Building The 21st Century Library
Planning For Technology In New Buildings

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Information Partners
Technology & Management Solutions for Libraries

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Overview

- We are going to discuss the vocabulary you need to “talk the talk”.
- We are going to discuss specific technologies and how to make your building flexible for the future.
- We are not going to discuss technologies that do not affect the building.
Foreword

- We can’t all be nuclear submarine officers.
- Sherlock Holmes thought the sun revolved around the earth.
Libraries & Technology

- Technical Services
- Circulation
- Public access
- Reference
- Business operations
Technology Devices

- PCs
- Printers
- Thin clients
- Self checkout machines
- Telephones
They All Need

- Space
- Data
- Electrical power
- Cooling (aka HVAC)
Space

This you should have taken care of in your building program.
Communications Basics

- Computers are binary devices
  - 1s and 0s
  - On and off
  - Positive and negative
  - Yes and no
- Binary DigiT or BIT
- 8 bits make a byte
Communications Basics

- Character encoding
  - Morse code
    Variable length - dots and dashes
  - Telex and telegrams
    Baudot - 5 bits - 32 characters
  - ASCII - 8 bits - 256 characters
  - ALA - 8 bits - 192 characters
Communications Basics

- Character encoding
  - AU:SMITH
    - A: 01000001
    - U: 01010101
    - : 00111010
    - S: 01010011
    - M: 01001101
    - I: 01001001
    - T: 01010100
    - H: 01001000
Communications Basics

◆ Speed

– Measured in bits per second or baud

  Original OCLC 2400
  Modern modems 56K
  LANs 10 or 100Mbps
  ISDN 128K
  T1 1.5Mbps
  ATM 155Mbps

– Also referred to as bandwidth
Communications Basics

- Why is speed so important?
  - A single web page can contain 200,000 characters or about 2 megabits
  - Download times
    - At 9600: 210 seconds
    - At 56K: 35 seconds
    - At T1: < 2 seconds
The Time before LANs

Directly connected RS-232 terminals

Mainframe

Terminals
The Time Before LANs

Remotely multiplexed RS-232 terminals

Mainframe → Multiplexor → Modem → Multiplexor → Terminals
LANs

- What is a LAN, anyway?
  - A LAN connects computers in a workgroup, department or building.
  - A communication network used by a single organization over a limited distance which permits users to share information and resources.
LANs

- Why do I need to know this stuff?
- Why would I want a LAN?
  - Link PCs to your local system
  - Share printers and disk storage
  - Share networked applications
  - Share CDROM databases
  - Provide Internet access
LANs

Link PCs to your local system
LANs

Share printers and disk storage

Network Server

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Introduction

- Share network applications
  - Electronic mail
  - Applications
  - Metered software
LANs

Share CDROM databases

Network Server

CD Server

CD Tower

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LANs

Provide Internet access

Router

CSU/DSU

Internet

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Types of LANs

A rose by any other name...
Types of LANs

- What type of LAN do you have?
  - 10BaseT
  - Ethernet
  - NT
  - Client - Server
Types of LANs

- What is your ...?
  - Cabling infrastructure?
    10BaseT
  - Frame type and collision detection mechanism?
    Ethernet
  - Network operating system?
    NT
  - NOS architecture?
    Client - Server
Protocols

Rules, manners formalities and conventions
Protocols

- **Definition**
  A set of rules specifying how a thing is to be done

- **Layered protocol**
  A protocol in which there is a division of labor among several agents each of which relies on its subordinate agents
## Protocols

<table>
<thead>
<tr>
<th>Cleveland</th>
<th>London</th>
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<tr>
<td>Mrs. Big</td>
<td>Mrs Big</td>
</tr>
<tr>
<td>Mr. Big</td>
<td>Mr. Big</td>
</tr>
<tr>
<td>Mr. Big’s Secretary</td>
<td>Mr. Big’s Secretary</td>
</tr>
<tr>
<td>The mail boy</td>
<td>The mail boy</td>
</tr>
<tr>
<td>The mail room clerk</td>
<td>The mail room clerk</td>
</tr>
<tr>
<td>Shp/Rcv clerk</td>
<td>Shp/Rcv clerk</td>
</tr>
<tr>
<td>FedEx</td>
<td>FedEx</td>
</tr>
</tbody>
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Protocols

- Ethernet
  - Used within a building
- TCP/IP
  - Transmission Control Protocol/Internet Protocol
  - Used for wide area networks
  - The language of the Internet
Ethernet

- It is not possible to determine physical location from an Ethernet address
  - PC1  34 56 87 99 01 45
  - PC2  78 32 44 37 89 61
TCP/IP

- It is possible to determine physical location from a TCP/IP address
  - PC1  204.96.225.31
  - PC2  204.96.225.50
  - Branch 1  204.96.225.x
  - Branch 2  204.96.224.x
Address Translation

- Private IP address ranges were created when IP was devised.
- Libraries assign these private IP addresses to all their devices and translate them to real IP addresses only for access outside the library.
Packets and Frames

- Two names for the same thing
- LANs send data in packages or packets
- Packets have:
  - To address
  - From address
  - Data
  - Other stuff
## Ethernet

- Defines a frame format - IEEE 802.3

<table>
<thead>
<tr>
<th>Flag</th>
<th>Addresses</th>
<th>Length</th>
<th>Data</th>
<th>FCS</th>
<th>Flag</th>
</tr>
</thead>
</table>

- Defines how to detect and handle collisions
  - CSMA/CD - Carrier Sense Multiple Access/Collision Detection

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Types of LANs

- **Peer-to-peer**
  Allows all connected hosts to offer services to other peers and to take services from other peers.

- **Client - server**
  Some hosts are clients who only receive services while other hosts are servers who provide services.
Types of LANs

Peer-to-peer
Types of LANs

Client - server

Network Server

CD Server

CD Tower
The Pieces and Parts

Parts is parts
The Pieces and Parts

- Clients and servers
- Wiring
- Hubs, switches, and routers
- Patch panels and racks
- Conduits, ducts and raceways
- Wall jacks
The Pieces and Parts

Wall Jack

PC

PC

Server

Patch Panel

Hub

Patch Panel

Hub

Router

Internet

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The Pieces and Parts

- Clients and servers
  Only smart devices need apply
  - PCs
  - Minicomputers
  - Mainframe computers
  - Printers with network adapters or print servers
The Pieces and Parts

- Wiring
  - Coaxial cable
  - Twisted pair
  - Fiber optic
The Pieces and Parts

Coaxial cable

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The Pieces and Parts

◆ Coaxial cable
  – Advantages
    » Longer distances than TP
    » Carries voice, data, video
    » Well known technology
  – Disadvantages
    » Hard to install
    » More expensive to install
    » Cable is more expensive than TP
The Pieces and Parts

Twisted pair

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The Pieces and Parts

◆ Twisted pair

– Advantages
  » Inexpensive
  » Devices easy to connect
  » Easy to install

– Disadvantages
  » More prone to noise and interference
  » Shorter distances than coaxial
The Pieces and Parts

- Twisted pair - shielded vs. unshielded
- UTP grades
  - Category 1 - Suitable for voice only
  - Category 2 - Data at 4Mbps
  - Category 3 - Data at 10Mbps
  - Category 4 - Data at 16Mbps
  - Category 5 - Data at 100+Mbps
The Pieces and Parts

- UTP - other decisions
  - Plenum vs. non-plenum
  - Solid vs stranded
  - Two or four pairs
- Costs (per foot)
  - Cat 3 2 pair = $ .05
  - Cat 5 4 pair plenum solid = $ .33
  - Cat 5 4 pair pvc solid = $ .13
  - Cat 6 4 pair plenum solid = $ .55
The Pieces and Parts

Fiber optic

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The Pieces and Parts

Fiber optic

- Advantages
  - Impervious to interference
  - Longest cable runs

- Disadvantages
  - The cables is expensive
  - Connectors are expensive
  - Requires the most skill to install
The Pieces and Parts

- **Wiring designations**
  - 10Base2 - Thin Ethernet - 185 meters
  - 10BaseT - UTP - 100 meters
  - 100BaseT - UTP - 100 meters
  - 100BaseFX - fiber optic - 2 kilometers
Structured Wiring

- Wiring closets
  - Usually one per floor
  - At least 10x5 feet
  - All devices served must be within 100 wire meters
  - Conditioned power
  - Single purpose, i.e., not also the janitor’s closet
Vertical Wiring

- Connects wiring closets
- May be UTP copper but is more likely to be fiber optic cable
Horizontal Wiring

- Connects devices to wiring closet
- Usually copper UTP
- May run in walls, floor or ceiling
The Pieces and Parts

Wiring components

1
2
3

Horizontal Wiring
Intermediate Hub
Vertical Wiring

Basement

Main Hub

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Standards & Certification

- All wiring should be done to EIA 568/569 standards.
- Each individual cable should be tested with a printed report produced.
Documentation

- Each cable should be numbered on both ends.
- A graphic cable plan showing all cable runs with their numbers should be produced.
The Pieces and Parts

- Clients and servers
- Wiring
- Hubs, switches, and routers
- Patch panels and racks
- Conduits, ducts and raceways
- Wall jacks
The Pieces and Parts

- Hubs
  Connect hosts in a single LAN
- Switches
  – Smart hub
- Routers
  Connect multiple LANs
The Pieces and Parts

Hubs (aka concentrators, repeaters)
The Pieces and Parts

Routers

Cisco 2500 Series

Cisco 4000 Series

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The Pieces and Parts

- Clients and servers
- Wiring
- Hubs, switches, and routers
- Patch panels and racks
- Conduits, ducts and raceways
- Wall jacks
Patch Panel & Rack

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The Pieces and Parts

- Clients and servers
- Wiring
- Hubs, switches, and routers
- Patch panels and racks
- Conduits, ducts and raceways
- Wall jacks
Conduit

- 1/2 to 1 inch round metal pipe which is run point-to-point

- Although the cheapest, it is the least flexible
Ducts

- Flat, rectangular troughs laid in a grid pattern in the floor
- Structural steel decking with built in ducts
Walker Duct

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Walker Duct
Walker Duct
Walker Duct
Walker Duct
Walker Duct

LA Studio City Branch

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Walker Duct

LA Studio City Branch

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Surface Raceway
Cable Tray
Advice

Never install conduit, ducts, or raceway that are more than 50% full initially. Make it 40% if you can.
Access Flooring

A floor that is raised above the concrete slab. The entire space between the slab and the floor becomes a pathway for wiring.
Cablefloor
Cablefloor
Cablefloor

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Cablefloor
Cablefloor
Wiring
The Pieces and Parts

- Clients and servers
- Wiring
- Hubs, switches, and routers
- Patch panels and racks
- Conduits, ducts and raceways
- Wall jacks

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Wall Jack
Costs

- Conduit, ducts, access floor
- Data and electrical cable
- Labor
- Outlets

- Some costs can be covered by Erate
Costs

- Walker Duct
  - 22,000 sq ft with 4 foot grids = $95,000
- Cablefloor
  - $7 - $10 per sq ft installed
Wireless LANs & WANS
2.4GHz Digital Spread Spectrum Radio Frequency

- 2.4GHz
- Digital
- Spread Spectrum
- Radio Frequency
Wireless LANs
Typical WLAN Configuration

Access Point

Wired LAN

Mobile Laptop & Other Computers

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Access Points
PCMCIA Cards
Wireless Laptop
Spread Spectrum

*Frequency Hopping*
- Multipath
- Interference tolerance

*Direct Sequence*
- Throughput
- Range
Access Point Coverage

- **2 Mbps FHSS**: 175 feet radius
- **2 Mbps DSSS**
- **1 Mbps FHSS**: 350 feet radius
- **5.5 Mbps DSSS**: 175 feet radius
- **11 Mbps DSSS**: 125 feet radius
Channels - Direct Sequence

- (11) 22 MHz wide stationary channels
- 11 Mbps data rate without complex modulation scheme
- 3 non-overlapping channels
- 3 Access Points can occupy same area

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Frequency Hopping

- 79 Channels, 1 MHz Each
- Changes frequency (Hops) at least every 0.4 seconds
- Synchronized hopping required

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FH vs. DS: A Summary on Interference Handling

- FH system hops around interference
- Lost packets are re-transmitted on next hop

- Data may be decoded from redundant bits
- Can move to an alternate channel to avoid interference

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Wireless Friendly

- Open floor plan
- No fine grid metal mesh in walls
- No metallic foil wallpaper
- Provide for the location of access points (i.e., power & data) even if you are not ready to deploy wireless now
Wireless WANs
Wireless Bridging
Point-to-Point Configuration

0 to 25 miles (line of sight)

Building A
- Bridge
- Optional Antenna
- Ethernet

Building B
- Ethernet

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Point-to-Multipoint Configuration

Building A
- Ethernet
- Bridge
- Omni-directional Antenna

Building B
- Directional Antenna

Building C

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Will a wireless LAN work for you?

A site survey is the only way to know

- Must be done in every case

- Use the actual equipment
  - Access points
  - Antennas
  - PC cards

- Environmental considerations

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Standards

- **802.11b**
  - Adopted in 1997 for FHSS at 1 and 2 Mbps and DSSS at 2 Mbps
  - Adopted in 1999 for DSSS at 11 Mbps

- **802.11a**
  - Provides for 45Mbps at 5.5GHz
Costs
Costs

- Access points
  - $250 - $1000
- PC cards
  - $130 - $250
- Bridges
  - $1500 - $2500
Use in Libraries

- Mobility
- Flexibility
- High ratio of network connection points to devices
- Historical building
- Construction problems
Uses I Know Of

- Smyrna Public Library
- William F Laman Public Library
- Battle Creek Public Schools
- SMU Law School
- U of Minnesota Biomedical Library
- Willard Public Library
- Franklin County North Carolina
- Allegany County Maryland
A Wireless WAN
What’s Hedy Got To Do With It?

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Wireless Goes Mainstream

Join the networking evolution

Networking lets all your PCs share the wealth—high-speed Internet access, printers, entertainment and more. Best Buy has the selection, the know-how and the great prices you’re looking for.

WIRED ETHERNET
Fast, reliable, affordable

Wireless for your desktop
This wireless PCI adapter card is perfect for homes or offices where cables would get in the way or are difficult to install. Requires the WPCL card shown below.
(WDFT11) $49.99; 15 instant Rebate = $34.99

CONNECT YOUR DESKTOP
Make your PC 10/100 Ethernet-ready with the PCI network card. It features a 25-footh data path for excellent performance. (LINK1000)
$49.99; 15 Mail-in Rebate - 15 instant Rebate = $49.99

WIRELESS
The ultimate in networking freedom

EXPAND WITH UP TO 5 PCs
Expand your network with the 5-port network switch. Each PC can share resources like printers, data, programs and more. You can also have a head-to-head gaming tournament (EZVS335W)
$29.99; 10 Mail-in Rebate - 10 instant Rebate = $19.99

WEARLESS central
This access point is the heart of your wireless network. Add wireless cards to your PCs and notebooks and enjoy freedom from the limits of cable networking. Transmits up to 11 Mbps up to 1000 feet. (NAP11)
$99.99; 30 Mail-in Rebate - 30 instant Rebate = $69.99

CONNECT YOUR NOTEBOOK
Networking your notebook is easy and makes moving between home and office a snap. Just plug this networking card into your PCMCIA slot and you’re ready to go. (PCMC1000)
$19.99; 10 Mail-in Rebate - 10 instant Rebate = $9.99

WEARLESS notebook freedom
Stay connected with wireless freedom up to 1000 feet from your wireless source. This PCMCIA card lets you go anywhere within your wireless network and stay connected at up to 11 Mbps. (WPCL11)
$49.99; 10 Mail-in Rebate - 10 instant Rebate = $39.99

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Urban Myths

- We need fiber to the desktop.
- We need 100Mbps Ethernet.
- Wireless is not fast enough.
Bandwidth & Bottlenecks
Types of Buildings
Types of Buildings

- Central
- Branch
- Administrative
Central Library

- Houses your servers
- Houses your IT staff
- May be large enough to require wiring closets
Branch Library

- Also applies to a central library where computer services are delivered by a consortium
- Has at least a telecommunications room
- May house print, file and/or management servers.
Administrative Building

- No public computers
- Typically houses administration and technical services
- May house servers
- More like a commercial office building than a library
Technology Infrastructure and Support
Computer Room

- Houses servers and telecommunications equipment
- Your principal computer room should be at least 10x20 feet
- Centrally located is better
- Requires conditioned power
- May require separate HVAC
- Does not house people

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Computer Room
Telecommunications Room

- Houses telecommunications equipment for a branch and may house servers
- Should be at least 10x10 feet
- Entry point for telco service
- Centrally located is better
- Requires conditioned power
- May require separate HVAC
- Does not house people
Wiring Closet

We’ve already talked about this.
Wiring Closet
Furniture

- Furniture should be a part of your structured wiring.
- Use furniture with built in cable management.
Cable Management - NOT
Cable Management
Cable Management
Technology Devices Need

- Space
- Data
- Electrical power
- Cooling (aka HVAC)
Electrical Power

- All servers and telecommunications equipment should be provided conditioned power on circuits not shared with other types of equipment.
- All PCs should be on circuits not shared with other types of equipment.
Grounding

- Common
  - Shared among all circuits
- Isolated
  - Dedicated to each circuit
- Driven earth
  - Ground connected to a copper rod driven into the ground
Technology Devices Need

- Space
- Data
- Electrical power
- Cooling (aka HVAC)
HVAC

- Although most computers used in libraries today say they will operate in an “office environment”, that does not mean an enclosed closet. Additional cooling may be required.
- Both a PC and a laser printer produce as many BTUs as a person.
Telephones

- Use Cat5 UTP for telephones.
- Voice over IP allows voice and data to flow over the same network.
- The current trend is to merge voice, video and data into one network.
Tradition Phone Systems

PBX

Telephone Central Office

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Traditional Phone Systems

Main Library

Telco CO

Branch 1

Branch 2

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VOIP Using Standard Phones
VOIP Using IP Phones

PBX

Hub

Router

Telephone Central Office
Voice Over IP

Main Library

Telco CO

Branch 1

Branch 2

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