

# What is "Bandwidth" and Why Does it Matter?



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# TechBridge TechEd Series

# Welcome!

# Agenda

- Welcome
- Presenters
  - Todd Edlin, UPS
  - Chris Scheels, Cbeyond
- Thank you to our sponsor
- Today's goal and schedule

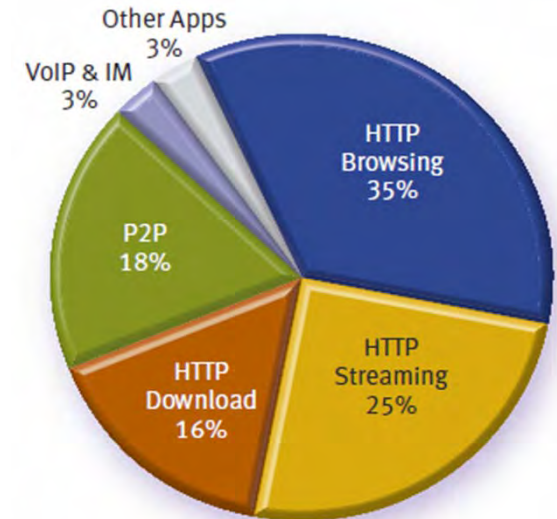
# Overview

- What is Bandwidth?
- How data travels to and from your computer through the internet
- *What factors cause congestion*
- How to troubleshoot issues with your bandwidth
- *How to decide how much bandwidth you need*
- *How Bandwidth is priced and what are the hidden costs*

# What is Bandwidth?



WIKIPEDIA



Source: Allot MobileTrends Report H2, 2009 (Americas)

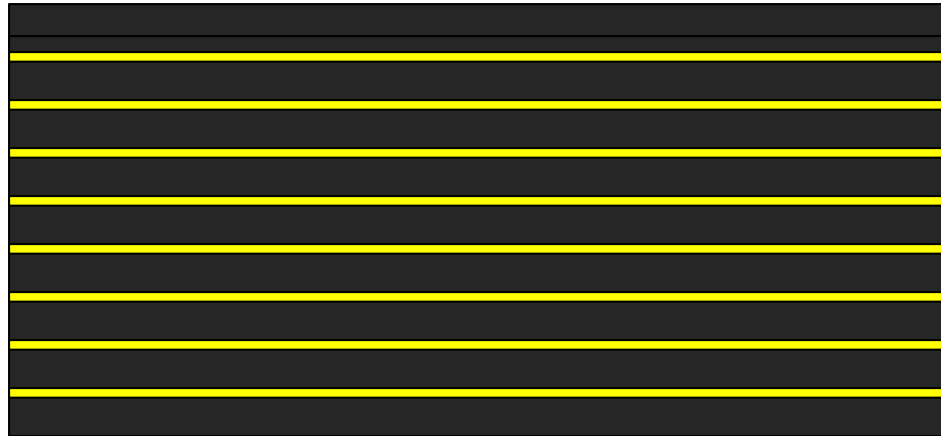
- What does it mean to you?



# Your Highway to the Internet



## Team Blue

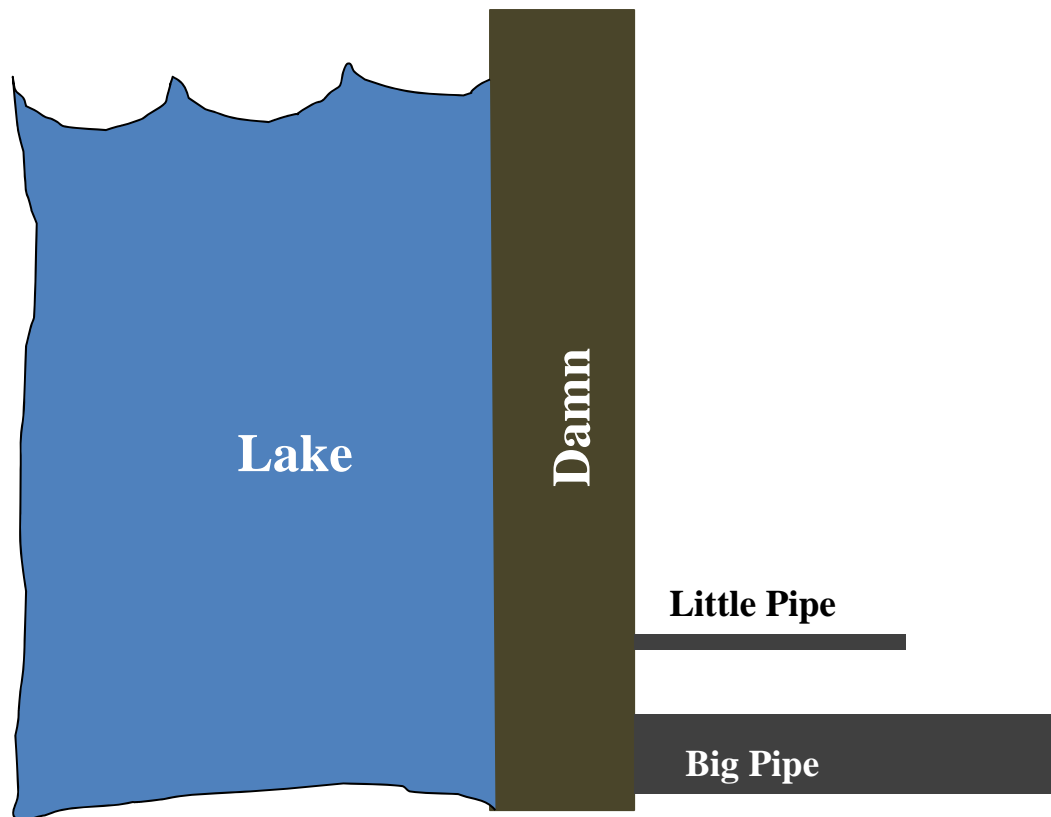


## Team Red



- Which road carries more cars per minute?

# The "Pipe" analogy



- Which size pipe will drain the lake the fastest?



- Your data flows through your bandwidth "pipe"

# How is Bandwidth Measured?

- bits and Bytes (little 'b' and Big 'B')
- 8 bits in a Byte
- A business grade T1 is 1.544 Mbps.
  - What does that mean?

Unit	Equals
8 bits (b)	1 Byte (B)
1024 Bytes	1 Kilobyte (KB)
1024 Kilobytes	1 Megabyte (MB)
1024 Megabytes	1 Gigabyte (GB)
1024 Gigabytes	1 Terabyte (TB)
1024 Terabytes	1 Petabyte (PB)
1024 Petabytes	1 Exabyte (EB)

# More bits and Bytes

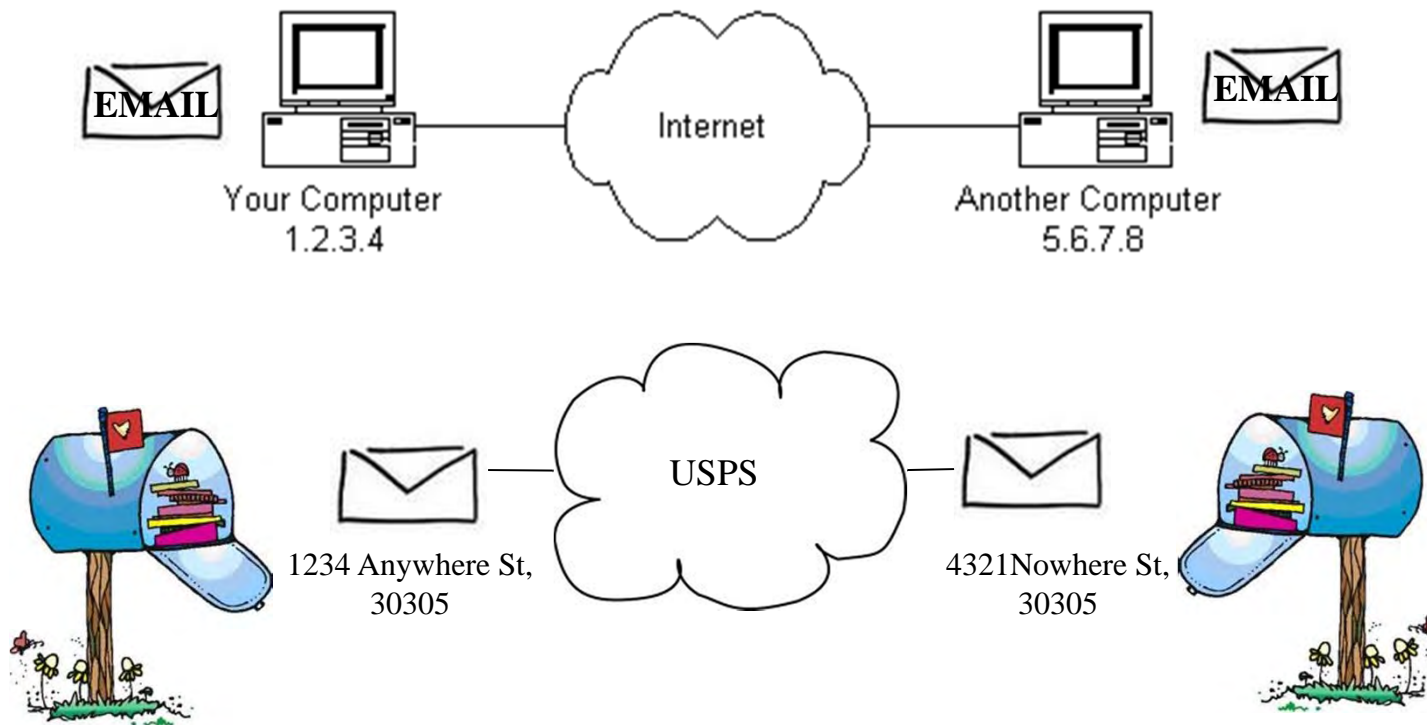
- one kilobit per second (Kbps) equals 1000 bits per second (bps).
- one megabit per second (Mbps) equals 1000 Kbps or one million bps.

Connection Type	bits per second	Bytes (B) per Second	KiloBytes (KB) per second	MegaBytes (MB) per second
T1	1.544 Mbps	193,000 Bps	188 KBps	0.184 MBps

- In theory, how long would it take to download a 800KB Document using the above chart?

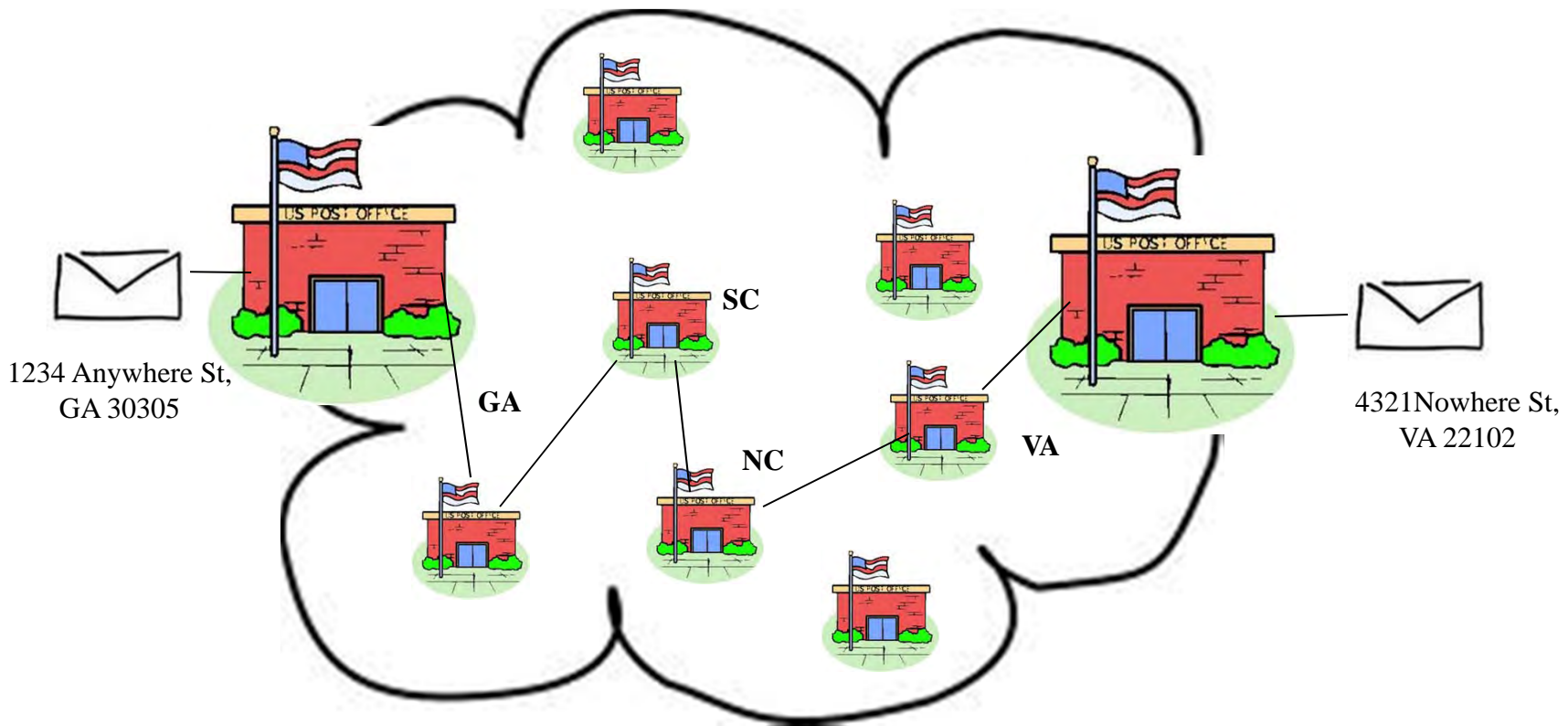
# Data Traveling in Style

- How data travels to and from your computer through the internet.



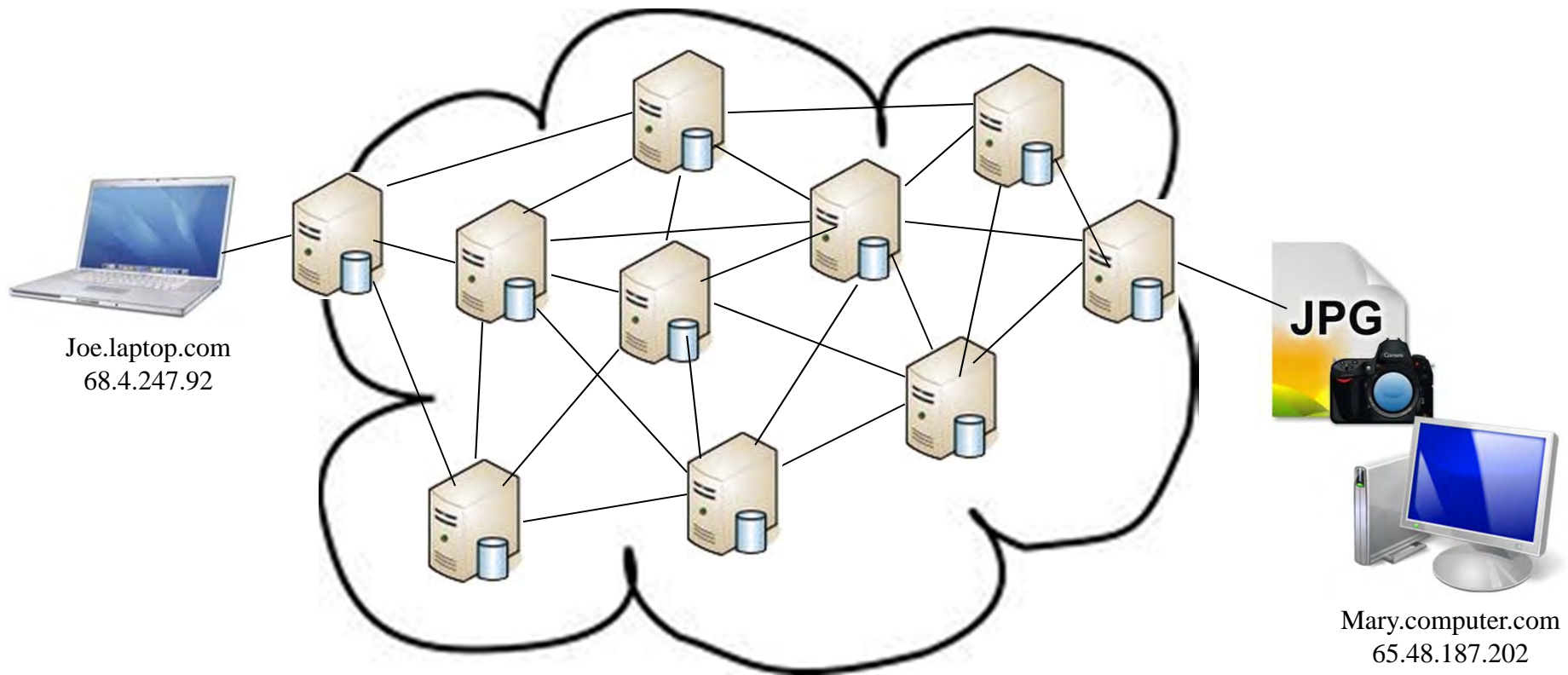
# Before Email & Texting

- How a letter travels to and from your house.



# The Mystery of the Internet Cloud

- How data travels to and from your computer.
  - Joe sends Mary a picture



# What factors cause Congestion?



September 22, 2011

# Congestion Factors

- Insufficient bandwidth
  - Do you really have enough to operate the business functions?

# Congestion Factors

- Applications that use excessive overhead
  - Ask your software provider what the overhead is for the application.
    - Typically recommend XX Kilobytes per user.
    - Ex. 10 users x 8 Kilobytes = 80 Kilobytes
  - Is the application really written to work over a telecommunications line?
    - Ex. Microsoft Access Databases

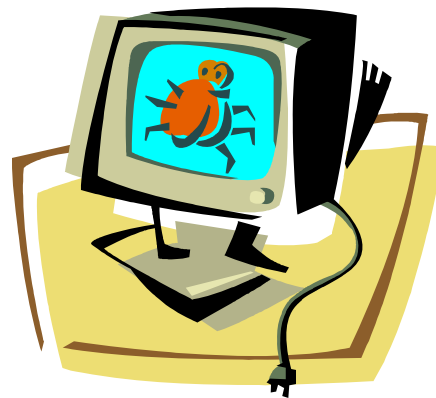
# Congestion Factors

- Office etiquette policies and practices
  - Streaming Video
  - Streaming Audio
- Are you really the only users?
  - Wireless security
    - Ensure your security settings are enabled

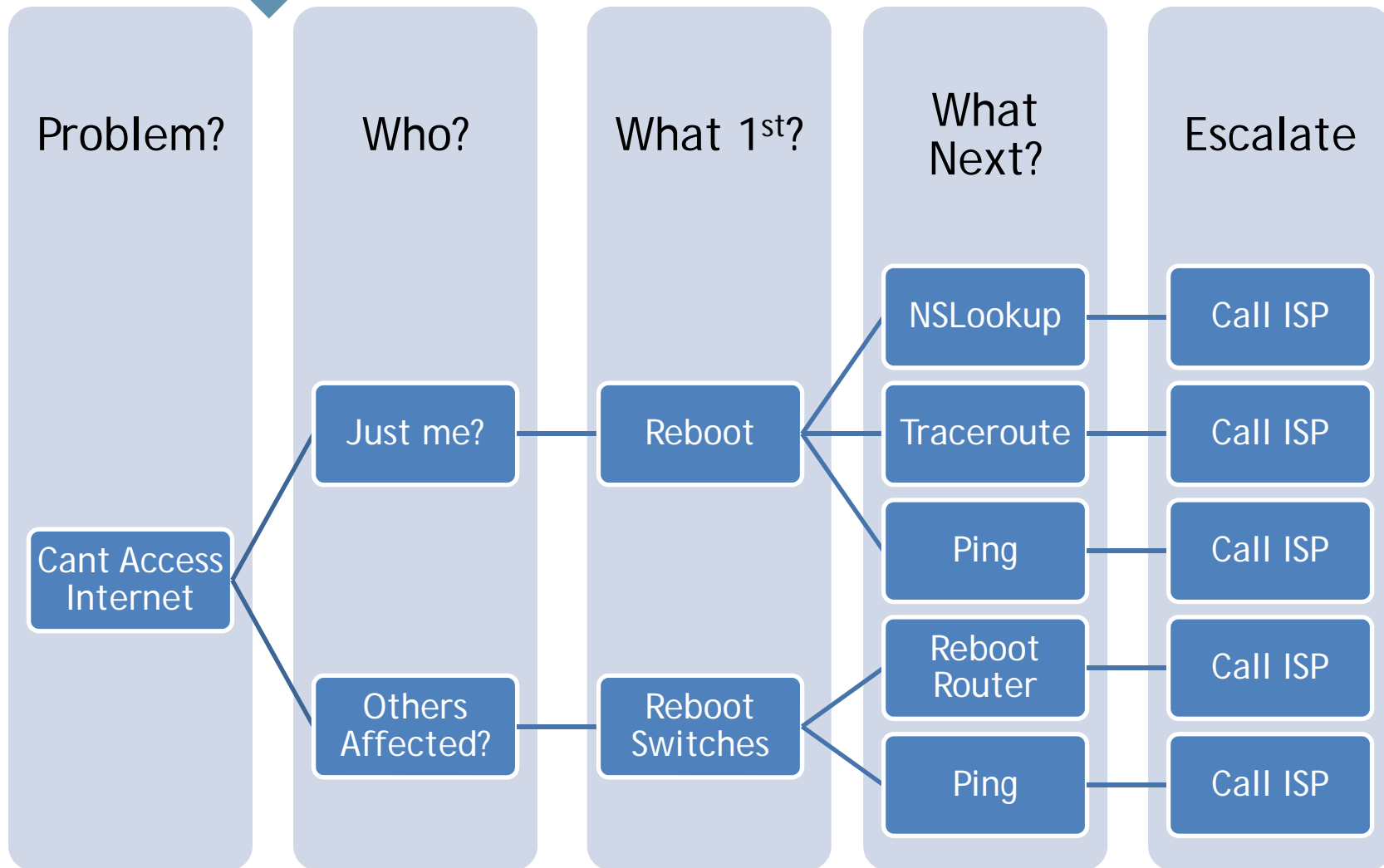


# Congestion Factors

- Bad Computer Network Cards
  - Re-transmission
- Software Distribution / Patching
- Virus Infestation

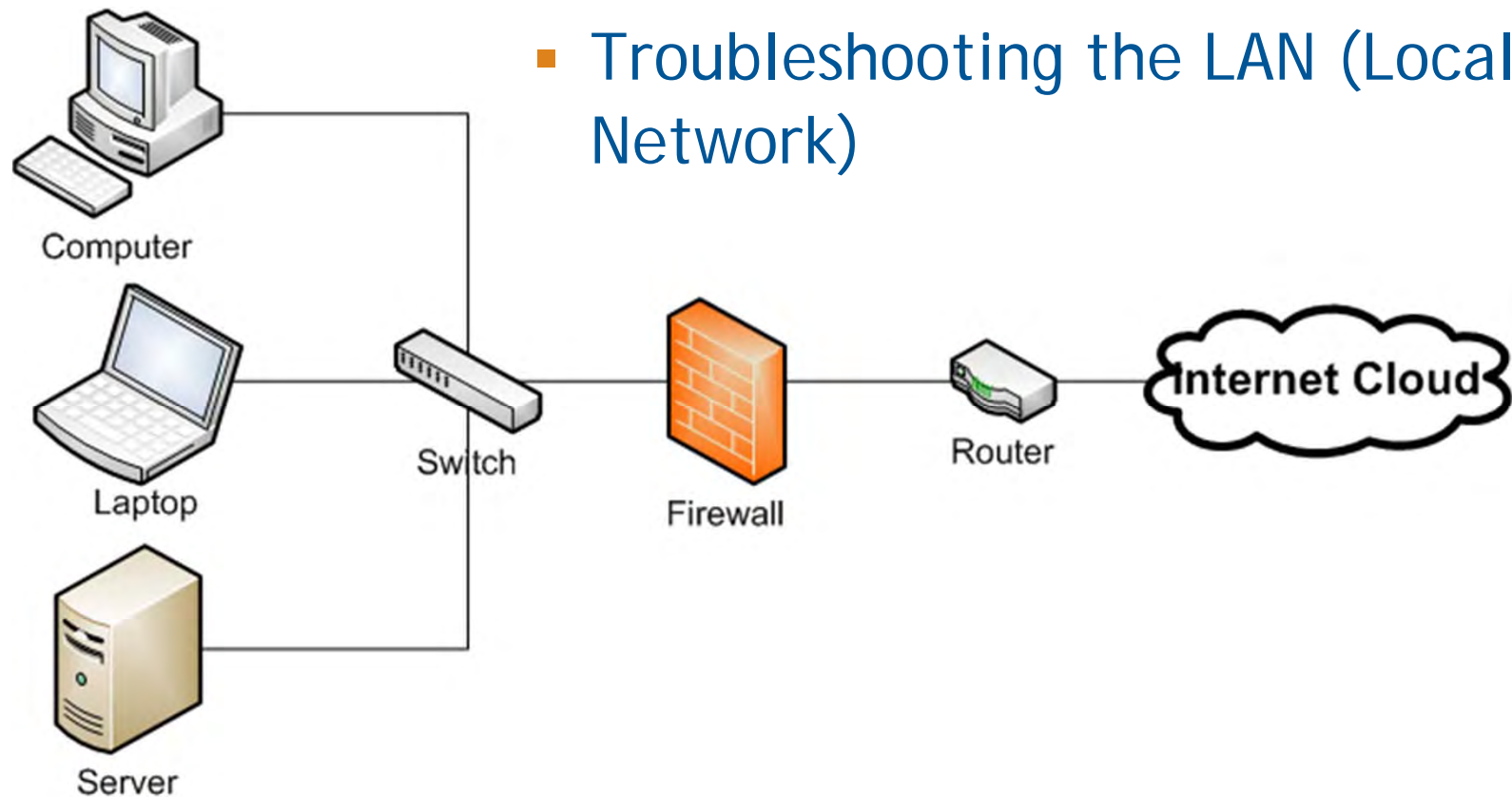


# Troubleshooting Bandwidth Tree



# Troubleshooting Internet Access

- Many things can go wrong before your data ever gets to the internet.



# Troubleshooting Tools

- ipconfig
- Click on Start, Run: Type 'cmd' or 'command' depending on version of Windows
  - Type 'ipconfig' and press Enter
  - Look for 'Default Gateway' and write it down.

```
C:\Users\cscheels>ipconfig

Windows IP Configuration

Wireless LAN adapter Wireless Network Connection:

    Connection-specific DNS Suffix . . . : 
    Link-local IPv6 Address . . . . . : fe80::b99a:9020:651
    IPv4 Address. . . . . : 10.6.8.190
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : 10.6.8.2
```

In this example  
the default  
gateway is:  
10.6.8.2

# Troubleshooting Tools

## ■ Ping

- Click on Start, Run:  
Type 'cmd' or  
'command' depending  
on version of Windows
  - Type 'Ping [*default gateway*]' and press enter
  - Type 'Ping google.com' then enter

### Normal Result

```
C:\Users\cscheels>ping google.com

Pinging google.com [74.125.47.147] with 32 bytes of data:
Reply from 74.125.47.147: bytes=32 time=2ms TTL=55
Reply from 74.125.47.147: bytes=32 time=2ms TTL=55
Reply from 74.125.47.147: bytes=32 time=2ms TTL=55
Reply from 74.125.47.147: bytes=32 time=2ms TTL=55

Ping statistics for 74.125.47.147:
    Packets: Sent = 4, Received = 4, Lost = 0 (0% loss),
    Approximate round trip times in milli-seconds:
        Minimum = 2ms, Maximum = 2ms, Average = 2ms
```

### Abnormal Result- DNS ok

```
C:\Users\cscheels>ping cnn.com

Pinging cnn.com [157.166.255.19] with 32 bytes of data:
Request timed out.
Request timed out.
Request timed out.
Request timed out.

Ping statistics for 157.166.255.19:
    Packets: Sent = 4, Received = 0, Lost = 4 (100% loss),
```

- If you can ping the Default Gateway, the problem is at the router or beyond. Reboot router, then call ISP

# Troubleshooting Tools

## ■ NSLookup

```
C:\Users\cscheels>nslookup
Default Server:  chycrpd01.corp.cbeyond.net
Address:  10.6.5.64

> www.google.com
Server:  chycrpd01.corp.cbeyond.net
Address:  10.6.5.64

*** chycrpd01.corp.cbeyond.net can't find www.google.com: Non-existent
> server 4.2.2.2
Default Server:  unsc-bak.sys.gtei.net
Address:  4.2.2.2

> www.google.com
Server:  unsc-bak.sys.gtei.net
Address:  4.2.2.2

Non-authoritative answer:
Name:      www.l.google.com
Addresses:  74.125.65.103
            74.125.65.104
            74.125.65.105
            74.125.65.106
            74.125.65.147
            74.125.65.99
Aliases:   www.google.com
```

Abnormal Result- DNS Problem  
from Ping

```
C:\Users\cscheels>ping www.google.com
Ping request could not find host www.google.com. Please check
gain.
```

# Troubleshooting Tools

## ■ Trace Route (tracert)

```
C:\Users\cscheels>tracert google.com

Tracing route to google.com [74.125.157.147]
over a maximum of 30 hops:

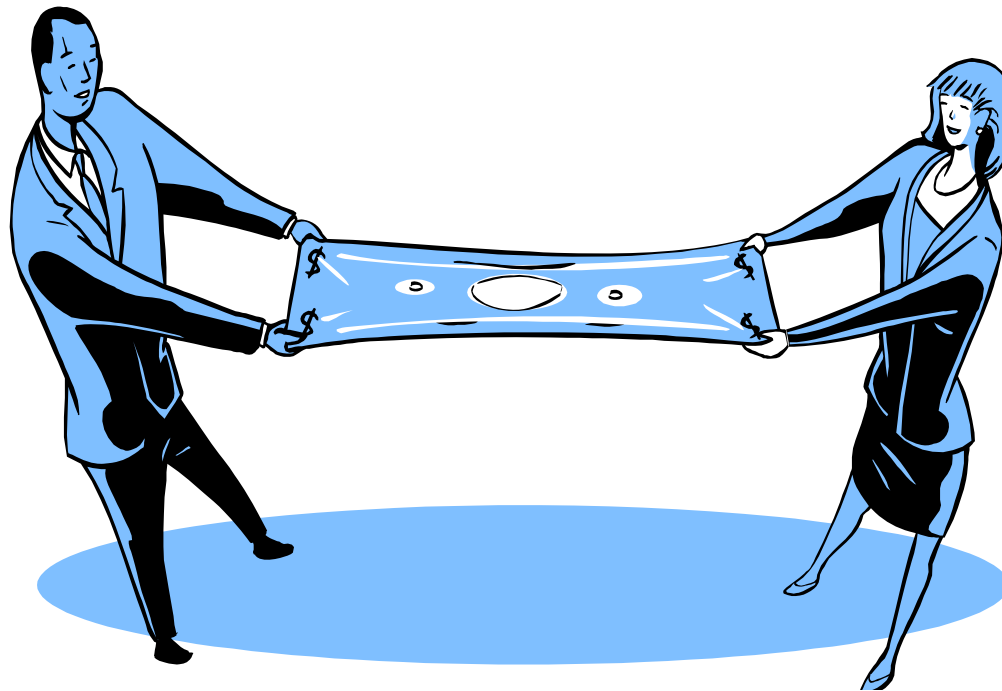
  1    <1 ms    <1 ms    <1 ms    10.6.15.1
  2     1 ms     1 ms     1 ms     10.6.255.61
  3     3 ms     1 ms     1 ms     10.6.255.253
  4     1 ms     1 ms     1 ms     192.168.16.134
  5     1 ms     1 ms     1 ms     10.6.182.251
  6     1 ms     2 ms     1 ms     69.199.69.2
  7     2 ms     1 ms     2 ms     74.125.49.33
  8     1 ms     1 ms     1 ms     72.14.233.56
  9     2 ms     2 ms     2 ms     209.85.254.249
 10    *         *         *         Request timed out.
 11     2 ms     3 ms     2 ms     gy-in-f147.1e100.net [74.125.157.147]

Trace complete.
```

- Tracert tells you if there is a problem with the 'post office system', if so call ISP. In this example the data reached google.com.
- If trace doesn't complete (i.e.- request time out) call ISP

# How much Bandwidth do you need?

You need to evaluate the balance between performance and cost



# It's all about the apps!

- Take an Inventory of what your team uses!
  - e-mail: Internal or external?
  - Accounting Software
  - On-line apps
    - Sales
    - Orders
    - Donation Management
    - Human Resources
- Understand if any new uses are coming up!

# Estimate bandwidth needed

- Use a tool
  - Several Free Network Analyzer tools
    - Ethereal , Wire shark, Wild packets
- Do the math
  - Develop a small grid for usage

# Add it up!

Application Client	Number of Users	Time of day	Bandwidth per User	Total
Typical Web Browser	4	8am - 5pm	8k	32K
Accounting application at remote office	2	8am - 12pm	7k	14k
Pandora Radio	3	8am - 5pm	12k	36K
On-Line Ordering System	5	10am - 7pm	13k	65K
Packet Overhead (15%)				22K
Room for spike and growth (40%)				68K
Total				237K

# How Bandwidth is Priced!

- Types
  - High Expense
    - Dedicated lines: Frame Relay or MPLS
  - Low Cost
    - Broadband Services
      - DSL, Cable Services
  - Variable Cost Options
    - Wireless Broadband

# Bandwidth Pricing Models

- Dedicated Connection: Typically has multiple components
  - Local Loop Access - The physical wire connection between the local exchange and the customer is known as a "local loop", and is owned by the incumbent local exchange carrier (also referred to as the "ILEC", "local exchange", or in the United States either a "Baby Bell" or an Independent telephone company). This is normally distance sensitive and may cost more as the distance between the LEC and the facility increase.
  - Internet Protocol Virtual Private Network (IPVPN) Port speed will determine the network throughput. The costs increases as the bandwidth speed increases.
  - Hardware - Modem Rental, Router optional

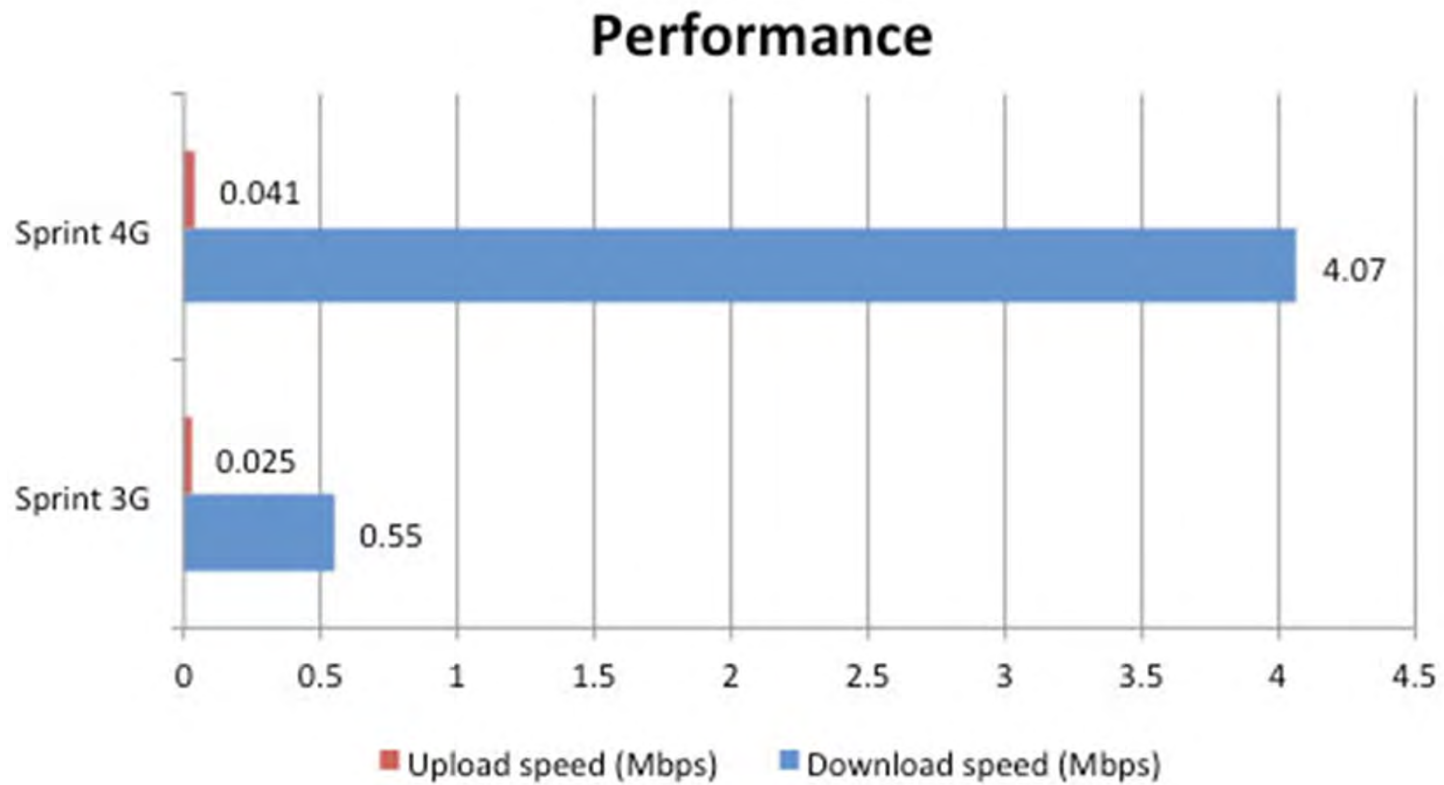
# Bandwidth Pricing Models

- Broadband: DSL or Cable
  - Digital Subscriber Line (DSL)
    - 2 Types
    - Asymmetric Digital Subscriber Line (ADSL), the most commonly installed technical variety of DSL.
      - Upload and Download speeds are different!
        - Typically ranges from 256 kbit/s to 40 Mbit/s in the direction to the customer (downstream) depending on DSL technology, line conditions, and service-level implementation. In ADSL, the data throughput in the upstream direction, (the direction to the service provider) is lower, hence the designation of *asymmetric* service.
    - Symmetric Digital Subscriber Line (SDSL) service, the downstream and upstream data rates are equal.
    - Costs are dependent on location and competition.
  - Cable Broadband
    - Typically Higher available speeds!

# Bandwidth Pricing Models

- Wireless Broadband - 3G or 4G
  - **Wireless Broadband** refers to technology that provides high-speed wireless Internet access or computer networking access over a wide area.
    - 3G (Third Generation)
      - Typical Outdoor (Typical Mobile device) = 50k to 384 K
      - Typical Indoor (not common) dedicated system = 512k to 2 MB
    - 4G (Fourth Generation)

# 4G vs. 3G



# Bandwidth Pricing Models

- Switched Service
  - **Integrated Services Digital Network (ISDN)** is a set of communications standards for simultaneous digital transmission of voice, video, data, and other network services over the traditional circuits of the public switched telephone network.
    - This is an older technology that is being phased out at areas around the globe.
    - Costs vary on geographic location however average approximately \$100 for every 128K of bandwidth

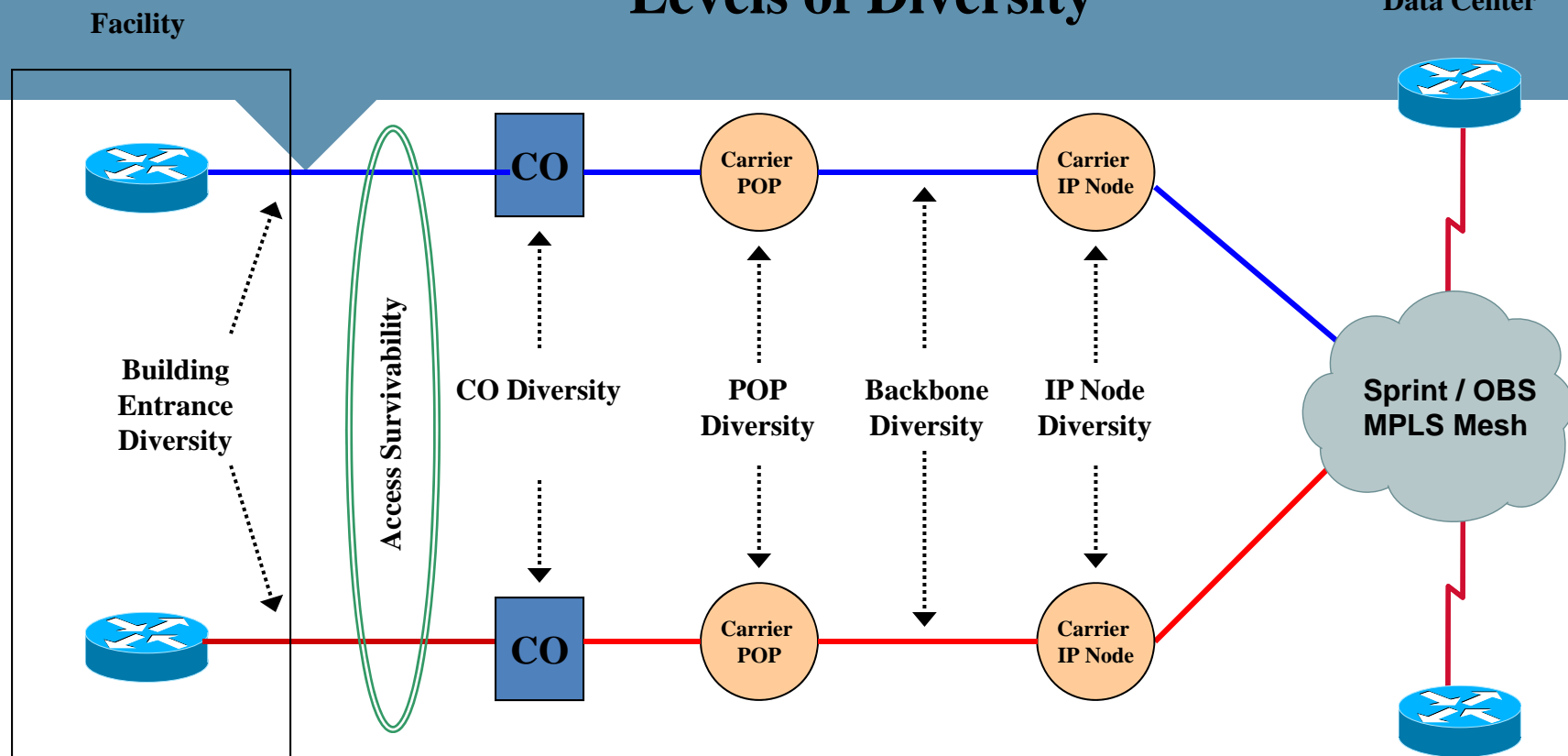
# Hidden Costs

- Managed solutions
- Equipment charges
  - Monthly costs
  - One time costs
- Port management charges
- Backup Cost - Do you need Redundancy?  
Diversity?

# Other Costs

- Common Costs for All Circuit Types:
  - Vendor provided Data Terminating Equipment (DTE) used by the LEC to interface with the customer's hardware. This could be a Channel Service Unit (CSU) or a Data Service Unit (DSU).
  - Inside Wiring may be required to extend the data circuit from the building demarc, the main point of entry into a facility, to the Main Distribution Facility (MDF).
  - Electrical power and conditioning equipment may be required where the data circuits and equipment will be used. This may require electricians, permits and other hardware. Power conditioners such as surge suppressors, uninterruptable power supplies (UPS) or other related hardware may be required to protect the network devices.

# Levels of Diversity



## Building Entrance Diversity

Two conduits into the building at least 50' apart

## Access Survivability

Local exchange carrier provided resilient fiber ring into facility

## CO Diversity

Primary and backup circuits go to diverse COs

## POP Diversity

Circuit entrance into the Carrier network at diverse points of presence

## Backbone Diversity

A diverse cable path between the Carrier POP and the Carrier IP Node

## IP Node Diversity

Circuit entrance into the Carrier MPLS network at diverse Carrier IP Nodes

# Next

Slides from today's presentation will be posted on the TechBridge website.

The link will be sent via email.

Post-seminar support for Bandwidth questions you may have for the next few weeks will be provided by volunteers from The Home Depot.

Their contact info will be sent via email.

Follow-up questions/content will be posted on the TechBridge discussion forum on LinkedIn.

# Feedback and Comments



# Raffle Drawing



Stay tuned for the next seminar!



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Thank You!