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Automated fiber network monitoring

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ABSTRACT

Telecommunication infrastructure providers, e.g., fiber network providers, benefit from accurate knowledge of the network footprint. This disclosure describes techniques to automatically monitor fiber networks. Datasets of fiber network information are hosted on suitable platforms, and can be easily customized. Network footprint, including information about the handholes and their adjacent handholes, provided by the network planner is captured as a dataset. Network splicing data points are identified and stored per customer along with their duct/microduct and ring information as a dataset. A breadth first search technique is used to analyze the datasets and provide information about usage of pairs and cores. Such information can be used for further analytics and to optimize network capacity utilization. The techniques convert a network management problem into a large-scale data problem. The techniques enable cost effective network monitoring of the network and provide powerful analytics capability.

KEYWORDS

- Fiber optic network
- Splicing point
- Network planning
- Breadth-first search
- Handhole

BACKGROUND

For small or medium sized wholesale telecommunication infrastructure providers, e.g., fiber network providers, managing a growing passive network footprint poses a challenge. Network connectivity needs to be configured for each customer. It is necessary for a network planning team to allocate network fiber cores for new site connections. Consequently, accurate knowledge of the network footprint is key to efficiency and scalability. Knowledge of the network footprint includes, e.g., information about the strands of fiber that are in use, information about free cores on the network, etc. In addition, troubleshooting, maintenance, and fault identification operations benefit from accurate network footprint data.

Spreadsheet-based tracking solutions are commonly used by small and medium sized operators. However, as customers are added to the network, the network footprint expands, and spreadsheet solutions become limiting and expensive to maintain. For example, it is difficult to use spreadsheets since they are unable to support a large volume of data, cannot identify used/unused cores between any network section, and are unable to track splice data. In addition, when using spreadsheets, data validation is a manual process, which can affect the quality, e.g., level of accuracy of the data, due to human error.

One possible solution includes use of passive network visualization tools. However, integrating a passive network visualization tool into network planning can be costly, as it requires substantial effort from network planners. Further, it can require deployment and maintenance engineers to redesign the network based on specifications of the visualization tools.

DESCRIPTION

This disclosure describes techniques to collect, store, and analyze network footprint information in an automated manner. The network management problem is converted into a large-scale data problem by creating and organizing network information in a network data warehouse. Network footprint defined by the network planner is utilized. A naming convention is determined for network components such as handholes, trunk cables, access cables, microducts, ducts, links, etc. Rules of the naming convention can be defined by the network planner. Splicing data is stored and retrieved in a manner that is easily accessible and readable.

An example naming convention is described below. Each handhole is represented as an alphanumeric (A#), for example, as A100 or A157. Trunk cables are denoted by a letter (for example, T), and each tube in the trunk cable is then labeled T1 through TN. The cable pairs or cores within the cable are represented by their corresponding 2-tuples, such as TN[X] or TN[X,Y] (e.g., T1(1), T1(1,2), T1(3,4))). Similarly, access cables are denoted as letters (for example, A), and the pairs or cores within the cable as AN[X,Y] (e.g., A1(1,2), A2(1,2))). Each duct (including microduct and ducts) is identified by a color and is mapped to a letter (for example, green cables can be denoted by "G").

A specific splicing point is represented as "cable_color_code:handhole_id_TN(X,Y)," for example, as G:A918_T6(9,10), which uniquely identifies the cable, handhole, and the trunk cable tube and pair (or core, where applicable) that correspond to the splice. As the network footprint expands with the addition of components to the fiber network, the naming convention provides the flexibility to add network components such as handholes, access cables, and trunk cables.

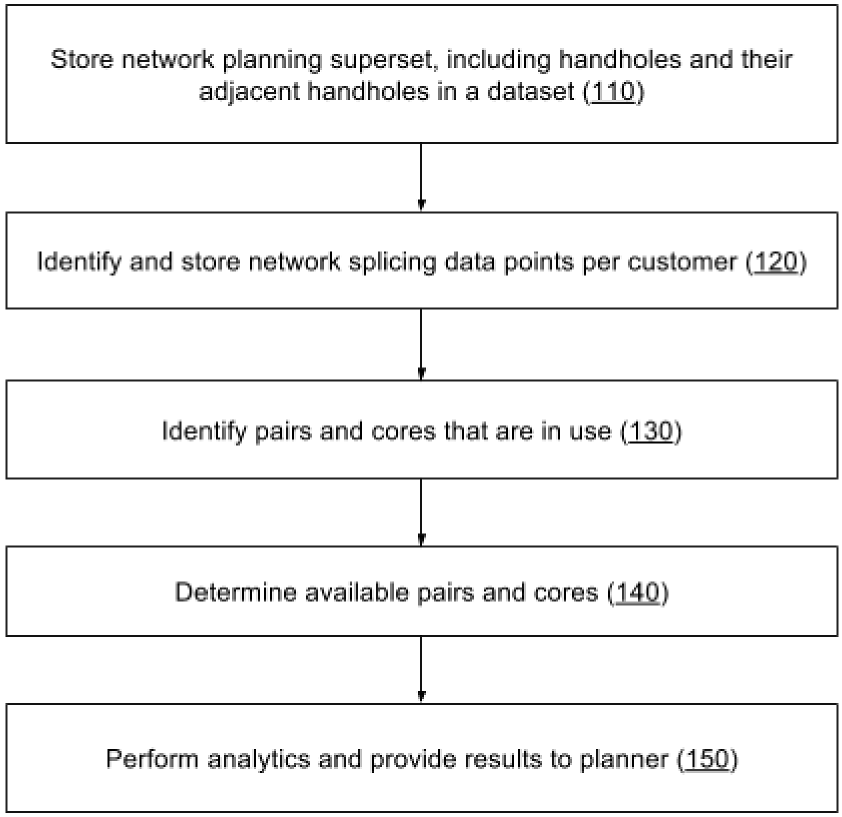

Fig. 1: Determination of available cores

Fig. 1 depicts an example process for automated collection, storage, and analysis of the network footprint. Based on network footprint provided by the network planner, handhole information, along with its adjacent neighbors, is captured as a dataset. Each handhole is tabulated (110) in a unique row and adjacent handholes are stored in various columns. Network splicing points along with corresponding duct/microduct and ring information are captured in a dataset (120), and stored per customer, based on the naming convention.

A modified breadth-first search algorithm is applied to the stored datasets (130), using the handhole and splicing datasets as the nodes. The search yields a breadth-first tree that provides the used cable pairs and cable cores on the trunk and access cables, and stored in a dataset (130). The available pairs and cores are determined (140) by performing a delta between the superset

(110) and the used pairs and cores (130), and stored in a dataset.

Analytics are performed on the resulting dataset (150) to provide insights such as network capacity utilization (for expansion planning), network mapping, and for validation exercises to verify that installations undertaken, e.g., by external contractors are in accordance with the network plan. The analytics enable network planners to identify pairs and cores that are used and free between any two handholes as well as the corresponding customers.

CONCLUSION

This disclosure describes techniques to automatically monitor fiber networks. Datasets of fiber network information are hosted on suitable platforms, and can be easily customized. The techniques convert a network management problem into a large-scale data problem. The techniques enable cost effective network monitoring of the network and provide powerful analytics capability.