

- Vertical dotted lines denote 8am to 4pm school day
- Excess network capacity denoted by marked area
- Regardless of oversubscription, most network operator's infrastructure must be able to deliver the peak usage bandwidth occurring nightly around 10pm



IEN Architecture Lessons Learned

- The original design appeared optimized for Inter-district connections
 - Ex: Rigby student takes a class from a Meridian teacher
 - These are generally called hub and spoke private connections
 - These dedicated connections are bandwidth and distance price sensitive
 - The connections need to be dedicated for the high performance (low latency and low jitter) needs of interactive video
- Intra-district traffic works well if fiber was in place
 - Ex: Wood River High student takes a class from a Silver Creek teacher*
 - No reason for Bandwidth limitations here if the school district has private use fiber
- Original design connections were **too** small for Internet Access
 - Trying to squeeze a 10lb watermelon through a drinking straw
 - They were highly managed but had low application performance making the user experience low
 - This is why schools started purchasing their own Internet outside of IEN

* Blaine County was not part of IEN but has its own intra-district fiber network

Next Generation IEN

- Internet purchasing – School decision
 - Keep decisions local and competitive
 - A lot of bandwidth will be made available at low cost
 - Decide what level of managed service is needed
 - Have Dept. of Admin vet qualified vendors
- Intra-district networks – School / Dept. of Ed decision
 - Lease, or build, dark fiber between schools in district
 - Have Dept. of Admin vet qualified vendors
- Inter-district networking – Dept. of Ed decision
 - Only after bell schedules have been aligned
 - Only after curriculum has been established
 - Purchase high performance connections as needed
 - Have Dept. of Admin vet qualified vendors

Thank You

