Fibre Reference Guidelines

Intelligent Transportation Systems Engineering

Ministry of Transportation and Infrastructure

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Revision History

Date	Pages Affected	Description of Revision

Preface

Thank you to James Driedger, formerly of the City of Vancouver, and to CICBC for their contributions and support for these guidelines.

British Columbia Ministry of Transportation and Infrastructure

SECTION 100
INTRODUCTION

101 INTRODUCTION AND PURPOSE

Fibre optic cable is becoming a crucial component for public agencies and many are deciding their own fibre networks are the right direction. Installing, operating and maintaining a fibre network is relatively new to the public sector and there is increasing demand for the sharing of knowledge and experience so that the benefits of a fibre network can be realized efficiently and effectively.

The purpose of these guidelines is to assist public agencies as they begin or continue to develop their fibre optic cable programs and to create a shared understanding with consistency to help facilitate sharing agreements among agencies The guidelines cover a variety of topics that include both the technical and business side of a fibre optic network, agreements with other organization and range from before the network to after it has been installed.

This manual is also intended to be a living document, so feedback and comments are welcome for further editions.

DISCLAIMER:

The following material is for general information purposes only. Any user of this document should not rely on this information as a basis for making any business, legal, engineering or any other decisions. This is only intended to be a guide and is not intended to be a substitute for sound engineering knowledge, judgment, or experience and does not attempt to duplicate material already covered in relevant engineering documentation, such as the Canadian Electrical Code.

Any action taken should be with advice from relevant agency staff.

The authors and contributors of this guide are not responsible for any false or incomplete information presented in this guide.

The Provincial Government, associated ministries and staff are not responsible for any false or incomplete information presented in this guide and this is not an official endorsement of any of the information presented.

102 DEFINITIONS AND ABBREVIATIONS

ADSS. All-Dielectric Self-Support.
AP. Access point. Typically, a small wireless location. Not a tower or rooftop location. May be found on a street light pole.
CICBC. Communications Infrastructure Committee B.C.
CRTC. Canadian Radio and Telecommunications Commission.
dB. Decibel. Used as a unit of measure to show loss over distance, or loss at splice or patching locations.
DWDM. Dense Wave Division Multiplexing. Uses lasers on different wavelengths on the same fibre strand to maximize bandwidth on each fibre.
EMT. Electrical metallic tubing.
Folded ring. A fibre “ring” where the ring is made up of different fibre strands in the same cable—sometimes even in the same buffer tube. Essentially, it is still a single point of failure (SPOF).
FOSC. Fibre-optic splice closure.
FRE PVC. UV rated PVC. Used for installation under a bridge or anywhere the duct may have exposure to direct, or indirect sunlight (such as reflection off water).
FSM. Fibre Strand Metre
HDPE. High density polyethylene.
ID. Inside diameter (usually in reference to a conduit).
IRU. Indefeasible right of use. (Typically, a 20–year term, or the life of the fibre cable.)
ISP. Internet service provider
ISP. Inside plant.
IT. Information technology.
LT. Loose-tube.
LTE. Long-Term Evolution (a standard for mobile communications).
MH. Manhole.
MM. Multimode.
NDC. Non-dominant carrier.
OD. Outside diameter (usually in reference to a conduit or a fibre cable).
OH&S. Occupational health and safety.
OSP. Outside plant.
OTDR. Optical time-domain reflectometer.
PLP. Pre-formed line products.
POP. Point of presence.
PVC. Polyvinyl chloride.
RoW. Right of way.
SB. Service box.
SCADA. Supervisory Control and Data Acquisition.
SDR. Standard Dimension Ratio**.**
SFM. Strand Fibre Metres.
SLA. Service Level Agreement.
SM. Single mode.

SPO. Specific Permit of Occupation.
SPOF. Single point of failure.
SSA. Support Structure Agreement.
SV. Service vault.
TMP. Traffic management plan.
VOIP. Voice Over Internet Protocol.

103 FIBRE OVERVIEW

103.1 MEASUREMENTS

a) Fibre is usually referred to in factors of 12 bundled fibres (labelled 12F or 12C). A single ribbon is made up of 12F, and a tube usually contains 12F Loose-Tube (LT) as shown in Figure 1. Sometimes, two 12F ribbons are folded together to make a 24F folded ribbon or 144F in sets of 12F ribbons. There are exceptions, however, as some smaller count cables have tubes containing only 6F.

b) Consistency regarding measurement units is important. Some organizations use metric measurements while others may use Imperial. For example, the distance between poles and vaults may be shown as 30 m or as 100' and duct sizing as 4″ or 100 mm. A 16,000' reel has approximately 5,000 m on it. (Note that there are approx. 3.28' in 1 m.).

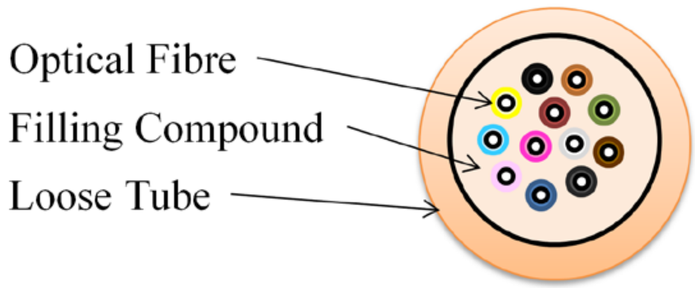

Figure 1: 12F LT

c) The individual fibres found in a ribbon are also differentiated by a colour code. A colour matrix is affixed to a single fibre (blue, orange, green, brown, slate, white, red, black, yellow, violet, rose, aqua) for easy field identification.

103.2 ROUTE DISTANCE

a) Route distance is commonly used to describe a fibre network, although, it is not always an easy calculation to make.

b) Total distance of the network is difficult to determine and depends on many factors. An organization may have two different cables running along the same route, one that is owned outright and the other is 3rd party owned, but with some organizationally controlled fibres. If inside the building fibres are included, it is important to account for both the building entrance length and how the cable has been swapped. The key is to be consistent and ensure all parties are aware of how route distance is calculated and what is included.

c) One option is to count only individual cables distance independent of the number of fibres inside. In this case, a 12F and 432F cable is counted equivalently.

d) Alternatively, the fibre strand metre (FSM) calculation can be used, for example in Figure 2, the calculation would be: $50{,}000(144+12)+14(12)+25{,}000(144+12)=\ 11{,}700{,}168\ fsm$.

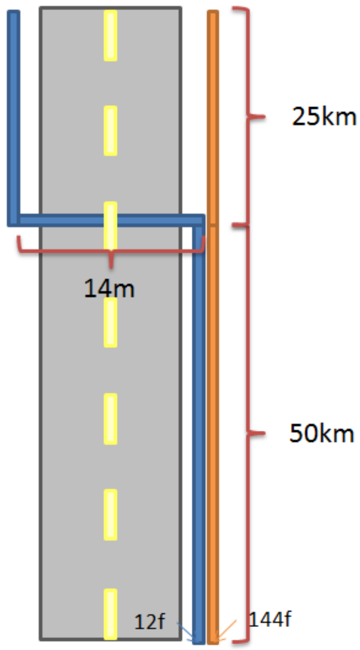

Figure 2: Fibre Strand Metre Calculation

SECTION 200
STARTING A FIBRE PROGRAM

201 BUILDING A SUCCESSFUL PUBLIC FIBRE NETWORK

201.1 WHAT IS FIBRE?

a) Fibre optic cable is comprised of a glass strand about the size of a hair over which lasers transmit light in different wavelengths to provide communications services. Through these cables large amounts of data can safely and securely be transmitted over long distances.

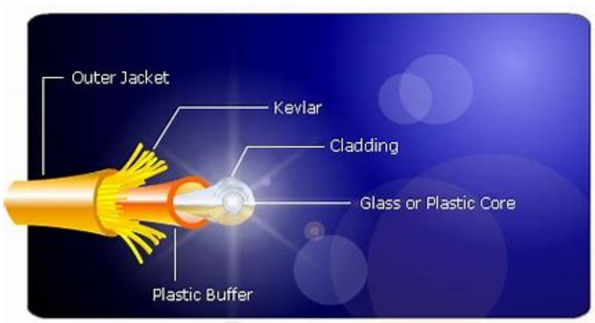

Figure 3: Optical Fibre

b) Fibre optic cable is the medium over which all present age digital media (including voice and data services) are delivered. Copper and coaxial cable, which previously were the method to provide these services, suffer decibel loss (noise) that limits the distance over which they can reasonably provide these services.

c) Early telecommunications companies provided voice services over copper and some were owned by the provinces to ensure that all citizens received a connection. Large companies needed to know they would be able to recoup their costs, so there was not much in the way of competition. As technology advanced, cable companies started up and used coaxial cable to provide their connectivity. The computer age brought us the internet; cellular networks were constructed with both advances in technology and customer needs bringing about the demand for more competition in the voice and data markets.

201.2 WHY BUILD A FIBRE NETWORK?

a) There are many benefits to building an organizationally owned fibre network, but the biggest are control, cost savings and increased redundancy and reliability.

b) Control of a network is an advantage as corporate and government timelines may not always coincide. Municipalities should factor in the long-term impacts of getting access to dark fibre, which is unused fibre that is available for use in fibre-optic communications. Fibre networks built today will benefit citizens for decades.

c) An example of the benefit of an organization controlling their own fibre network is that during a fibre outage a commercial company may take over 18 hours to complete a repair, while municipal networks can be repaired in a fraction of the time since municipal engineering crews and IT staff are able to respond quicker and are familiar with the network. This can be crucial depending on where the outage is and if redundancy is sufficient.

d) Cost savings compared to a commercially managed lease can be significant. In some cases, it can pay for itself within four years. The right plan (and coordination with other parties) can make a department self-funding.

e) A recent example posted by the Institute for Local Self-Reliance (ILSR) is the town of Virginia Beach, Virginia. https://muninetworks.org/tags-343. Their municipal network saves the city approximately $500,000 / year on connection fees.

f) Building a fibre network gives an organization control and full knowledge of their network architecture, which is important for redundancy and reliability.

g) Fibre cable is relatively cheap to buy and installing surplus cable is recommended as the upfront cost will be less than future installations. This will allow adding new services as necessary without having to install a new fibre cable.

201.3 IS FIBRE A UTILITY?

a) Determining if fibre will be considered a utility is key to understanding how a dedicated fibre department would be organized or if it will be managed by another department. Everyone benefits from a fibre network, but who will manage the assets within an organization may depend on this decision.

b) One such argument for fibre as a utility is that it is expensive to operate, expand and critical systems can be entirely fibre dependent. The fibre network architecture also builds out in a similar fashion to other utilities such as water or sewers. The expansion of a fibre network is usually driven by IT needs, with Engineering as a partner or facilitator, but it can be a challenge finding the right processes to coordinate the two. In some organizations the direction will come from the Planning Department.

c) The Canadian Radio-television and Telecommunications (CRTC) declared that broadband internet is a basic service (CRTC 2016-496), which gives additional weight to the argument that a fibre network could be considered a utility.

202 GETTING STARTED

a) Start with a map and a plan showing how you will move ahead with fibre connectivity in the organization. A good design sets a good path.

b) Wireless and fibre can complement each other. Fibre is a secure path for handling large quantities of data, while wireless provides greater reach at a fraction of the cost of extending fibre. Hence wireless companies sometimes connect access point (AP) sites with power and fibre. A hybrid network (wireless, copper, and fibre), can be a viable solution for traffic networks.

c) Manage right-of-way (RoW) space as it is valuable real estate.

d) An operational person or team will be required to operate and maintain the fibre network along with the possibility of getting crew access for civil work, mapping work, placing and splicing. Government organizations may sub-contract this (although a few use internal resources).

e) Identify external contractors and vendors who will be able to supply the materials, design and install the fibre network and inspection of the network.

f) Organize information about the network prior to building it to avoid future time and cost issues (See Section 801, Mapping and Documentation).

203 BUILDING A BUSINESS CASE

203.1 PRELIMINARIES

a) Determine how the organization will manage, operate and maintain a fibre network, whether it is IT, Planning, Engineering or another department, before starting a business case.

b) Identify funding sources for construction, operation and maintenance of the network.

c) Determine return on investment and the long-term value of the network.

d) Identify a champion for the business case within the organization.

203.2 SCOPE

a) Having a clear fibre network scope statement that sells the idea of a fibre network will start the process of filling out a formal business case and make the case stronger.

b) The scope of the business case should include the purpose and benefits to the organization, priorities and options to complete the network and any risks that may be present.

c) Determine the purpose of the proposed network. For example, it could be to save costs, build for reliability and redundancy, generate revenue, or to attract business opportunities.

d) It is important to keep everyone informed on the project goals, benefits status and progress.

203.3 ORGANIZATIONAL SUPPORT

a) The core of a business case will always be the cost-benefit analysis (CBA). There are ways to offset costs by looking at deals, partnerships, or cost recovery via an open access network. An organization will have to determine if these options will work for them and if the network provides an opportunity for them, such as extra capacity in the conduit or fibre optic cables.

b) In the business case include a network map, prepare a budget estimate and identify a project team to champion, support, plan, design, construct, operate and maintain this fibre network.

c) Have check-in points (milestones) along the way to ensure that inevitable changes and issues can be dealt with, while maintaining the overall goals and metrics of the plan.

204 STRATAGIES FOR BUILDING OUT A FIBRE NETWORK

a) There are many ways that a fibre network could be constructed, and these range from capital build projects to using abandoned ducts, partnerships or a combination of options to achieve the desired goal.

b) Organizations often focus on just one or two of the five options. This can work, but the ideal way is to make use of all five and maximize their potential benefit. This is the quickest way to expand a fibre network, save the most money and will ultimately produce the best value for your organization.

204.1 CAPITAL BUDGETS

a) Use capital budgets and projects to drive builds, such as VOIP, traffic signals, road widening and infrastructure improvements, security cameras, and connecting facilities and buildings.

b) Using the organization's own capital allows direct control of the project. Deals and partnerships may be directed by the other party, which could mean the outcome does not fully achieve the desired goal for the organization.

204.2 NEW DEVELOPMENT

a) Developers can install communications conduit along their RoW as part of the development benefit/amenity for the community. Through the permitting process, developers can install conduit for the benefit of the organization.

b) This approach may take years, and patience, but over time and with good mapping and record keeping a significant route can be created at a lower cost.

204.3 UTILITY UPGRADES AND DIG ONCE POLICY

a) Install a communications duct and vaults along with other utility upgrades. (This is referred to as Dig Once Policy.)

b) Advocate for the organization to adopt Dig Once. This policy has many advantages, including cost saving and minimization of impact to roadways.

c) There will need to be cooperation from the Engineering Department to ensure proper implementation through advocating and planning. The Engineering Department should be notified of projects and review designs to take advantage of opportunities. With their assistance, the fibre network will be built in a fraction of the normal time and cost.

d) Limiting how often trenching occurs on the roadway will saves money and preserves the integrity of the road. It is approximately 10 times more expensive to add infrastructure after installation has occurred. (https://www.fhwa.dot.gov/policy/otps/workplan.cfm).

204.4 ABANDONED DUCTS

a) There are abandoned ducts in many public RoWs and this is a great opportunity to repurpose into communication duct since the route has already been established.

b) Water and sewer mains and gas pipes are the most common abandoned ducts. An inspection is required to determine how usable the pipes will be and the cost to make it suitable for communications cabling.

c) This is a good application for using High Density Polyethylene (HDPE) to subduct the existing conduit. Valve locations may have to be cleared and additional vaults may have to be installed, but the relative cost savings is still significant over building a completely new network.

d) Note that there is risk and potential liability if the abandoned main collapses in the future and is the reason why an inspection by qualified engineers should be done to determine the structural integrity.

204.5 PARTNERSHIPS/DEALS

a) Partnering agreements with other organizations can greatly reduce costs for all parties involved.

b) Government organizations can lower costs through joint builds or cost sharing. Commercial carriers can also benefit, such as through leasing ducts, minimizing permit fees, providing fibre to offset fees, etc. However, partnerships should complement the plan, rather than drive the build-out and reliance on partners can affect control and timelines.

c) Government organizations are important customers for commercial carriers. The carriers can use existing routes and/or fibre networks to serve customers that support the local economy.

d) Another option is to arrange for an Indefeasible Right of Use (IRU) to fibres in a partner’s cable or own the sheath/jacket (which usually means ownership of the cable) to ensure access and control.

e) During partnership negotiations it may be possible to include upgrading of ducts and vaults as part of the fibre deal that may have been damaged or crushed in the past and are otherwise unusable.

f) Using commercial carriers to organize and coordinate the installation will save staff time. Commercial carriers install fibre every day, whereas many government organizations may do so only once or twice a year. Commercial carriers also have access to processes and resources (e.g., maintenance agreements), which may otherwise be unavailable.

205 CHALLENGES

a) There are many challenges that may be faced when building a fibre network including challenges based within the organization, related to ownership and funding, right-of-way management and ensuring fair deals are reached.

205.1 ORGANIZATION

a) A big challenge in implementing an overall plan is that experience with fibre in the public sector may still be limited. Identification of staff in the organization who can help create a successful network is crucial, as well as having a champion at the executive level who understands the issues and opportunities.

b) Another challenge is determining which department should fund a fibre network and who will own and operate it. A fibre optic cable can benefit many different departments and groups within the organization, such as community centres, fire halls, police stations, subsidized housing, engineering sites, pump stations, Supervisory Control and Data Acquisition (SCADA) networks, traffic and security cameras, traffic controllers, transfer stations, municipal halls, etc. Locations the network bypasses may soon need traffic cameras and controllers, cameras for monitoring SCADA networks near pump stations, security cameras, or other unforeseen needs.

c) The organization may be open to standing authority to pursue deals or council/ executive may need to vote or decide on each deal. Delays in negotiations can cause issues or perhaps cause a deal to not be completed. A commercial company may look elsewhere if they do not get a timely response.

d) There may be changing priorities within an organization and one key to success is having a long-term plan for the network. A business case or strategic plan document can be a framework for project budget proposals. This will allow taking advantage of opportunities when they arise.

e) Some organizations are starting with a Digital Strategy and/or Fibre Strategy and some have gone with an “open access” fibre network, while others have taken a more opportunistic advantage of outside deals and partnerships so that the fibre network evolves over time without a set plan.

205.2 OWNERSHIP AND FUNDING

a) The question of who will own the fibre is an important matter to resolve. As discussed previously, it is an issue that must be identified and understood early in the process. The most common owners in a government organization are IT, Engineering or Planning. This may be different for each organization and one choice is not always right for all organizations.

205.3 ROW MANAGEMENT

a) There are situations where RoW space is sold or used for other purposes resulting in joint builds being the only way for expansion to continue. For example, as wireless sites expand they need power and fibre. If each major wireless carrier did a civil build for both power and communications down the same road or lane, all available RoW space in dense urban areas would be used up in the next two or three years. Carriers should work with government organizations to help manage this limited resource.

205.4 FAIR DEALS

a) Since many government organizations are new to fibre, they need to be careful to ensure they are getting a good deal. Not all agencies have decided to share ducts or fibres in a cable with third parties. Determining a cost/benefit calculation can be difficult as every situation is unique when reviewing potential deals.

b) The timing of a deal is important. Differing timelines can result in lost opportunities. For municipal partners, the challenge is to find ways for their internal review and approval processes to accommodate the (typically shorter) commercial timelines.

c) Most government organizations are not set up to offer commercial Service Level Agreements (SLA) and can instead only provide “best effort” service. Government organizations may not have trained staff on 24/7 to maintain the fibre they own and may not have maintenance agreements in place. It is important for both sides to understand what maintenance can reasonably be expected based on a “best efforts” agreement. Once the government organization gains experience with fibre, it will be better able to support a commercial maintenance SLA.

BRITISH COLUMBIA

Ministry of Transportation and Infrastructure

SECTION 300
PLANNING

301 STANDARDS

a) Organizations often use different standards, which can result in a variety of practices and equipment. It is important to prepare and follow standards established by engineers within the organization as much as possible. It is common to connect a fibre network to other organizations' networks to extend its reach and reduce costs, but they may have different standards. It is also important to keep in mind that there are the physical engineering standards as well as the policies and practices related to privacy and security standards.

301.1 ENGINEERING STANDARDS

a) Many organizations have standards related to civil construction, but fibre optic cable work is different than the electrical standards referred to under the electrical code. Vault sizes, conduit bend radii, fibre cable designs, pulling standards, etc. all require background knowledge specific to communications. Fibre optic cable has only been commonly used in the private sector over the past 20 years. The training and skilled workforce required for this type of undertaking is even less common in the public sector.

b) Identify any internal resources with a background in fibre. Alternatively, hire a fibre-specific resource to help guide the early stages of expansion.

c) Over time, government organizations should create a fibre standard specific to the organization based on the geography, specific stakeholders and their needs. Remember that this document is a guideline and not a standard.

301.2 PRIVACY AND SECURUITY STANDARDS

a) Organizations should have standards for privacy and security related matters, which should be developed prior to the expansion of a network or partnership deals if none are in place.

b) It may be necessary to conduct a Privacy Impact Assessment when devices are connected to a fibre network. The types of devices that collect, use or disclose personal information via a fibre network could be cameras or Bluetooth detectors. A Privacy Impact Assessment examines the privacy impacts and mitigates risks. Please contact the internal IT department to discuss further.

c) It also may be necessary to conduct a Security Threat Risk Assessment to determine the need to protect the information of information technology assets supported by the fibre network. Often an assessment is conducted to determine the level of harm and system criticality. Risks are measured, and an action plan is developed to mitigate the risks. Please contact the internal IT department to discuss further.

302 VALUE AND COST

302.1 COST ESTIMATES

a) There are many factors that can affect estimating costs for fibre installation but determining cost estimates on a rough order of magnitude is possible. Over time an organization will build a comfort level for the average costs for each project.

b) Budgets usually dictate building for immediate needs, but putting in a larger vault, some additional conduit, or a cable with a larger fibre count can yield significant future savings as demand grows.

c) Any mitigation-related savings may be lost to increased operational and maintenance costs. Understand the various build methods to pick the right solution for the project.

d) The following cost estimates are rough and generalized and are for illustration only.

e) Cost estimates related to trenching:
- Rural trenching can range from $100-150 per metre
- Urban trenching can range from $500-650 per metre and in very dense areas may reach $1,100 per metre
- Once a trench is opened, adding another 100mm duct is approximately $20 per metre.

f) Cost estimates related to vaults
- A new 1.5 metre service vault (SV) may be $10,000

g) Cost estimates related to cable
- Cable-placing cost typically ranges from $4-12 per metre
- Upgrading a 48F cable to a 144F after five years could cost $10-12 per metre (additional civil work if required may add $500-1,000 per metre)
- If a 144F had been pulled originally the additional costs be $3-4 per metre
- Leaving slack coils of cable for future splices or for maintenance can cost $400 per location but can save a future $10,000 repair bill.

303 VALUING THE ASSET

a) There is no single way to value fibre assets. A variety of methods can be used for estimating value and each organization should develop their own methods that work best for them. Other government organizations who may have already gone through the exercise can assist. Consideration for capitalization versus operational spending as well as depreciation is needed to determine how best to set up the valuation and funding of the asset, as well as how to value deals.

b) Some considerations that can have a significant impact on how an organization views and funds the fibre work are the savings from not having to pay for a managed service, the cost to build a network from scratch, the depreciation of an asset and the cost to the organization if a site is lost due to a network outage for a day.

c) As the network grows and the asset increases, there must be an operational and maintenance budget associated with the asset to maintain the value of the network.

d) The reliability of the network is crucial to provide a valuable service for the organization and partners.

e) Applying for internal and external funding for fibre-specific projects can be a challenge, as fibre has (until recently) not usually been publicly funded. Understanding the value of what is being proposed is a key element to being able to sell a request for budget estimates.

304 RISK MITIGATION

a) Although fibre is a recent development for government organizations, the risks associated with taking on something new are offset by the advantages of having a fibre network. There are significant savings from not having to lease fibre from a commercial carrier. (As with renting versus owning a property, a mortgage should come down over time, but rent will always go up).

b) There is the ability to build diversity into the network and make it more secure in the event of a minor or major disaster. The risk in owning a fibre network is mitigated by the advantages the network affords the organization in times of disaster.

c) Starting the process with a few small projects or smaller deals can produce confidence in stakeholders. As the organization’s fibre department gains experience, risk mitigation of small projects will become less of an issue. Fibre can be discussed as something positive, improving the organization’s reliability and redundancy through fibre diversity, as well as saving money.

d) For any fibre project or agreement, legal advice should be considered to assist with risk mitigation.

305 RELIABILITY AND REDUNDANCY

305.1 REDUNDANCY

a) Redundancy and diversity makes the network more resilient. Redundancy of equipment and diversity of paths gives communications networks a better chance of surviving a major disaster.

b) Even if the fibre does not survive a disaster, recovery will be faster if there is a plan, accurate maps, access to staff and contractors and if equipment and fibre cables are on hand to quickly rebuild the fibre network.

c) Ensure the network's weaknesses are noted (such as single points of failure) and plan future projects to improve the network to add increased diversity.

d) Some government organizations may not be able to build in diversity to individual sites but are able to build in diversity to hubs and core sites. This may change over time as opportunities and the network size and reach grows.

305.2 SPOF (SINGLE POINT OF FAILURE)

a) Despite diversity between hubs in the network, there may still be outages that occur and must be repaired.

b) In many cases, the organization builds a fibre pathway that costs a significant amount of money, but when they get to the building on either end the building entry is the same conduit and vault as the diverse path. So, in this case they are approximately 99% diverse, but the last 1% is still a single point of failure (SPOF).

c) Building a second entrance to a site can be very expensive. However, a common misconception is that a SPOF can be remedied merely by using a different entry duct than the primary path; but, if the two ducts are mere inches apart, they are just as vulnerable as before.

d) It has been suggested that having at least 10m distance in between ducts is enough to avoid both being destroyed by an errant back hoe. Diversity can also be an underground and aerial cable on the same route.

e) There is a large cost to building in diversity, which is why it is often recommended for negotiations to consider diversity as part of the agreement.

305.3 FOLDED RING

a) A folded ring (sometimes referred to as a collapsed ring) may carry fibre on the same path for many kilometres. However, it does not provide true diversity as a folded ring is merely different fibres on the same path. This makes it a SPOF.

305.4 INFORMING THE ORGANIZATION

a) Building in full physical redundancy is expensive and it may take years to achieve. Informing executive of the network's reliability and redundancy status, its limitations and significant failure points is important. If building diversity with an organization's own capital is not feasible, consider swapping fibres with other organizations.

306 TRAFFIC AND CAMERAS

Figure 4: Traffic Cameras (https://www.axis.com/yourtraffic/index.php)

a) Many government organizations run their traffic controllers on copper or over wireless. A few have already moved toward fibre. Getting fibre to a controlled intersection allows using cameras for traffic monitoring. Once operating cameras on fibre, why not put the controller onto the fibre? Why not security cameras, too? The opportunities are endless, but it potentially requires a lot of fibre.

b) Some organizations use 2F per traffic camera. In some cases, there is more than one camera at an intersection and a city may has over 800 controlled intersections. If there were one traffic camera at each intersection, then it would require 1,600 fibres. As cameras increase the number of cameras per fibre should be increased.

c) Security cameras are sometimes different from traffic cameras since they do not have the same purpose and therefore different requirements. Typically, neither group wants to share. Traffic does not usually record video footage and do not need high definition cameras. Traffic may also want to share with other regional groups, whereas (for legal reasons) security groups usually need strict access controls over their footage.

d) The number of fibres needed can climb quickly. For example, perhaps an organization needs six fibres to each community site, six for each controlled intersection, another two fibres to each bus stop, plus connections for engineering sites, fibre to wireless AP's, core fibre backbone, plus surplus fibres for growth and deals. It can be easy to use up a fibre cable containing hundreds of fibres. Many backbone fibre cables have upwards of 432F. In some commercial networks there are 864F cables and in at least one case a commercial group installed a 1,728F cable into Harbour Centre, which is the western Canadian Internet exchange. Therefore, always consider future needs when placing a new cable.

307 REGULATORY MATTERS

307.1 SUPPORT STRUCTURE AGREEMENTS (SSAS)

a) Support Structure Agreements (SSAs) allow organizations to apply to Telus and/or BC Hydro for access to their structures: poles (aerial) and vaults and ducts (underground). SSAs can be far cheaper than a civil build.

b) As Telus is regulated by the CRTC, they may require an organization to be a non-dominant carrier (NDC) to work in their structures and will need to sign their SSA.

c) BC Hydro also requires an SSA, and both groups will charge annual fees in addition to the upfront engineering costs.

d) In BC Hydro vaults if there is space in neutral ducts they can be assigned to third parties if there is enough space. This also requires qualified Hydro standby people for access.

e) For BC Hydro aerial applications, the communication space is above the Telus strand on joint use poles (JUP) and below the Hydro secondary neutral cable. A new strand will normally be required, as well as anchoring.

307.2 CANADIAN RADIO-TELEVISION AND TELECOMMUNICATIONS COMMISSION

a) The CRTC is the federal regulatory body that controls and guides decisions about how carriers work together. An organization may choose to become an NDC, but there are pros and cons to doing this. Even if they choose not to become an NDC, it is important to know the implications and to have the legal department review the topic for a better understanding of the issues.

307.3 DARK FIBRE

a) Dark fibre is fibre that is unlit and has no services running on it. The commercial carriers normally sell a managed (lit) service for voice and data and they charge more for a higher amount of bandwidth. Access to dark fibre allows the customer to install whatever they want to manage their own needs, requirements and upgrades.

b) The CRTC may regulate that commercial carriers must lease out dark fibre to other parties, but currently the carriers will only swap dark fibre amongst themselves. Organizations will need to be registered NDCs if they want to take advantage of this opportunity. Consult with the legal team for details.

Ministry of Transportation and Infrastructure

SECTION 400
DESIGN GUIDELINES

401 MAPPING AND DRAWINGS

a) Several types of maps should be used for a fibre network, including high level routing maps, civil permit drawings, engineering drawings and splicing finger diagrams.

b) Independent of the type of maps used, the key factor is accuracy. There is often a delay between work starting in the field and the updates to maps or other records. There are many examples of jobs coming to a halt as mapping did not accurately reflect ownership, which can cause long delays and cost a significant amount of money to correct.

401.1 MAPPING

a) Building a fibre network is a matter of connecting the dots. The map is the best tool to help make this happen and is considered a fluid document that will show progress over time. It will also help track metrics and build the business case for expanding the network. During emergency outages this resource will play a key part in repairing the fibre and thus minimizing any impacts to the organization.

b) Maps will also need to show the division between the public RoW and any private property.

401.2 ENGINEERING DRAWINGS

a) Engineering drawings and scope of work documents are important for companies to bid on any projects or perform easier installations. After construction, obtain redline drawings and record drawings (as-builts) to ensure the accuracy of what was constructed.

b) Accurate drawings will minimize accidental infrastructure strikes. If contractors know the true fibre depth, installed location and correct contacts, then the infrastructure is more likely to be avoided. However, if the infrastructure does not show up on the map then it is more likely to get hit.

402 INSTALLING FIBRE

402.1 PULLING, PLACING, AND JETTING

a) Underground fibre installation must identify confined spaces locations, the duct assignment (if known), whether string, rope, or mule tape is required and if it is already in place.

b) Aerial fibre installation must identify the strand assignment, any anchoring requirements and any tree trimming requirements.

c) For fibre installation using jetting, there must be identification of the locations where slack is required and where duct has been placed through a by-pass vault.

d) For all installation methods there must be calculation for the extra fibre needed for slack loops and end-location slack.

e) Ensure vaults are in places where crews can safely park to perform the installation and splicing work, i.e., away from an intersection, on a sidewalk, at a highway pull-over, behind barriers, etc.

BRITISH COLUMBIA

Ministry of Transportation and Infrastructure

SECTION 500
PROCUREMENT

501 PROCUREMENT PRACTICES

a) Most government organizations will have a formal procurement department and policies in place to follow. Below are some items to reference specific to fibre and bidding.

501.1 DRAWINGS

a) Prepare a drawing showing splicing, placing, and/or a civil drawing. This will also help when verifying as-built drawings.

501.2 SCOPE OF WORK

a) Keep the description or scope of work brief.

b) Refer to the drawing and require bidders to “verify the distances on the drawing.” This will protect you in the event of a discrepancy.

c) Request Optical Time Domain Reflectometer (OTDR) testing after the work is complete.

502 BID DOCUMENTS

502.1 TENDER DOCUMENTS

a) Decide on how to split up the work: by itemizing or lump sum.

.1 It is recommended the following be broken out:

- Materials.
- Labour.
- Flagging and Traffic Management Plan (TMP).
- Equipment.
- Miscellaneous items.

.2 Other important items include:

- Being named on the contractor’s insurance.
- Receiving a copy of the contractor’s Occupational Health and Safety (OH&S) program.
- Identifying the Prime Contractor.

.3 A 10% holdback should apply, based on receipt of the following:

- Signoff by inspector or representative.
- Receipt of daily tailgate sheets.
- Receipt of record drawings/as-builts/redlines within 10 business days of substantial completion.
- Extras will not be paid until the end of the project and then only if signed off by the inspector before the work began.
- OTDR test results

.4 The procurement department may wish to define how bids are to be structured, particularly under public tender.

.5 Ask for materials to be shipped to site as this may save on freight charges.

.6 Consider having commercial partners supply the fibre cable material since they have bulk buying power that government organizations do not have access to.

502.2 PRIME CONTRACTOR

a) Note that the safety responsibility on the worksite lies with the organization unless another party is indicated as the "prime contractor". If unfamiliar with this, then consult with the procurement department about this and how it may impact the bidding process.

502.3 PUBLIC TENDERS

a) Fibre cable installation often goes out to public tender, especially if the communications work is included in a larger electrical project.

a) Most communications companies are smaller than larger electrical contractors, and they do not usually have the funds for large bid bonds or have the staff time to review a 100+ page bid document.

b) The electrical contractors who are awarded the work go to their data group to do the outside plant (OSP) work. However, the data groups typically do not have the tools, equipment or the expertise to do the OSP work. They are more experienced working inside the premises. OSP cable installation is very different than outdoor fibre cable installation

c) Hire an inspection company to monitor the work to ensure you get a good final product.

SECTION 600
CONSTRUCTION GUIDELINES

601 CIVIL CONSTRUCTION

601.1 COMMUNICATION DUCTS

a) Polyvinyl Chloride

Figure 5: Bell end of PVC http://www.vinidex.com.au

.1 Communication duct is typically orange (standard for signifying underground communications) PVC DBII, Schedule 40, 100mm (4"). This is the most common duct size, which can fit as many as four or five cables in this duct. Additionally, 50mm (2") and 75mm (3") diameters are also available.

.2 The PVC DBII comes in 10′ and 20′ lengths. At one end is a bell end with the next duct needing to be primed and glued as the pieces are fitted together. The smaller 10′ lengths are preferred by crews as they are easier to move around a site.

.3 Note that the bend radius (sweeping bend) for fibre communication ducts are longer than those for copper or electrical cable ducts. This information is often available on the fibre data sheets.

.4 Do not forget to order end caps and elbows with bends of 22°, 45° and 90°.

b) Fibre Reinforced Epoxy conduit has a special UV rating for installation in exposed conditions such as bridges or overpasses

c) High Density Polyethylene

.1 High density polyethylene (HDPE) conduit comes on a reel of single, duplex or triplex and can be anywhere from 32 mm all the way up to 100 mm in diameter. HDPE is usually used when sub-ducting or drilling due to its increased flexibility.

.2 The conduit Outside Diameter (OD) is usually classified as either a normal walled measurement Standard Dimension Ratio (SDR) 11 or a thin walled measurement SRD 13.5. In cases where extra protection is required, a thick-walled measurement SDR 9 is usually installed (e.g., crossing a highway, or a rail track).

.3 Internal ribbing reduces the overall friction environment for pulling a cable. Fusing an HDPE conduit is very different from gluing a PVC duct.

601.2 VAULTS

Figure 6: Armtec Vault https://www.armtec.com/photo-album/hydro-communication-vaults/

a) Communication vaults are typically larger than those used for electrical installations due to the added space required for slack loops, fibre cable splicing and their larger bend radii. A typical slack storage loop or coil is 30m, with some parties installing almost 40m. The standard vault sizes are 1.2m SVs, 1.5m SVs and for large commercial applications the 3152 MH with dimensions of 3m x 1.5m x 2m.

b) One advantage of the 1.2m and 1.5m SVs is that either a vault-style lid or an H20-rated manhole (MH) lid can be used for road installation. The vault-style lid creates a better work environment, as the MH lid installation is considered a confined space.

c) Smaller style vaults, such as Service Boxes (SB), provide functionality in different conduit situations. Ask the engineering department what vaults they use, which may also work for fibre optic cable installation.

d) Fibre cable can be routed through existing traffic signal conduit with small vaults and tight bend radii. However, as fibre counts and cable sizes increase, so does the required size of the conduit and vaults. Remember to Dig Once, as mentioned previously.

e) Some microtrenching designs utilize very small vaults or direct buried splice cases and some microtrenching designs require full size vaults (ie 1.5m SVs). Product knowledge is critical to customize the design to match the requirements.

601.3 INSTALLATION OF CONDUIT AND VAULTS

a) Duct installs

.1 Ducts should be built entering horizontally near the bottom of the vault, with a bell end that is grouted flush to the vault wall. Ideally) these ducts line up with their equivalent ducts on the opposite side of the vault. Ducts should enter the vault on the ends, if it is rectangular. Avoiding the side walls is recommended so there is more room for entering and exiting splice boxes.

b) Drainage

.1 If the vault does not have a bottom, install washed rock for drainage. Larger vaults should come pre-built with a sump pump. The vault can also be tied into a local storm-drain system.

c) Grounding

.1 Larger concrete vaults with rebar do not typically require grounding since the vault will act as a ground (if the soil conditions are correct). However, in heavy rock or cobble locations ground rods or plates may need to be installed.

d) Depth of Cover

.1 When installing ducts typically there is 3′ or 1 m of cover (which means the total depth will likely be around 1.2 m).

e) Warning Tape

.1 A warning tape should be installed at about 12–18" depending on asphalt cover.

f) Concrete Encasement

.1 Concrete encasement is not usually required unless additional protection or shallow depth is needed. Concrete encasement can also be poured in place.

g) Locating/tracer Wire

.1 Being able to locate fibre is critical. Many newer fibre cables are all-dielectric and do not conduct electricity, therefore a tracer wire in the ground outside of the ducts is needed, such as a 10AWG.

.2 If this is missed at the civil stage, the tracing wire can be installed with the fibre cable but it will likely wrap around the cable and may complicate future work. For tracing wire inside the duct, 12AWG is recommended. The wire can be connected to a bus bar on the inside of the vault. Armored cables do not require a tracing wire

h) Placing Pull String

.1 Ensure that the civil installer blows a string through the installed duct to “prove out” the connectivity between the vaults. In some cases, the conduit may require it to be more formally proofed with a “mouse.”

i) End Caps

.1 Cap or plug the ends of the conduit so the ducts are less likely to be plugged in the future, especially if the ducts are elevated. This plugging happens over time as debris and sediment builds up and can create a blockage.

j) Distance Between Vaults

.1 Vaults should not be more than 200–250m apart with bends that do not exceed 180° in between. If the run is straight and level then the distance can be as much as 500 m, but it is not recommended to exceed this specification since it will make pulling difficult in the future (especially as cables are added and dirt and debris inevitably enters the duct system).

k) Innerducts

.1 Innerducts are smaller conduit that separate cable, protect them, make it easier to push new fibre, increases capacity in the conduit and makes identification easier.

.2 Fabric duct liners can also be used within the conduit, similar to innerducts.

601.4 BUILDING ENTRY

a) For civil work:

.1 New entry points where there is no access to an existing conduit.

.2 Install T-drains on the outside entry conduit to mitigate water migration.

.3 Come up an outside wall and enter above grade if possible.

.4 Ensure that the duct is sealed using fire-retardant at both the entry vault and the building's inside entry point. This seal will also act as a water seal, preventing damage.

b) Entry pull box

.1 Typically, an entry box is installed near the entry point either inside or outside the building (assume 12 x 36 x 36″). Store slack in this entry pull box for future maintenance.

.2 The entry pull box is also a good location to transition from PVC to Electrical Metallic Tubing (EMT). EMT is metal conduit placed inside a building to protect the cable and to provide a safe fire-code rating for the OSP cable.

c) Bend radius

.1 Keep the bend radius so as not to exceed 180° between pulling points (boxes or vaults).

d) Private property

.1 Typically, there will be a shared room for organizations and commercial carrier fibre.

.2 Under CRTC regulations, the property owner owns any structure and/or cables on their property. Therefore, some parties have built from the public RoW and then connected into commercial duct or vaults on the private property. In this case, it is advisable to contact the structure installer and consult the legal department before proceeding.

602 CABLE PLACEMENT

602.1 FIBRE CABLES

a) Manufacturers

.1 Corning is probably the largest supplier of fibre cable on the market. Most other cable manufacturers use Corning glass. Prysmian, Sumitomo and Draka Comteq are also major fibre cable manufacturers. Picking a single manufacturer is recommended to be as consistent as possible.

b) Current standards

.1 Typical fibre cables start at 6F, then 12F and increase in increments of 12 (i.e., 24, 36, 48, 60, 72, etc., all the way up to 864F).

c) Maintenance Reel

.1 Consider keeping a maintenance reel on hand. 500m should be sufficient.

d) Reel lengths

.1 Fibre comes in bulk reel lengths up to 5,000m or more. The fibre jacket can have metre or imperial marks on it.

e) Ordering Cable

.1 Custom orders of fibre cable lengths and reel sizes are possible, but usually manufacturers will have a minimum length, e.g., 500m. Other fibre cable options are as follows:

- Single Mode (SM) vs. Multi Mode (MM).
- Ribbon v. Loose-Tube (LT). 12F vs 24F ribbons.
- Gel-filled vs. dry block.
- Armoured vs all-dielectric (single- double- and triple-armoured cables are available).
- Centre tube vs buffer tube. Buffer tube is preferred in most cases. Centre tube is only ordered for a very small OD.
- All-Dielectric Self-Support (ADSS).

f) Fibre Connections

.1 Patch cables are used to connect two points, but also introduce a potential failure point.

.2 Patch cords are the least expensive part of the job, but commonly the biggest failure point. People often install new patch cables without first cleaning them, which leads to failures due to dust or dirt particles obstructing the light's path through the glass connection. often install new patch cables without cleaning them. The reason this is such a large fail point is that the fibre or glass connection is a patch.

.3 Cables that are too short or too long cause installation issues. When patch cables are too long, the issue is where to store the extra slack. Once cable in the server environment starts to go bad it usually gets worse over time as newer cable must go around, under, over, or through the slack. This presents difficulties during trouble-shooting and during outage repairs. Even something as simple as caps for unused patch cords is a common low-cost issue. It cannot be emphasized enough how critical cable organization is.

.4 A splice is the process of fusing the fibre together forming together a continuous glass pathway, free from dirt or debris. This method is considerably more secure than using a patch cord.

602.2 AERIAL CABLE

a) Fibre cables installed above ground are usually on utility poles

b) Strand Messenger Cable

.1 Selecting the strand messenger cable size and methods to attach to poles requires engineering advice

.2 Tensioning of the strand is not typically measured. Experienced crews will know the limits.

c) Lashing

.1 Single lashing (wrapping around another cable) for main fibre optic cable runs is adequate but double lashing is recommended at higher security locations (i.e. across a river, through an industrial yard) or at major road crossings. It is common to see up to four or five cables on a strand when there are fibre and coaxial cable and small-count copper cables.

.2 A lashing machine will typically do no more than 84 mm in diameter (just over 3").

d) Anchoring

.1 Anchoring specifications typically are not reviewed as most parties rely on Telus and/or Hydro for access to their existing structures.

e) Slack coils

.1 Slack coils can be left in the air in either fibre storage boxes (not ideal) or on loop backs left on the strand between poles. Typical storage is about 30–40m. If in doubt, default to the Telus specifications and use an inspector.

f) ADSS (All-Dielectric Self-Support)

.1 ADSS cables can be placed on poles but this can only be done once. It is not general practice to place a second cable on top of the first one. This is typically used on custom installations where long spans need to be cleared, such as wireless connections in difficult terrain, or up mountains to wireless sites on power poles and typical safe working clearances are difficult to maintain.

602.3 UNDERGROUND CABLE

a) Pull Strings

.1 Pull strings should always be installed at the same time as the civil duct.

b) Mule Tape vs. Rope

.1 When installation takes place either a mule tape or bull line will be used. Rope is not commonly used unless heavier cables are being installed. The mule tape's tensile strength can vary from 1,200lbs to 1,800 or 2,400 lbs, or something similar depending on the manufacturer.

.2 Caution is essential when pulling a line in with a new cable to minimize wrapping of the cable.

.3 The contractor should always leave a mule tape behind for the next installation. At minimum, a string should be left in the duct. Try to minimize wrapping of any existing cables.

c) Tracing

.1 If installing a dielectric cable in a new duct system, an additional trace wire (10AWG or 12AWG) will be needed for locates.

d) Slack coils

.1 Slack coils provide for future splicing locations or for pulling back to create a maintenance splice.

.2 Typical storage length is 30m, but this may vary depending on the situation.

e) Confined spaces

.1 Many vaults are considered a confined space.

.2 Ask crew members for a copy of their OH&S program and confined spaces training cards.

.3 Ensure crews' or contractors' confined spaces training is current and that they are following the proper procedures.

602.4 JETTING VS. PULLING

a) Jetting relies on compressed air to create a vacuum, which allows the cable to guide through the duct, as there is very little friction on the cable.

b) Using jetting allows vaults to be upwards of 1,500m apart rather than the standard recommended distance. HDPE is required so an air seal can create a vacuum for the compressed air to move the cable through.

c) A traditional duct system must be modified to be prepared for jetting. Subducting a larger duct and connect the sections between MHs is needed.

d) Only one jet cable can be placed in a duct, unless two are done at the same time, which is complicated. Jetting is very different from pulling. A solid understanding is required to come up with an appropriate design.

602.5 MICROTRENCHING

Figure 7: Microtrenching (http://www.betongservice.no/microtrenshing/)

a) Background

.1 Since civil work is the most expensive part of the job, organizations often try to save money through microtrenching

.2 While this approach has its place, there are implications for future costs due to the damage it can cause to the roadway. Plan accordingly and allow for higher maintenance costs when using these build methods.

.3 Use of microtrenching can complement a fibre network, particularly for redundancy and last-mile building entries.

b) Installation

.1 Identify the depth of the install. The specifications may be 12", but the microduct may be located anywhere from 6–11". A standard saw cut is normally around 12".

.2 Identify the restoration method, which may include infrared, T-cut, or grout flush with the surface, etc.

.3 Microduct usually comes on a reel and has a “memory.” The product needs to be as low in the cut as possible. Grout is weak until it sets, so the microduct may float up in grout that has not set. There are a few different methods to keep microduct down, such as to apply a foam strip or to use the native cut material to pack the duct down (usually requires 2–3").

c) Restoration

.1 Some restoration preferences include infrared or a more traditional T-cut. Additional options including mastics, engineered products like PermaPatch or using hot patch asphalt can provide an adequate seal. There are pros and cons to each method but it is ultimately the weather conditions and workmanship that are most important.

.2 One item that is not always mentioned is the aesthetics of the repair. Infrared does not usually leave a clean line, while the T-cut method does.

.3 Monitoring the installation over time to see which went well and which did not, will be important for future installations. Visible cracking in the joint or separation between the two sections of asphalt can cause performance issues and is aesthetically displeasing.

603 SPLICING

603.1 SPLICING LOSS SPECIFICATIONS

a) Specifications (Ref. Std TIA-568) vary for testing, but most contracts accept the following loses as thresholds:

  .1 0.3 dB/splice.

  .2 0.5 dB/patch.

b) For ribbon splicing, the specifications are more lenient:

  .3 0.7 dB/splice.

  .4 0.4 dB/km for the overall distance of the circuit.

c) Generally, a 0.4 dB/km average loss for longer installations is the standard. With newer cables, well maintained splicing machines and good crews working on the project, this specification should not be too difficult to maintain.

d) It may be more difficult for older fibre networks, which have had their share of maintenance hits over the years, to meet this specification.

e) Poor workmanship on newer cables may show through as poor test results, but it is possible that test results can be inaccurate or misleading. If the initial results are unsatisfactory send in the same trace twice or test at a different wavelength other than 1310 nm or 1550 nm. Reading results can be an art that takes lots of experience. Having a third party perform an inspection may ensure clearer results.

603.2 OPTICAL TIME-DOMAIN REFLECTOMETER AND OPTIMAL MODULATION DEPTH

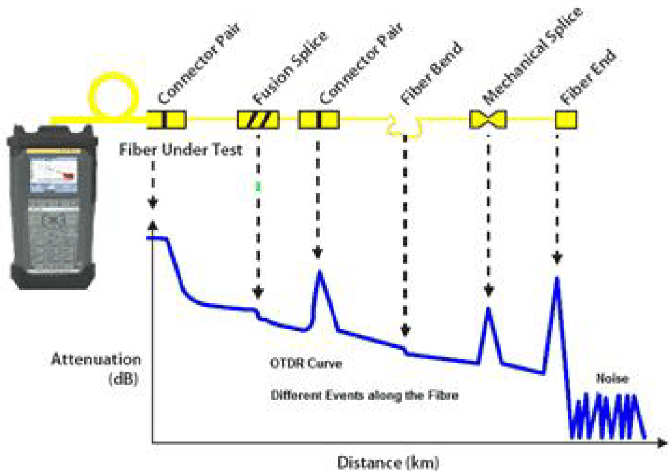

Figure 8: OTDR Trace http://www.opwill.com/en/solutionsdetail.aspx?id=1001&sid=2

a) The most common device for locating faults, checking splices and patching is the Optical Time-Domain Reflectometer (OTDR). This device injects optical light pulses and measures the amount (power) that is scattered or reflected. Decibels (dB) are a unit of power ratios that are well suited to graphically showing orders of magnitude differences. For example, a loss of 20 dB is 100 times worse than a loss of 10 dB.

b) The output of OTDR testing is commonly a graph/trace with attenuation (loss in dB) on the vertical access and distance on the horizontal as shown in Figure 10.

603.3 SPLICING MACHINES

a) The standard splicing machine is Single Mode (SM), however if you use Multi Mode (MM) most splicing machines have that option. Machines can be V-grooved or core-aligned and are either single or mass fusion (ribbon) splicing machines. Fusion splicing is considered the standard method while mechanical splicing should only be acceptable for urgent repairs.

603.4 FOSCS (FIBRE-OPTIC SPLICE CLOSURES)

a) A Fibre-Optic Splice Closure (FOSC) is a waterproof enclosure that separates and organizes fibres for splicing and protects the splices from water and debris.

b) Managing slack within the FOSC is vital.

c) FOSC cases can be very difficult to fix once the fibre is lit and critical systems are using the fibre.

d) Inspecting and testing the installation and photographing the trays should be part of the contractor’s completion handoff.

604 LOOSE-TUBE VS RIBBON CABLE

604.1 CHOOSING A TYPE OF FIBRE

a) Once a fibre cable type is selected transitioning to a different cable adds complications. If it is likely that a fibre cable will require more than 144F cable sizes than a decision to use ribbon initially may be more efficient.

b) It is possible to ribbonize loose-tube fibres and vice versa, however, over time this scenario with high count cables will be a maintenance nightmare.

c) It is a difficult to go from loose-tube to ribbon cables as the splicing of ribbons requires a different machine. This task will require more experienced splicers so that slack baskets and trays are properly managed.

605 SAFETY

a) Review the OH&S (Occupational Health and Safety) program to ensure it covers fibre topics like confined spaces and working around fibres (splicers can get glass in their eyes and skin if they are not careful).

b) Understand the role of the prime contractor as many government agencies will use external contractors to perform much of their fibre-related work.

c) Ask for daily tailgate sheets to ensure crews are taking job site safety seriously.

d) Use an inspector to ensure that safety is being followed on sites.

e) Make sure safety plans align with all organization safety programs and with procurement policies.

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SECTION 700
FIELD INSPECTION

701 INTERNAL VS EXTERNAL - CREWS AND INSPECTION

a) Completed OTDR test results must be kept for future maintenance and installations.

b) Most government organizations will have access to inspection resources, but the challenge will be to find someone who has a fibre optic experience. While internal staff may be able to check on the civil works, the cable-placing and especially the splicing results will probably have to be done by an outside resource.

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SECTION 800
PROJECT COMPLETION

801 MAPPING AND DOCUMENTATION

801.1 GENERAL

a) Plan and organize to have accurate information about the network before building it to avoid significant time and cost issues later.

b) Keep a back-up of whatever documentation system is used. Keep a separate physical copy of all fibre maps.

c) Update and backup the latest records (maps and splicing diagrams) every 3–6 months so the information is relatively current. These records will not only serve as a backup, but during an outage, when the mapping program may be unavailable, a paper copy can still be used to coordinate a repair.

801.2 WHAT TO DOCUMENT

a) Types of documents that are needed include:

- High level map of the entire network
- Civil engineering drawings showing route and vault locations
- Splicing records (finger diagrams) showing the individual fibres and how they connect to each other

b) What type of information to record includes:

- Network routes and nodes/components
- Splice locations, vaults, building entries
- Splices records of cable connections

801.3 AS-BUILT DOCUMENTATION

a) It is important to note that there is usually a time lag between crews finishing an installation and the job being updated into a system, or onto a map. The sooner information is updated, the better and an unplanned outage is less likely to occur.

b) Come up with a standard time line for receiving and updating civil drawings, placing drawings, and splicing results.

c) Set up a process that other internal groups can follow to ensure that records are being updated.

801.4 LABELLING

a) Devise a labelling plan. This will become vital later when troubleshooting outages and coming up with backup repair paths.

b) Label the following:

- Fibres, cables and circuits
- Hubs, cabinets and/or racks
- Optionally, the electronics on either end of the fibre

c) There are telecommunication standards that can be followed, or the organization can develop their own standard

SECTION 900
MAINTENANCE

900 MAINTENANCE

900.1 "BEST EFFORTS"—WHAT DOES IT MEAN?

a) Best effort is the level to which an organization will perform maintenance and repairs as if their own infrastructure was damaged. This is different than contractually set response times, such as with commercial carriers. Fibre fixes are typically very expensive compared to copper or coaxial cable outages. Splicing a fibre cable requires a lot of slack, which can mean doing a temporary repair and then following up with a permanent repair later.

b) It is difficult to schedule outages since critical systems are usually running on the cables. If there are others on the cables, scheduling outages is even more complex.

c) Consideration for maintenance include:

- A monthly maintenance contract with a vendor
- If internal crews can perform maintenance and repairs
- Maintenance that may be required on weekends or holidays
- Extra material or components available on hand
- After-hours access to critical sites and storage yards where critical materials are kept

900.2 OUTAGES

a) Outages are temporary disruptions to a fibre network and can be either planned or unplanned

b) Planned outages are scheduled and the organization has time to coordinate the work for new construction, maintenance or temporary work for a future permanent repair.

c) Fibre outage where an accident occurred and fibres were damaged or taken out of commission (i.e. sometimes a patch cord just gets "bumped"). It usually takes time to troubleshoot, find the location of the outage and then a repair must be determined (temporary or permanent). Afterwards, it is important to determine who or what caused the outage in order to help with cost recovery and to prevent future occurrences.

900.3 DOCUMENTATION

a) An as-built drawing is supposed to be an accurate portrayal on a map of what was built in the field. This could refer to civil drawings, placing drawings, splicing and testing documents.

900.4 BC ONE CALL

a) The provincial standard for locates is BC One Call. Membership in this system is strongly recommended to avoid damage to the fibre network.