Developing a Green & Sustainable Fiber Optic Infrastructure with Air-Blown Fiber Technology

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Definition of a Blown Fiber System

- Air Blown Fiber (ABF) is a fiber optic cabling system which uses dry nitrogen, compressed air or bottled air to carry small, light weight, multi-fiber bundles into previously installed tubes or tube cables from point to point for a splice-free continuous fiber run.
- Tube cables are deployed throughout the building, campus or network to facilitate the installation of the fiber bundles in lieu of innerduct or even conduit systems.
- Optical fiber bundles can be quickly and easily blown at speeds of up to 150 per minute in and out of any route of coupled tubes, when and where needed (even in restricted areas) eliminating dark fiber, and providing the exact fiber types and counts required.
- ABF changes the dynamics of optical fiber design, deployment and labor. Minimizes time, effort & expense of installing optical fiber, giving the customer maximum control and flexibility with continuous ROI and reductions in cost of ownership.

Designing a Blown Fiber System

- Not all blown fiber systems are the same
- All use a variation of the major components
- Issues to be covered:
  - Basic components
  - Basic Design Guidelines
  - How a Blown Fiber System Contributes to a “Green” Design

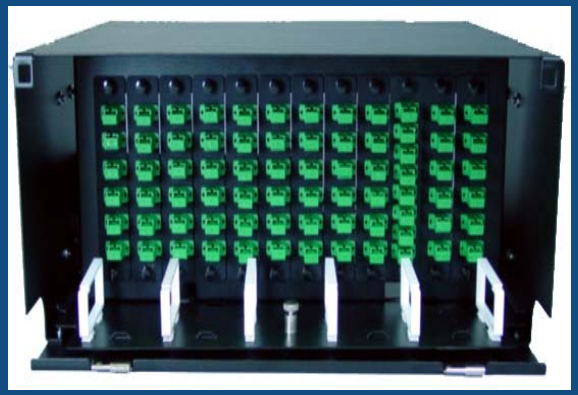
Major Components

Tube Cables

Blowing & Test Equipment

Fiber Bundles

Tube Distribution Equipment



Fiber Termination Equipment

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Major Components – Tube Cables

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Major Components – Tube Cables

- Individual tubes are typically 6mm ID x 8mm OD
- Multiple tubes are jacketed to create a “tube cable”
- Tube cables are designed for appropriate installation environment
  - Inside plant, outside plant, low smoke zero halogen, Class 1 Div. 1 & 2 and other special applications
- Tubes are connected with a push fit coupling
- Tubes and tube cables create the flexible pathway system

Definition of a Blown Fiber System

ABF Inside Plant Tube Cables

Gen. Purpose

Riser

Plenum

Tubes are numbered for ease of identification

Simple transitions between cables

All Dielectric

Thermal Enhanced

Armored

ABF OSP Tube Cables

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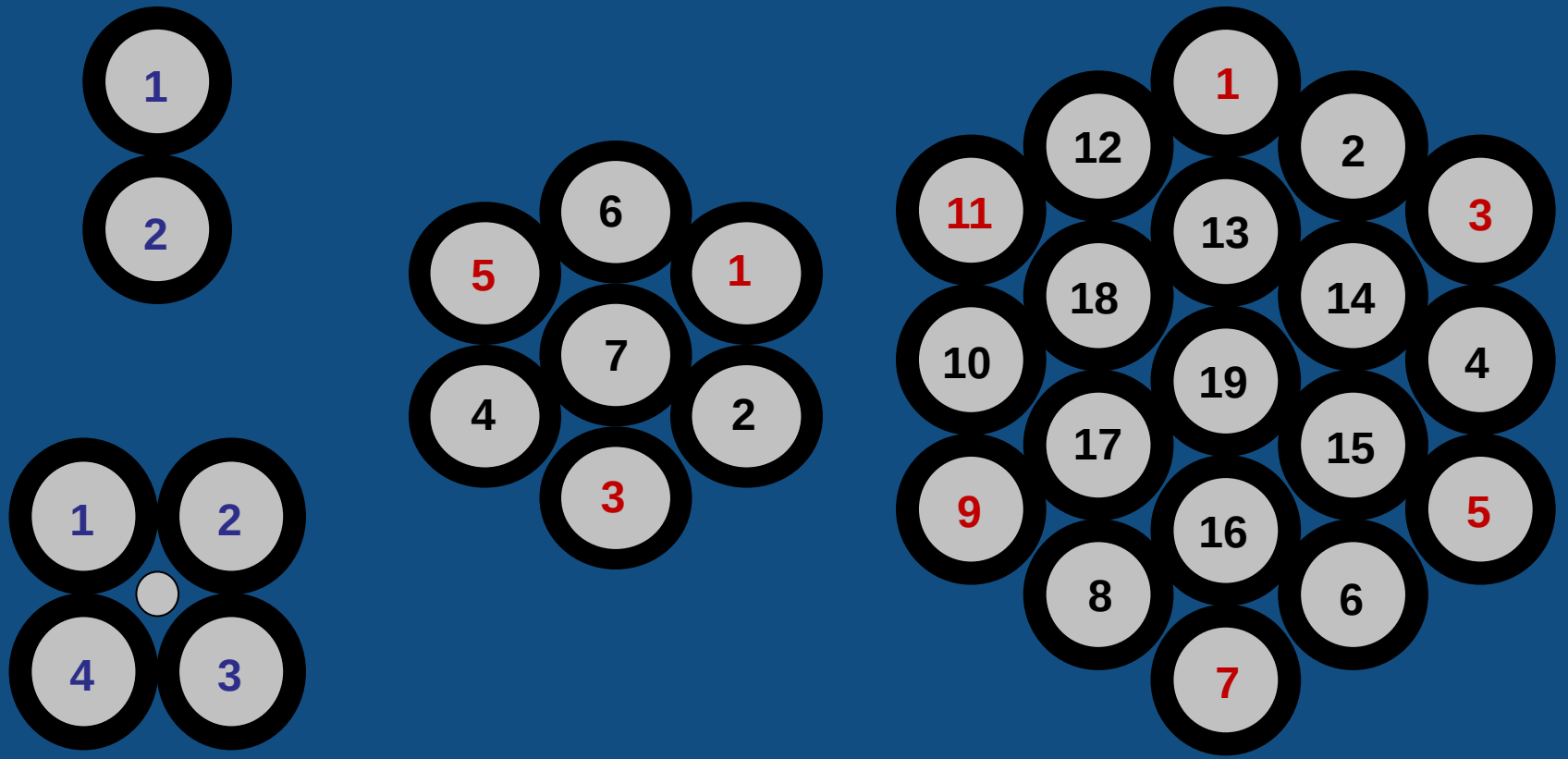
Major Components – Tube Cables

Typical Configuration



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Major Components – Tube Cables

2 – 19 Tube cables
in 4” PVC Conduits

3 - 1 ¼” Innerduct
in 4” PVC Conduit

38 Pathways vs. 3 Pathways

Major Components – Fiber Bundles

Major Components – Fiber Bundles

Most systems have the following fiber types available

- Single-mode; Low Water Peak
- 1-Gigabit 50µ Multimode
- Laser Optimized 10-Gigabit 50µ Multimode 300 meter & 550 meter
- 62.5µ Multimode

Fiber Bundle strand counts & sizes available

- 2, 4, & 6 strand fiber bundles are 2mm OD
- 12, 18, & 24 strand fiber bundles are 3mm OD

Major Components – Tube Distribution Units

Tube Distribution Units are use to connect segments of tube cables to form the pathway system

May be NEMA rated enclosures or splice cases

Major Components – Tube Distribution Units

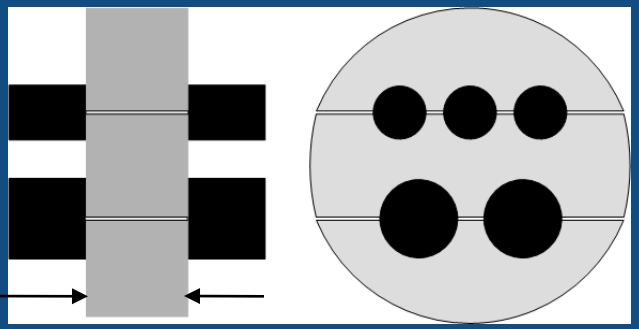
Re-enterable outdoor watertight enclosures for submerged conditions

- Stainless Steel Shell with two (2) 3-Section Drillable End Plates
- Up to 52 tubes capacity; (2) 19-tube & (2) 7-tube cables on either End Plate

Or larger size

- Stainless Steel Shell with two (2) 3-Section Drillable End Plates
- Up to 95 tubes capacity; (5) 19-tube cables on either End Plate

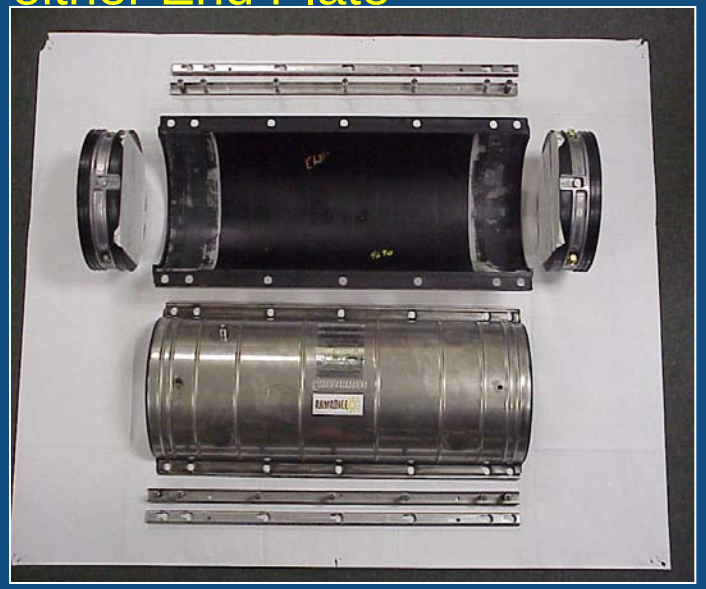
3-Section End Plates allow more cable entries



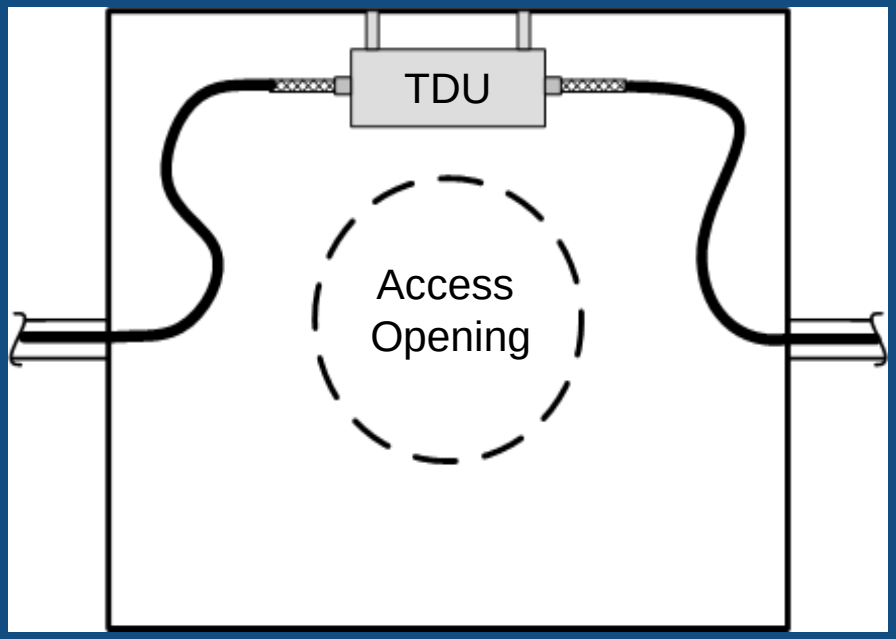
Top Section

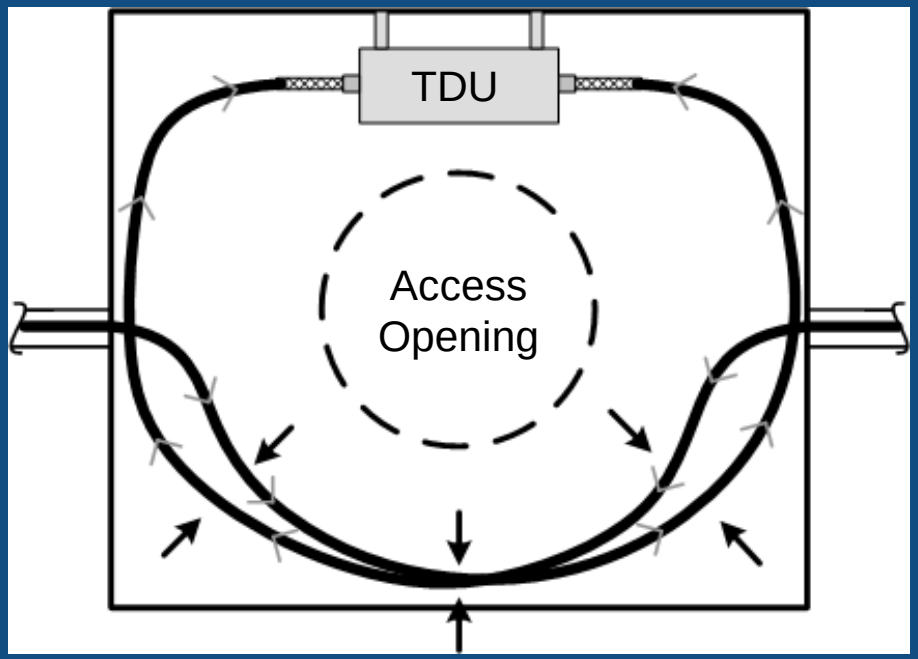
Middle Section

Bottom Section



Tube Distribution Units





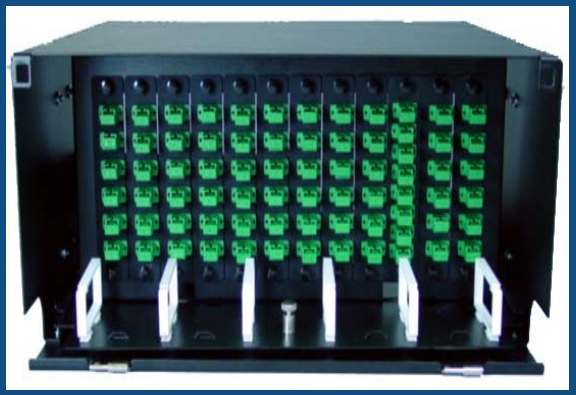
Definition of a Blown Fiber System

Major Components – Fiber Termination Units

Fiber termination units should allow direct field termination, fusion splicing and splice-on connector methods

Should allow all industry standard connector types – SC, LC, ST, MTRJ, FC

Wall and Rack Mount



Major Components – Blowing Equipment

- Blowing equipment can be air or electric powered
- Air source can be nitrogen, bottled air or compressed air
- Provide a clean, dry stable air source

Designing a Blown Fiber System

Step 1 — Fiber Bundle Design

Step 2 — Tube Cable Design

Step 3 — Tube Distribution Hardware Design

Step 4 — Tube Interconnection Planning

Step 5 — Fiber Termination Hardware Design

Step 1 — Fiber Bundle Design

Start the initial Design Process by first understanding the fiber requirements

Provide only the fiber type and fiber count needed based on immediate needs

Use Point-to-Point “Links” … no fiber splices as in Conventional Fiber Designs

Design for one (1) fiber bundle per tube

- “Hybrid” fiber bundles are available
- Add extra tubes if required

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Fiber Bundle Design Considerations

More fiber considerations …

Try to standardize on common size fiber bundles

Refer to Manufacturer's Product List for fiber reel length information

- Determine if special cut-lengths are appropriate
- Cut-lengths may be especially useful on installations requiring Extended Blowing operations

✓ Start preparing the Bill of Materials (BOM)

Fiber Bundle Installation Using one (1) Blowing Head

Typical distances for OSP cables with low count fiber
6,000 - 7,000 feet

Typical distances for OSP cables with high count fiber
5,000 - 6,000 feet

Typical distances for ISP cables with low count fiber
4,000 feet

Typical distances for ISP cables with high count fiber
3,000 feet

Step 2 — Tube Cable Design

Next Step … Choose the tube cable type based on …

Initial and expected future fiber requirements

- Use a 3:1 design ratio … three (3) tubes to one (1) fiber bundle in the initial design process
- At this point, extra tubes are “good insurance”

Installation Environment

- Select best tube cable type for the application
- Comply with Local Code requirements re: indoor fire-rated tube cable types, outdoor tube cable types, etc.

Direct buried armored tube cable can eliminate the need for buried conduit

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Outdoor Tube Cable Installation Techniques

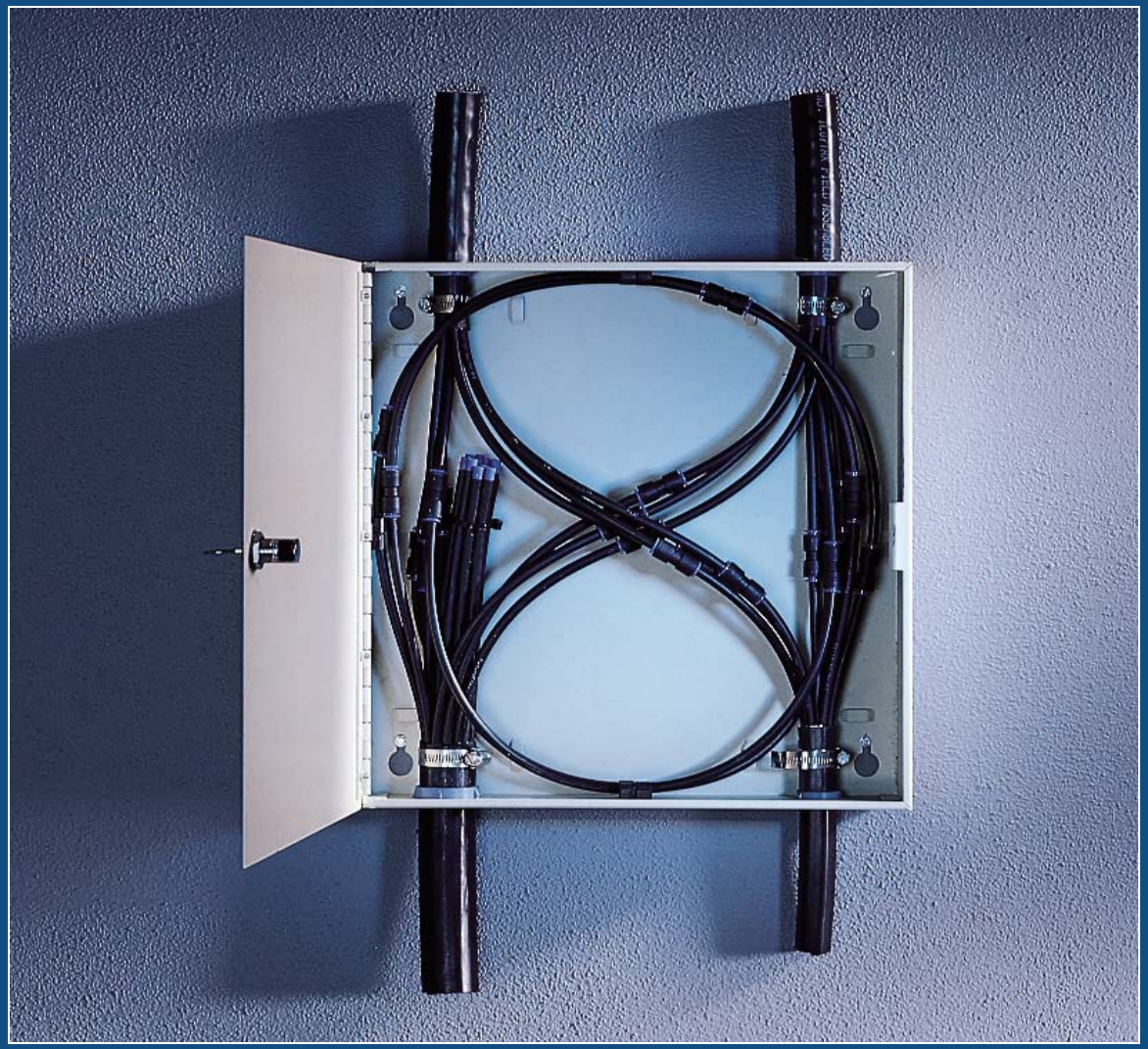
Standard outdoor installation techniques apply … but … ALWAYS

1. Avoid sharp 90° bends
2. Observe minimum bend radius requirements
3. Adhere to maximum allowable pulling tension limits

Trenching

Directional Boring

Step 3 - Tube Distribution Hardware



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Step 4 — Tube Interconnection Planning

Next Step … Design and document a Tube Interconnection Plan

Ensures a successful cabling system design and prevents problems downstream

A basic 5-Step approach is recommended

1. Lay out tube cable route(s), tube cable types, tube counts, and distances
2. Add in the TDU locations
3. Identify each tube to be filled with fiber bundle type and strand count or to be left empty and sealed
4. Identify tube cable and individual tube numbers
5. Identify the number of tube couplings, tube plugs, tube caps, fiber bushings, etc. required

Tube Interconnection Plan – An Example

Suggested Legend

= Tube Coupling

= Tube Plug / Cap

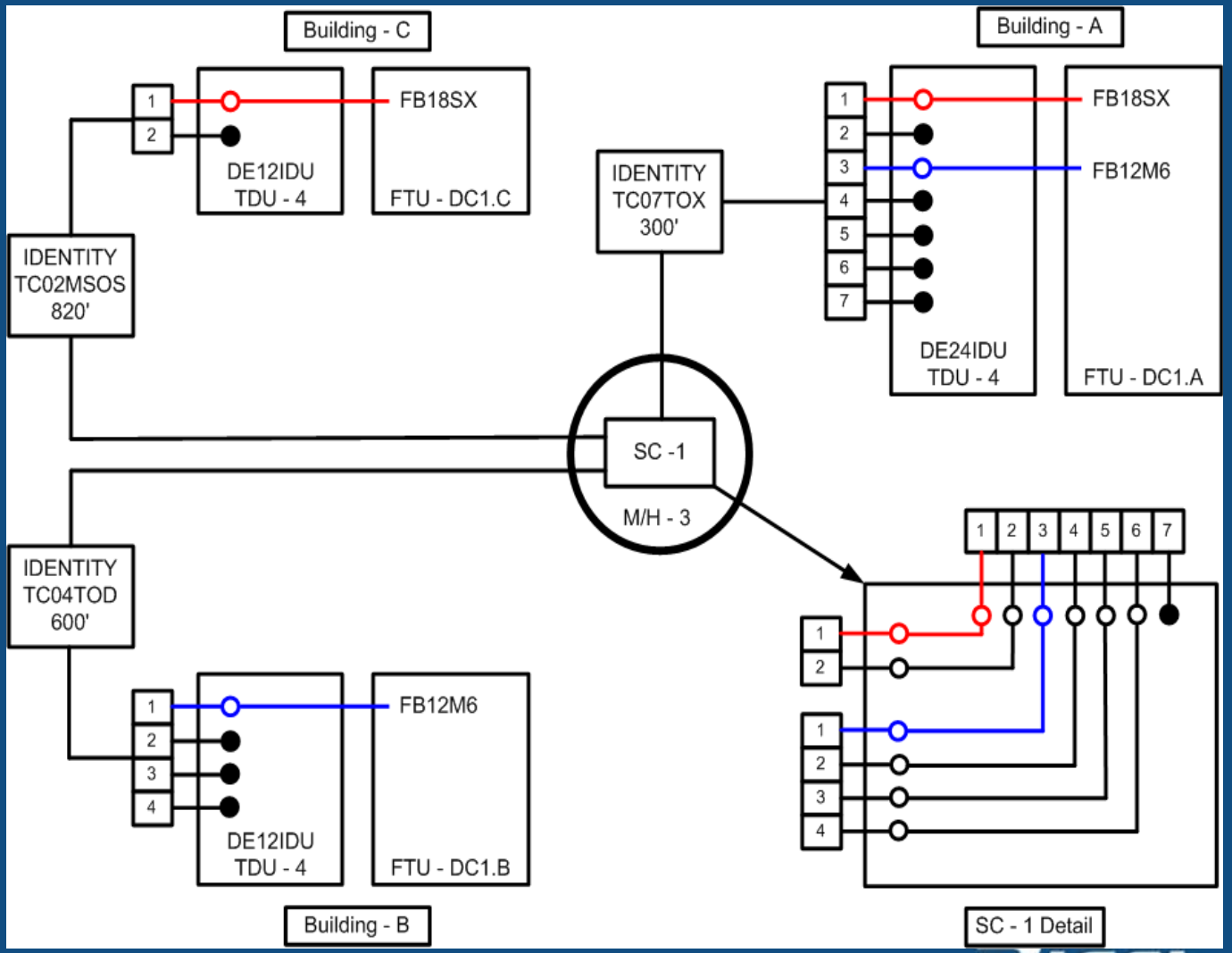
= SM Fiber (Red)

= MM Fiber (Blue)

"Identity" = Tube Cable Number / Designation

"M/H" = Man Hole

"SC" = Splice Case



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Designing a Blown Fiber System

BICSI Standards ANSI / EIA / TIA 568-B & 569-B Guidelines

Mechanical & Environmental Performance Standards …

Tube Cables

- ANSI / ICEA S-83-596 Standard – Indoor Tube Cables
- ANSI / ICEA S-87-640 Standard – Outdoor Tube Cables

Fiber Bundles

- TIA / EIA 492CAAA – Single-mode
- TIA / EIA 492AAAB – Standard Grade Index 50 / 125µ
- TIA / EIA 492AAAC – Laser Optimized Graded Index 50 / 125µ
- TIA / EIA 492AAAA – Standard Grade 62.5 / 125µ

Indoor Fire-Rated Tube Cables are UL, cUL, & CSA Listed

Outdoor Tube Cable jackets are UV resistant

Step 5 – Fiber Termination Units

Plan for the termination to be employed:

- Fusion Spliced Pigtails
- Direct Field Termination
- Type of Connector
- Provide the most flexibility for growth & change

Definition of a Blown Fiber System

Sustainability is:

"forms of progress that meet the needs of the present without compromising the ability of future generations to meet their needs"

World Commission on Environment and Development

Sustainability

How does Blown Fiber fulfill that promise?

- Bundles are blown in and out in real-time providing immediate scalability
- Blown fiber is a continually renewable resource using the same tube cable over and over again
- The same fiber bundle may be removed and reused again and again.
- Eliminates the need more for construction work when upgrading or adding new networks or applications
- Speed – up to 150 feet per minute with 2 installers

Designing a Blown Fiber System

LEED MR (Material & Resources) Credits

- ✓Eliminates dark, unused, wasted fiber and installation
- ✓3R's – Renewable, reusable, recyclable
- ✓Eliminates the hazard of abandoned cable
- ✓Eliminates or greatly reduces the congestion in conduits
- ✓Eliminates repeatedly going into conduits, ceilings or hazardous areas
- ✓Eliminates the need for special HEPA filters, NAPEs and other installation processes used with conventional cable

Leadership in Energy and Environmental Design (LEED)

Designing a Blown Fiber System

LEED MR (Material & Resources) Credits

✓Eliminates the need for special HEPA filters, NAPEs and other installation processes used with conventional cable

Image Shows NAPE Enclosure in a Typical 8 ft. Wide Hospital Corridor.

With the NAPE, there are also the contractors performing the fiber related IT change and a fiber reel

Although the NAPE reduces the risk of disease, contractors still must lift ceiling tiles & continually move the NAPE, often in front of important access doors

Congested Corridors impact patient flow, and pose a risk to patient and staff safety

Designing a Blown Fiber System

LEED EQ (Environment Air Quality) Credits

- ✓Provides non-disruptive design for installations & MACs
- ✓Eliminates construction work and intrusions in ceilings
- ✓Eliminates disruptions to daily operations providing for occupant safety
- ✓Complies with the AIA ICRA (Infectious Control Risk Assessment) standards.
- ✓Eliminates the need to engage the infectious disease control officers

Designing a Blown Fiber System

LEED EA (Energy & Atmosphere) Credits

- ✓Takes up less building/ceiling space allowing HVAC systems to operate with unobstructed air flow
- ✓Provides virtually unlimited network capacity
- ✓Continuously renewable and sustainable infrastructure

Designing a Blown Fiber System

7 World Trade Center, considered New York City's first "green" office tower by gaining gold status in the U.S. Green Building Council's LEED program.

Designing a Blown Fiber System

UNLIKE Traditional Infrastructures, Air-blown Fiber …

- Generates Continuous & Significant Cost Savings with each Network Upgrade, Expansion or Reconfiguration Project
- Yields Continuous ROI Compounded by Multiple Network Projects
- Allows You to Pay-as-You Go, One Project at a Time
- Eliminates Dark Fiber Investment
- Blows Out Fiber Bundles, Undamaged, for Reuse

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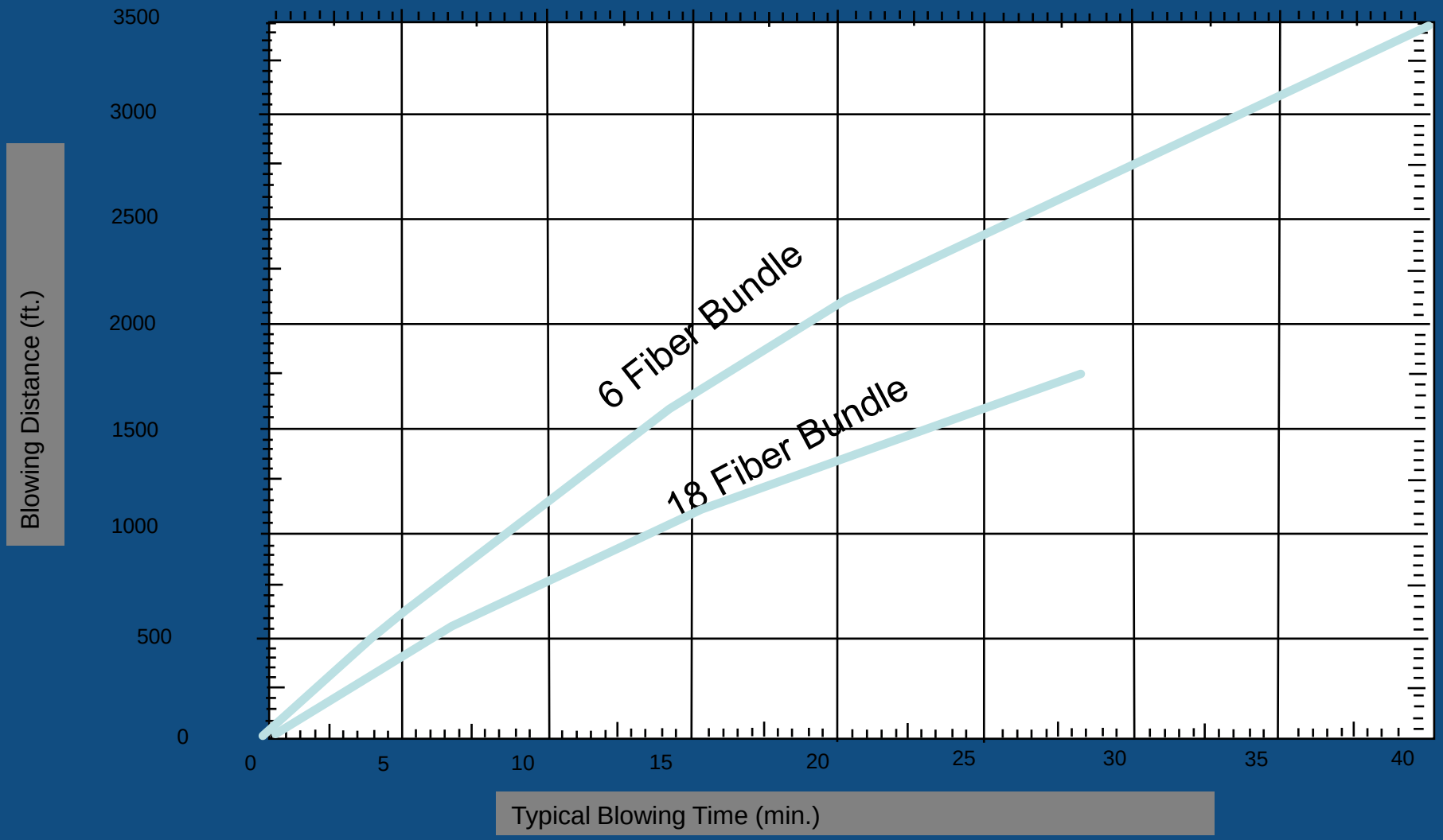
Designing a Blown Fiber System



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Designing a Blown Fiber System

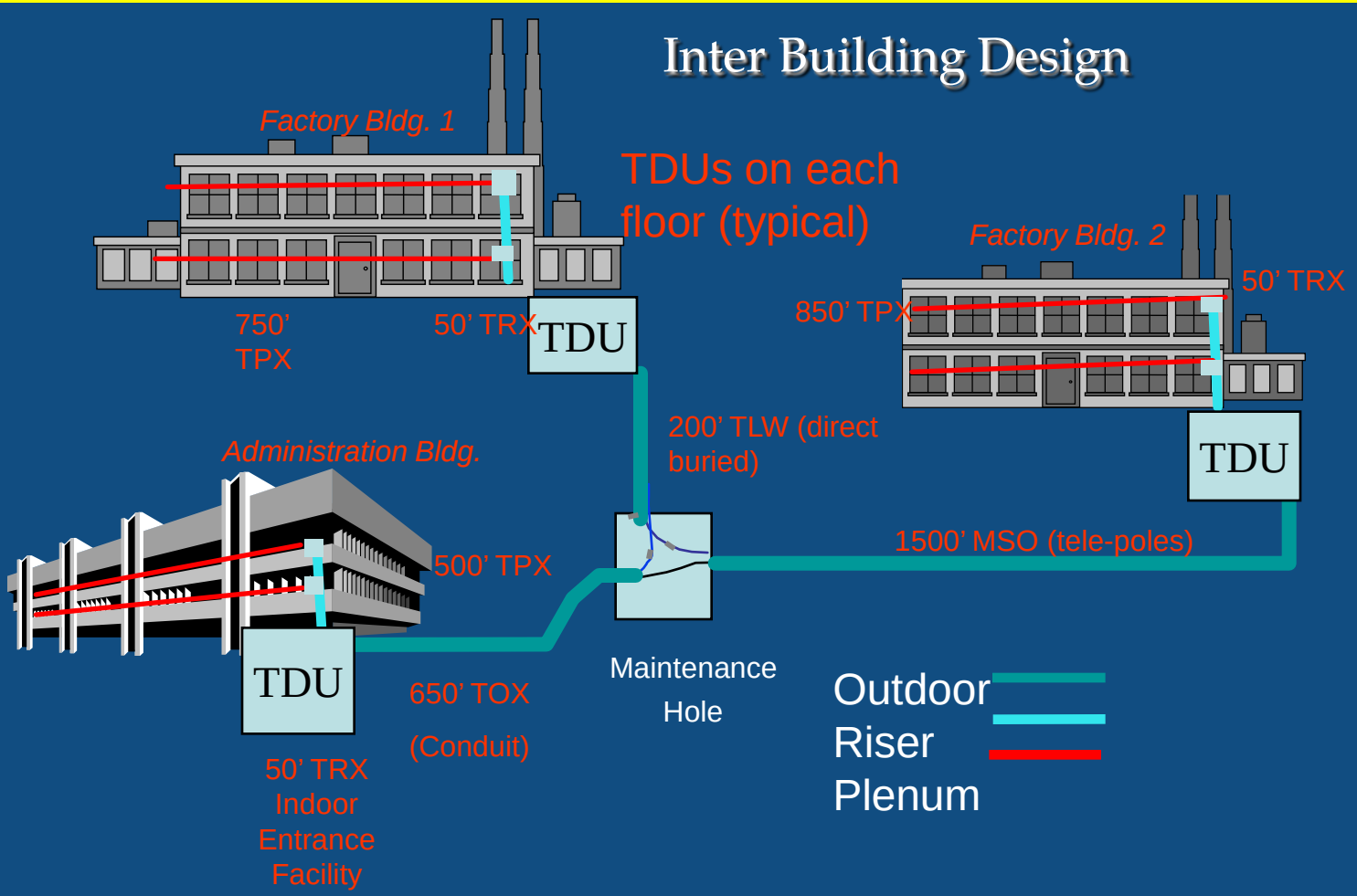
2, 4 & 6 Fiber Bundles	Approx. Distance
OSP MSO Aerial TC	4000 ft
All other OSP & TRX TC	3300 ft
TGX, TPX & NA3 TC	1950 ft

12, 18 & 24 Fiber Bundles	Approx. Distance
OSP MSO Aerial TC	1950 ft
All other OSP & TRX TB	1750 ft
TGX, TPX & NA3 TC	1000 ft

*All distances are approx. using one (1) blowing head

**Factors that influence actual blowing distance: location, number & severity of bends. The fiber bundle size and tube cable type.

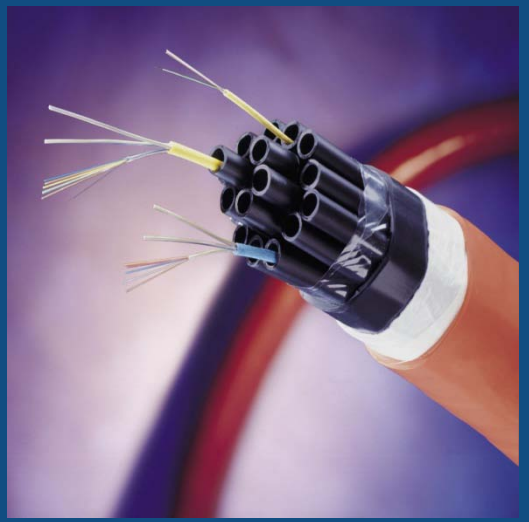
Designing a Blown Fiber System



Designing a Blown Fiber System

On-Demand Capacity

Infrastructure + Capacity =
Delivery at An Efficient Cost



- With Air-blown Fiber, We Always Know there is Enough Capacity for Emerging Technology Adoption & Growth
- Provides the Bandwidth When and Where We Need it
- Utilize Only the Amount of Tubes We Currently Need, While Leaving the Others Empty for Expansion & Growth (up to 19 tubes within overall tube structure)

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Designing a Blown Fiber System

Major Limitations of Traditional Infrastructures

- Causes Disruption to Daily Activities & Operations of Health Facility
- Speed & Delivery of IT Projects, Implementation of New Medical Equipment etc. can be Slow due to Network Upgrade and Bandwidth Needs
- Limited 5-6 Year Life Cycle Before Hospital-Healthcare Requirements Change
- Time & Expense to Prepare for Infectious Disease Processes Prior to any Network Infrastructure Changes Due to Construction Work

Designing a Blown Fiber System

Major Limitations of Traditional Infrastructures

- Forces IT or Facilities Management to Forecast Predetermined Type & Amount of Fiber for Next 5-6 Years
- Limits Bandwidth and Network Capacity for Growth
- Paralyzes the Network Against Change
- Uses Today's Capital for Tomorrow's Projects
- Network Upgrades, Expansions, and Reconfigurations are Time Consuming & Expensive (Labor-intensive Costs) — No ROI; Recurring Costs
- Cannot Easily Make Network Changes to Clean Rooms, Clinical, and Sanitized Areas

Bill Spooner— Senior Vice President & CIO Sharp HealthCare

Designing a Blown Fiber System

Trends in Healthcare Affecting the IT Network…

- Emergence of *Bandwidth-Intensive* Imaging Equipment & Technologies (CT Scanners, MRI Telemedicine, Nurse Call Systems)
- Convergence of Clinical, VOIP, & IT Systems
- New Infectious Disease Mandates Calling for Improved Patient Safety
- Quicker Turnaround of IT Projects
  - Faster Implementation of New Technologies
  - Clinical Flow Processes and more
- Uncertain Network Growth
- Cost Control -- Constrained Budgets to Do More with Less

These Trends Require a More Flexible Network Infrastructure to Keep up with Hospital/Healthcare Change

Definition of a Blown Fiber System

Healthcare's Need for a More Flexible IT Network

Today's Hospital-Healthcare IT Networks Require an Infrastructure that Provides...

- Real-Time Control of Bandwidth For Fast Implementation of New Medical Equipment, Scanners, Telemedicine and Emerging Technologies, as well as Capacity for Growth
- Fast & Easy Network Reconfigurations, Expansions, & Upgrades for Speed and Delivery of Clinical Workflow, IT Projects, HIPAA Mandates, and Campus Expansions
- Patient Safe Methods of Delivering Network Adds, Moves & Changes
- Reliable Integrated Connectivity with Less Downtime
- The Most Cost Effective Infrastructure Available with Measurable ROI

Definition of a Blown Fiber System

Patient Safety

Traditional Fiber Optic Infrastructures

- **Required Preparation for IT Network Changes with Patient Safety Compliance is Time Consuming & Expensive**
- **REQUIREMENTS:**
  - **USE OF NAPEs (Negative Air Pressure Enclosure) — Cost Ranges from $3,500-$6,000**
  - **USE OF HEPA Filters**
  - **MOVEMENT of Patients Often Necessary**
  - **Special Protective Clothing for Construction Crew**
  - **Special Disease Control Training for Labor Workers**
  - **Infection Control Procedures Add Approx. 30% to the Labor Hours & Cost of a Network Project**

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Definition of a Blown Fiber System

Traditional Fiber Optic Infrastructures:

- Require Construction Work for Network Upgrades, Expansions, Reconfigurations or any Adds, Moves or Changes
- Conventional Fiber Optic Infrastructures Require Entrance into Ceiling Tiles, Walls, or Floors where Toxic Mold Spores or Airborne Pathogens Can Lay Dormant Until Disturbed — Representing a Direct Threat to Immune Deficient Patients & to Highly Sanitized and Intensive Care Areas
- **MUST** Comply with ICRA (Infectious Disease Control Risk Assessment) Standards & Risk Management Planning from OSHPD (Office of Statewide Health Planning & Development)

Definition of a Blown Fiber System

Air-blown Fiber & Patient Safety

- After the Air-blown Fiber Tubes have been Installed, Network Expansions, Upgrades, & Reconfigurations Are Made at the Endpoints of the Network Pathway
- *Eliminates* the need for CONSTRUCTION Work and Infectious Disease Processes - Even in Sterile & Immunocompromised Areas

Definition of a Blown Fiber System

Why Air-blown Fiber is Clean?

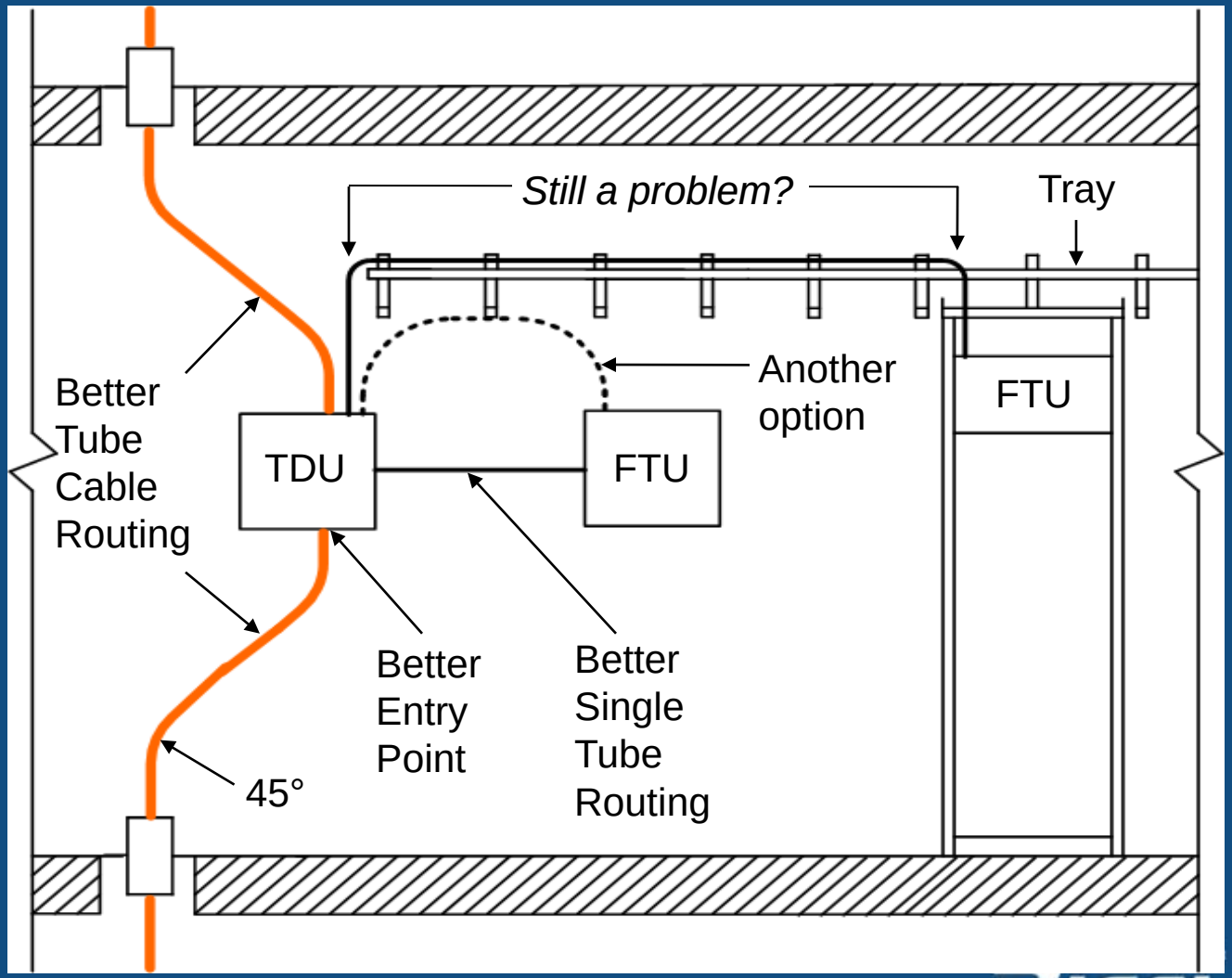
Once Tube Cable is Installed, Network MACs are Accomplished with...

- No Re-Entrance into Conduit
- No Disruption to Facility or Daily Operations
- No Large Work Crews
- No Disruption to Ceilings, Walls, Floors etc.
- No Additional Conduit in Most Cases

Designing a Blown Fiber System

Tight bends eliminated for smoother routing and better blowability

If Single Tube route still contains numerous bends, *"Push"* Fiber Bundle from TDU to FTU



Definition of a Blown Fiber System

ABF-Who's Using & Why

4 Primary Characteristics of the ABF Adopter/Customer:

- (a) Zero Downtime Environment
- (b) Restricted, Secure, Dangerous, or Highly Sanitized Areas
- (c) Dynamic LANs with Network Changes & MACs, Requiring Speed and Quick Network Project Turnaround

Based Upon Characteristics, Typical ABF Customers Include:

- (a & b) Hospital/Healthcare, Manufacturing/Automation/Process Controls, Airport, Government & Military, Utility & Sanitation, Mine, Prison, Research, Municipal, and Casino Facilities
- (c) Hospital/Healthcare, Airport, Government & Military, Casino, Convention Center, Entertainment Park, University, Some Stadium, and Some Corporate Facilities/Campuses

Definition of a Blown Fiber System

Air-blown Fiber…Summary

- Saves Time and Money
- Expansion and Replacement Made Easy
- Fast & Easy Turnaround of Network Changes—Even in Clean Rooms and ALL Sterile Areas — for Quicker Response Time to Meet Critical Hospital-Healthcare Needs
- Reduces Network Downtime
- Virtually Unlimited Capacity for Growth
- Eliminates Disruption
- Reduces Risk of Infection to Patients
- Bandwidth-on-Demand for Quick & Easy Adoption of Emerging Medical Technologies and New Clinical Processes
- Allows for Real-time Control of Bandwidth, Capacity, and Budget
- Guards Against Network Obsolescence Allowing the Network to Evolve in Real-Time with the Evolution of Healthcare

Definition of a Blown Fiber System

Thank You!

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