Best Practices for Outside Plant Administration and Oversight

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Introduction

This document outlines a general approach for an organization to effectively document and manage its Outside Cable Plant (OSP) infrastructure.

Scope

This document focuses on OSP infrastructure, and is limited to providing a general business approach to documenting and managing OSP using a Configuration Management System (CMS). It also outlines many of the benefits that can be realized as a result of such an effort.

OSP Overview

OSP forms the physical foundation over which high bandwidth trunk signals providing network backbone connections between hubs and control centers as well as low speed distribution signals from field elements such as telephone kiosks, CCTV systems, display panels, and variable message displays. OSP is a very simplistic term. “Plant” refers to all layer 1 telecommunications infrastructure, to include cabling, pathways, and connected electronic equipment. For the purpose of this paper it is expanded to include backbone circuits running over devices and cables as well. “Outside” limits the scope of the infrastructure to all installed infrastructure outside of the building up to and including the building's Entrance Facility (EF) demarcation point or Service Delivery Point (SDP). The term OSP is contrasted with ISP (inside plant), which refers to the communications infrastructure contained within the building up to the building's OSP demarcation point (or demark). The EF of each facility building is where the OSP cables enter the building and terminate on demarcation panels, and marks the transition from OSP to ISP infrastructure.

The cable feeds into the building are usually supported by either ducts/conduits, raceways or aerial cable and in some cases direct buried cable. These pathway systems support the OSP cable distribution to other OSP infrastructure such as buildings, manholes, street furniture, kiosks, displays, and CCTV systems. Raceway systems are most commonly found in industrial complexes such as refineries and mining facilities, whereas duct-based systems are commonly used along highways, within residential areas, commercial areas, and campus environments.

In a duct/conduit-based OSP pathway system, access points must be a maximum distance of 2500ft, although this is usually only found on highway OSP infrastructure, as city, residential and campus environments require more frequent access points.

Access points (commonly referred to as Maintenance Holes, Manholes, Pullholes and/or Handholes,) are a key part of any OSP infrastructure, as they provide access to the installed OSP duct/conduit and cable infrastructure. This allows installed cable to be reconfigured by means of splicing to other installed cables to alter or extend service routes; it also provides access to pull new cable into the duct/conduit pathways.

When new access points are required, sufficient conduit/duct is also installed to provide for future capacity. When pulling new cable into the duct, it is common practice to install cable with media counts greater than the current requirement, as this free media can be utilized for future services without requiring new cable to be installed.

Comprehensive OSP management includes both active and passive assets. Active components are defined as devices that must have external power in order to function (switches, routers, etc.). Passive devices do not require electrical power to work; they connect to active components and transmit the electrical or optical signals (cables, patch panels, etc.).

Pre-Implementation Steps/Considerations

OSP and its components can be represented in a variety of ways. In general, there is a trade-off between the level of detail maintained in the system and the system's ease of maintenance. This is a very important consideration, as too little detail or too much maintenance effort can place the continued usage of a CMS in an organization at risk.

The following is a list of tasks to perform leading up to the kickoff of an OSP documentation project.

- Establish the project team
    - Select the Project Manager.
    - Develop the team charter.
    - Select the team. Team should consist of subject matter experts (SME) from all key infrastructure areas.
        - Recommended team members:
            - OSP operations
            - Applications
            - Network/Telecommunications
            - Facilities management
            - NOC/SOC
            - Acquisitions & Contracting
    - Define the Scope of the project and develop the project schedule and milestones with clearly delineated goals and responsibilities.
    - Develop method statements on how data is to be provided, collected, processed and implemented
    - Schedule regular In-Process reviews.
- Conduct project kickoff meetings to provide the team a technical overview and determine field- or product-specific question/concerns.

Preliminary Decisions

The first decision when establishing an OSP documentation project is whether the goal is only to document what exists or whether the CMS will establish and enforce new standardization upon the infrastructure. The latter case does not apply to all scenarios. For example, if the existing infrastructure is well organized and labeled according to a centralized set of standards, there may be no need to change the status quo. However, if the organization's existing OSP infrastructure documentation is in disarray, then the enforcement of new standards can be managed by the CMS.

As part of any CMS implementation, a data and gap analysis is necessary to determine the quality of existing infrastructure data maintained for the OSP infrastructure. Prior to developing the finalized project schedule, the GAP analysis determines any additional data and surveying tasks required due to lack of detail in the existing OSP documentation. These additional tasks will impact the overall project schedule and budget.

Another key aspect of the project is defining a common naming/labeling standard for all infrastructure components loaded into the CMS. This ensures that objects created in the database have a structured identifier and allows data processing routines to streamline data capture and loading, as well as provides a structured approach to querying, locating and reporting on data from within the CMS.

It is also important to define and develop change control procedures and the associated process management during the CMS implementation phase to ensure that changes are captured in a format that is conducive to loading into the CMS.

During the requirements definition, it is also necessary to identify to what extent the OSP documentation in the CMS may need to interface with other systems. These systems can include service desk applications, network management systems, property management databases, and many other components of a federated Configuration Management Database (CMDB).

Consideration should also be given during this initial stage as to whether the CMS' role will be expanded to manage Inside Plant, Datacenters, WAN, and/or End User Management. While it is possible for this data to be implemented in parallel to OSP implementation, we recommend that each role is undertaken sequentially, as a separate project over a period of time. This allows the organization to mature with the CMS and determine the best process flow for maximum potential benefit.

Readiness Assessment

The OSP facilities manager and supporting staff must undertake a readiness assessment of the existing environment prior to implementation. This will involve input from every discipline involved in the management and configuration of the existing OSP operational environment. The purpose of this study is to identify the data requirements that will be captured in the CMS, the accuracy of existing documentation, and information systems, standards, processes, and procedures. Below are the focus areas within which the CMS may provide documentation and control:

- Supporting infrastructure
- Service Level Agreements
- Asset Management
- Contract Management
- Financial Management

- Change Control
- Network Architecture
- Capacity Planning
- Stakeholder Management
- Resource Availability
- Logistical Planning
- Continuity of Operations / Disaster Recovery

The process of gathering and collecting this information can be time consuming and involves survey, audit, discovery, consolidation, correlation, and planning tasks. It will ultimately require many inputs from many parts of the organization. To effectively complete the readiness assessment, it is essential that a comprehensive set of data requirements for each input is clearly identified, as these will drive the data collection process.

The organization does not benefit by taking a rushed or compressed approach to this assessment, as the information gathered during this process provides the strategic foundation for ensuring the successful documentation and maintenance of hardware, connectivity, and circuit data. It is for this reason that readiness assessments must be undertaken prior to the project kickoff and development of the project schedule.

Readiness assessments are serious undertakings, and are technically projects all by themselves. If not undertaken as a separate pre-project task, then it will be necessary to embed such tasks throughout each stage of the project schedule to discuss the assessment's findings and synchronize all stakeholders prior to OSP documentation and implementation in the CMS.

Infrastructure Documentation

The most important aspect of managing infrastructure is having up-to-date documentation detailing current configuration. The infrastructure administration team needs to understand how the infrastructure is currently configured to foresee the impact of infrastructure outages or proposed configuration changes.

By using the CMS, an organization will realize the following benefits beyond those of a typical documentation suite composed of disparate, stovepipe systems:

- Standard defined database structure and data hierarchies for physical layer data
- Standard database repository allows quick and easy systems integration
- Data driven graphics and layout, eliminates the need to manually draw and label network diagrams and paths associated with using Visio, CAD or similar non-enterprise point solution drawing tools.
- Web Based Enterprise-wide real-time query, reporting and graphics capability, which cannot be achieved by using drawing tools such as Visio or CAD
- Integrates graphics, connectivity and inventory data into a single integrated database solution
- Single common interface and point of access for entering and updating infrastructure documentation
- Simplified data capture and management

- Data-driven drawings and labeling, which can be modified automatically based upon new data being integrated to the CMS infrastructure repository, reducing the need to manually update drawing layouts.
- Ability to report and query against the entire infrastructure and all associated graphical information.

Data Analysis

As part of the data collection process, it is essential to identify analytical requirements, expectations, and the minimum data requirements to assist in determining a transition plan. While possible to identify requirements common to most OSP infrastructures, it is also essential to address any customerspecific requirements. The outcome of this analysis will drive the data collection requirements and detailed plans for the baseline data calls necessary to complete the data collection phase.

Analytical requirements should be collected by means of formal meetings and documentation so that a concise data collection plan can be formulated and agreed upon.

Data Collection Framework

Before being able to determine the best way to represent the data in the CMS from existing repositories, it is necessary to obtain a clear and concise picture of any existing infrastructure and its physical dependencies. This requires a thorough and coordinated data collection and audit plan, which typically involves gathering:

Site plans
Floor plans
Pathways
Butterfly drawings
Rack elevations

- Splicing schedules
- Patching and cross-connects
- Circuit assignment
- Hardware & cable product specs

For each OSP component, it is essential to:

1) Define the requirements for data collection and how to correlate different information sources.
2) Identify how the collected data will be presented and the analytical functions required.
3) Define a mechanism for controlling and tracking the transition of each component's documentation from the legacy system to the CMS.

During each phase of this process, the information being funneled into the CMS is integral to monitoring, retrieving, and analyzing progress.

Successfully capturing OSP infrastructure requires a number of data collection initiatives to obtain and correlate the existing information into a format that can be loaded into the CMS. To do so, input may be required from the following disciplines:

- Facilities Management
- Telecommunications / Network Management
- Acquisitions / Vendor Management
- Help Desk / Service Management
- Cable Plant and Connectivity
- Hardware Configuration

- Space Management

For each discipline, it will be essential to classify and define data collection requirements and expectations. The manager of each discipline must provide all information present in the minimum data collection requirements. By using this methodology, it is possible to define a clear, comprehensive data baseline.

If not previously completed in the Readiness Assessment, it is necessary for the manager of each discipline to provide access and/or information regarding all existing data repositories and information sources used to maintain and store their data. Once sources are identified, then the implementation team leaders must analyze it to identify any data that can be provided to the CMS.

OSP Drawings

The facilities department is generally responsible for obtaining and/or maintaining accurate drawings. These plans provide the underlying visual context for the OSP infrastructure, and as such are the foundation of the OSP documentation in the CMS.

For OSP environments, the following drawing information should be provided:

- Site Plan
- Manhole Butterfly layouts
- Entrance Facility Floor plans
- Entrance Facility Rack Elevations

The provided **scale** drawings should contain the following information:

SITE PLANS	**ENTRANCE FACILITY FLOOR PLANS**
Building outline & labels	Room Outline and Room number
Manhole positions and labels	Doors & Windows
Duct routes & assigned cable labels	Raceway/Cable tray paths
Civil infrastructure (roads, paths, etc)	OSP Cable Point of entry
Fences, boundaries, rights of way	Terminating Rack for OSP cables and rack labels
Dimensions	Dimensions
MANHOLE BUTTERFLY LAYOUTS	**RACK ELEVATIONS**
Duct configuration for each wall and duct id	Rack Identifier
Cable Id and route through manhole	Rack Dimensions
Any splice housing in manhole	Equipment position, type and identifier in rack
Service loops associated with cables in the manhole	Port ranges for each equipment
GIS coordinates of the manhole	
Dimensions	

Pathways

Pathway routes are an essential part of the OSP infrastructure, as they represent duct banks between manholes, external raceway and aerial cable routes; however, the CMS can manage additional pathway details. These details include the material constituting pathways (metal, PVC, etc.), cross-sectional area, fill thresholds and fill ratios based upon routed cable, condition, and length to name a few. A CMS may also have the ability to define a pathway hierarchy allowing innerducts and fiber tubes to be assigned to the main duct.

Unfortunately, it is rare that spreadsheets contain pathway details. In most OSP environments, the duct information is obtained from both the site plan drawings, which identify the path duct route between buildings and manholes, and Butterfly drawings, which show the duct wall position, duct arrangement, type, and identifier of each duct in the duct bank.

Equipment Details

The Product Library is a database within the CMS that stores templates for specific models of equipment. These templates consist of information that is common to every instance of that model that is entered into the CMS. This information includes dimensions, model number, port configurations, and many other details.

A product library definition refers to a specific model of device, and an equipment instance refers to a specific device (with a unique serial number, etc.). This is important to know because once a library definition is defined, it is no longer necessary to capture all of the details stored in that template. It is only necessary to relate the surveyed details for the instance (serial number, host name, asset number, etc.) to the correct library definition. Note that if, during survey, it is not possible to identify the specific model of the inventoried device, then it is a good idea to note down the information that would otherwise be in a library definition. This information may then enable the correct mapping of instance to library or allow a new library definition to be created, if necessary.

Documenting Passive Infrastructure

The difference between active and passive equipment is outlined in the OSP Overview section. Active equipment, from a documentation standpoint, is much more likely to already be tracked within an organization's property system. Active devices are typically much more expensive, and as such are afforded a spotlight in most IT Asset Management systems. For the purpose of OSP documentation, however, passive equipment is the true star.

Passive devices form the permanent structure upon which active devices may send signals and route network traffic. They are the foundation of a successfully functioning network, yet tend to be neglected for lack of glamor until something breaks. This category of devices includes faceplates, patch panels, fiber shelves, pull boxes, blocks, splitters, taps, and many other types of relatively inexpensive devices. Because these devices are generally treated as commodities, they are less likely to be labeled with asset tags or have visible serial numbers or even model numbers. This can make the documentation of passive infrastructure more of a challenge.

Successfully documenting passive infrastructure typically requires SME support. IT facilities personnel or contractors doing the survey work will often inventory a passive device and label it as a “patchpanel” without describing how many ports or what types of ports it contains. In addition, since there is typically no model number to cross-reference against specifications readily available on the Internet, assumptions can lead to identification problems. When surveying passive infrastructure, it is critical to capture the information required to use the full functionality within the CMS.

OSP Cabling

OSP cabling, or distribution cable, is a static fixture used to connect buildings or field elements to centralized hubs. The cable types in these runs are typically rigid and inflexible, and the connection types made on either end are generally permanent. OSP cables are usually routed either through ducts and/or innerducts or via raceway systems. Due to the nature of OSP cable plant, cables may be spliced to other cables within manholes or at service cabinets in the field to extend or reconfigure OSP cable plant.

OSP Cable Labeling and Identification

In an ideal world, all OSP cables would be clearly labeled, with labels placed at the cable endpoints that indicate the near- and far-end connections as well as the cable's type, number of media, and unique identifier. Unfortunately, this is not always the case, and surveying OSP cabling without the help of cable labels can be extremely time-consuming. If labels do not exist on OSP cables (or the devices to which they connect, provided they indicate the far-end connection), then it is essential that someone who knows the infrastructure very well be made available to provide as much of that information as possible. If such a person is not available, be sure to allow **a lot** more time in the survey schedule.

Within the CMS, OSP cables have unique identifiers that correspond directly with the endpoints of the cable. Because these cables do not change often, neither do these identifiers. This is contrasted with the identification and labeling for administration cables, which change often and are named in such a way as to avoid the hassle of changing labels and identifiers.

Patch Cabling and Cross-connects

Patch cables and cross-connect cables are intended for administration, and as such may be changed frequently. The cables themselves are flexible, and most of the cable ends have connectors on them that allow for easy disconnection and reconnection.

Because patch cables and cross-connects are typically very short, the pathway routes that they take from one device to another (in either the same rack or adjacent racks) do not need to be maintained.

Patch Cable and Cross-connect Labeling

Unlike OSP cables, patch cables and cross-connects require frequent relabeling if their labels include reference to both endpoints of each cable. When documenting patch cables and cross connects, we recommend that a generic incremental identifier be used such as XC-00001...*n*. Taking this approach eliminates the need to enter complex FROM/TO information for the cable identifier. However, due to the relational database, it is still possible to generate FROM/TO label data, which is used for the physical label on the device, and can incorporate the generic number of the patch cable. This helps to streamline the operational use within the CMS, while still providing the required labeling standard for the physical installed cable.

Circuit Data Collection

Circuit data is generally maintained by the facilities engineers for the building. Network engineers may also be excellent sources of information for how the circuit bandwidth is distributed across the OSP infrastructure. Details that an organization may want to collect for each circuit includes bandwidth, circuit owner, signal protocols and coding, circuit path, alternative paths, billing information, etc.

Network Diagrams

Network diagrams generally denote logical relationships between active network devices. As such, they will not include passive equipment or cabling details. It is very common for customers to provide logical diagrams to the documentation team and assume that everything needed to document the OSP infrastructure is included, which is rarely the case.

In addition to network diagrams, the proper documentation of OSP infrastructure includes:

- Rack elevations
- Patch cable and cross-connect cut-sheets
- OSP cut-sheets
- Cable types
- Details on device cards and modules
- Duct bank routes
- Butterfly layouts
- Cable Splicing details
- Service loop locations and lengths

Configuration Management (CM)

An effective Configuration Management plan provides the means to track and manage the topology, hardware, firmware, software, and code configurations in a diverse communications system. It builds upon several components:

- Processes and procedures define the roles and responsibilities of the personnel responsible for the CM program and define the mechanisms for tracking asset, circuit, or configuration changes. This includes changes from growth, design, or failures.
- A data management tool is required to store, maintain, backup, and track system assets and circuits through their lifecycle.
- An inventory of manageable assets and circuits is required for all system components that reflect the hardware and software configuration of the fielded infrastructure. Configuration items are mapped to the infrastructure nodes in which they are installed.
- Infrastructure drawings should be maintained to accurately illustrate the current system design.

Operations and Maintenance (O&M)

A typical O&M plan consists of a variety of workflows in which procedures are laid out and responsibilities are assigned for ongoing tasks such as repairs, upgrades, infrastructure maintenance, and IMACs (installs, moves, adds, changes). A chain of command is established to approve and document all changes in order to ensure current records, justify the need for changes, and limit unauthorized activities.

In a given organization, there are a number of tools used to facilitate these actions. Examples include a help desk system, a service provisioning system, and a configuration management system. These tools exist to make operations and maintenance easier by automating workflows, generating work orders, maintaining audit records, providing data, analyzing impacts, and reducing human error.

A well-organized change and configuration management system makes use of technology to perform these functions, but no single software product can do everything. In order to ensure streamlined processes, the various tools in use need to have a way to pass information back and forth. For this reason, application programming interfaces (APIs) are essential, and can be used to link multiple systems together in a way that preserves workflow and maintains consistency.

For example, a help desk ticket results in a request for connectivity to a certain office. This request goes to the CMS, which is used by an engineer to analyze the current infrastructure in order to determine what ports are available and what OSP cabling may already exist to that room. The engineer initiates a move-add-change (MAC) transaction, reserving ports on a switch and a patch panel within the CMS for this purpose, or reserving an entire end-to-end path and all associated hardware ports and cable media for a new circuit assignment. The CMS generates and issues a work order and communicates the status of the MAC back to the help desk system, in case the user needs to be updated on the progress of the ticket. Once the change is complete, the engineer finalizes the MAC in the CMS, which then communicates with the help desk system and provides an updated status along with a list of all the steps performed in the MAC, which is filed in the help desk system's records.

This is a simplified example of how connectivity can be provisioned. Depending on the organization, certain systems may not exist or may interact in different manners; but the example does serve to highlight the role that interfaces between software tools can play in streamlining activities. Without automated communication between systems, the odds of process delays or failure grow considerably.

Conclusion

This document is for general use, and as such does not take into account the subtle details that determine the most effective strategy for OSP implementation in a specific enterprise. It does provide a number of discussion points, however. All of the elements mentioned in this document should be examined for relevance, as it is always easier to adjust an implementation strategy prior to execution.

Guide to Abbreviations

API	Application Programming Interface
CCTV	Closed Circuit Television
CLIN	Contract Line Item Number
CM	Configuration Management
CMDB	Configuration Management Database
CMS	Configuration Management System
EF	Entrance Facility
ISP	Inside Plant
IT	Information Technology
MAC	Move, Add, Change Transaction
O&M	Operations & Maintenance
OSP	Outside Plant
PO	Purchase Order
SDP	Service Delivery Point
SME	Subject Matter Expert

Planet IRM

Planet IRM acts as a visual front-end to a comprehensive CMDB. This database stores ISP infrastructure information with an emphasis on the physical layer.

In addition to OSP, Planet IRM is able to document LAN, data centers, inside plant, wide area networks, and many other types of IT infrastructure. Combining all of these data points can provide significant benefits over stovepipe systems in ease of maintenance, accuracy, and analytics.

The Planet IRM software is distinct from many CMS tools in that it does not actively monitor a customer's network, but rather focuses on the physical locations of network components and their relationships. In general, this physical data cannot be discovered, captured, or managed adequately by Layer 2+ discovery tools, and yet they are essential components for providing overall inventory and configuration management of each configuration item - be it a hardware element, location, or circuit connected to the IT infrastructure.

Planet IRM also acts as an aggregator of information. It can import and correlate logical relationships and discoverable data into the CMS, providing a comprehensive view of the infrastructure. This greatly assists in resolving conflicts between trusted data sources, such as:

- help desk systems
- billing databases
- network discovery tools
- patch management tools
- cut sheets
- logical diagrams
- ... and many others