Title: A SYSTEM AND METHOD FOR DEPLOYING FIBER OPTIC NETWORKS THROUGH WATER DISTRIBUTION SYSTEMS

Abstract: A method for deploying a network link (530) in a locality’s active pipeline system (510) is provided. The method includes transporting the network link (530) from a first location (502) to a second location (504) in the pipeline system (510) and capturing the network link (530) at the second location (504).
A SYSTEM AND METHOD FOR DEPLOYING FIBER OPTIC NETWORKS THROUGH WATER DISTRIBUTION SYSTEMS

TECHNICAL FIELD

The present invention relates generally to networks and, more particularly, to a system and method for quickly deploying a fiber optic network through water distribution systems.

BACKGROUND

While communicating via a fiber optic network is often desirable, installation of such networks in a metropolitan environment is a time-consuming and expensive task. For example, underground installation of the fiber optic cables typically requires that the roads and sidewalks of the metropolitan area be torn up through the use of backhoes and other construction equipment. Such a process not only affects the businesses that operate in the area of the construction, but also affects traffic.

Moreover, in order for a company to install an underground fiber optic network in a metropolitan area, the company must obtain a right of way from the property owners where the fiber cabling will be laid. Not only is such a process time-consuming (having to negotiate these right of ways with multiple parties), but it may also be expensive.

Another major impediment with the conventional approach to installing fiber optic networks in a metropolitan area may be finding and building appropriate shelters along the network to house and power optical repeater equipment and/or routers. These shelters add additional cost to the implementation of the fiber optic network and typically require the routing of electrical power in the fiber cables themselves in order to power the optical devices housed therein. Routing of electrical power through the fiber cables makes for a more complex network design.
There exists a need for a system and method that facilitate the deployment of a fiber optic network in a metropolitan area.

**SUMMARY**

Systems and methods consistent with the present invention address this need by providing a mechanism by which a fiber optic network may be easily deployed.

In accordance with the purpose of the invention as embodied and broadly described herein, a method includes transporting at least one network link from a first location to a second location in an active pipeline system of a locality and capturing the at least one network link at the second location.

In another implementation consistent with the present invention, a network includes at least one network link located in an active pipeline system of a locality, a first network device connected to the at least one network link and located at a first area of the pipeline system, and a second network device connected to the at least one network link and located at a second, different area of the pipeline system.

In a further implementation consistent with the present invention, a method for installing a network in an active water distribution system includes inserting at least one network link into a pipeline of the water distribution system, transporting a first end of the at least one network link from a first location to a second location in the pipeline, connecting the first end to a first network device, and attaching a second end of the at least one network link to a second network device.

In yet a further implementation consistent with the present invention, a method for deploying a network in an active water distribution system includes routing a plurality of network links through the water distribution system, and connecting the plurality of links to network devices located outside the water distribution system.
BRIEF DESCRIPTION OF THE DRAWINGS

The accompanying drawings, which are incorporated in and constitute a part of this specification, illustrate an embodiment of the invention and, together with the description, explain the invention. In the drawings,

FIG. 1 illustrates a locality in which a system and method, consistent with the present invention, for deploying a fiber optic network may be implemented;

FIG. 2 illustrates an exemplary water distribution system consistent with the present invention;

FIG. 3 illustrates routing of fiber cables, consistent with the present invention, in a water distribution system containing an obstruction;

FIG. 4 illustrates routing of fiber cables, consistent with the present invention, in an exemplary water distribution system in which a segment of the water pipeline contains a branch;

FIG. 5 illustrates an exemplary system, consistent with the present invention, for deploying a fiber optic network through a water distribution system; and

FIG. 6 illustrates an exemplary process, consistent with the present invention, for deploying a fiber optic network in a water distribution system.

DETAILED DESCRIPTION

The following detailed description of the invention refers to the accompanying drawings. The same reference numbers in different drawings identify the same or similar elements. Also, the following detailed description does not limit the invention. Instead, the scope of the invention is defined by the appended claims.
Systems and methods consistent with the present invention provide a process by which a fiber optic network can be quickly and inexpensively deployed. The process involves routing the fiber optic cables of the network through a locality's (e.g., a city's) water distribution system. As such, the number of rights of way that must be obtained and the amount of digging involved are minimized.

EXEMPLARY LOCALITY

FIG. 1 illustrates an exemplary locality 100 in which a system and method, consistent with the present invention, for deploying fiber optic cabling may be implemented. In FIG. 1, the exemplary locality 100 includes a group of houses 110-118, a store 120, a factory 130, a financial institution 140, and an office building 150 that are interconnected via fiber optic cabling 170 through the locality's water distribution system 160. The locality 100 may include a city, town, and the like, where water distribution systems are employed.

Each house 110-118 may include one or more devices (not shown), such as cable televisions, telephones, or computers, that transmit and receive signals via the fiber optic cabling 170 in a well-known manner. Similarly, the store 120, factory 130, financial institution 140, and office building 150 may include devices, such as telephones or computers, that transmit and receive signals via the fiber optic cabling 170.

The fiber optic cabling 170 includes conventional fiber optic strands that transmit signals for cable television, computers, telephone networks, etc. The fiber optic cabling 170 interconnects the houses 110-118, store 120, factory 130, financial institution 140, and office building 150 to allow signals to be transferred there between. The fiber optic cabling 160 may be connected to one or more other networks, such as the Internet.

In an implementation consistent with the present invention, the fiber optic cabling 170 is routed through the water distribution system
160 of the locality 100 in which the houses 110-118, store 120, etc. are located. The water distribution system 160 may include any conventional underground water distribution system that routes water in the locality 100, such as a municipal water supply. As will be described in more detail below, routing of fiber cables through a locality's water distribution system 160 simplifies network deployment.

EXEMPLARY WATER DISTRIBUTION SYSTEM

FIGS. 2-4 illustrate exemplary water distribution systems consistent with the present invention. The water distribution systems depicted may include more or less elements than are actually illustrated. For example, while only one fiber cable connects the components of the water distribution systems, it will be appreciated that multiple fiber cables may be used.

In FIG. 2, the water distribution system 200 includes a water pipeline 210, a group of optical switches/repeaters (OS/R) 220-1 to 220-N, and fiber cables 230. The water pipeline 210 may include any conventional water pipeline used in water distribution systems.

The optical switches/repeaters 220-1 to 220-N may include one or more conventional optical switches/repeaters that route optical signals to appropriate destinations. Each optical switch/repeater 220-1 to 220-N may be implemented via hardware or a combination of hardware and software. The optical switches/repeaters 220-1 to 220-N are positioned along the water pipeline 210 at predetermined locations. These devices 220-1 to 220-N may be positioned, as needed, in order to properly repeat the optical signal, and/or to interconnect with other (dry) optical segments in the overall network. The optical switches/repeaters 220-1 to 220-N may be housed in buildings that are already in place along the water pipeline (e.g., in the store 120 in FIG. 1) that house pumps, filters, and the like, in connection with the water distribution system 200. Since these buildings already have power supplies, the optical
switches/repeaters 220-1 to 220-N may be simply powered by this existing power system.

The fiber cables 230 may include conventional fiber cables used in underwater environments. For example, the fiber cables 230 may be similar to those used in a coastal festoon system, i.e., they may contain only fiber filaments with protection, but need not contain any medium for distributing electrical power.

FIG. 3 illustrates routing of fiber cables 230, consistent with the present invention, in a water distribution system 300 containing an obstruction 340. As illustrated, the exemplary water distribution system 300 includes a water pipeline 310 containing an obstruction 340, a group of optical switches/repeaters 320-1 to 320-3, and fiber cables 230.

The water pipeline 310, optical switches/repeaters 320-1 to 320-3, and fiber cables 230 are similar to those described above with respect to FIG. 2. The obstruction 340 may be any type of obstruction that would prevent the continuous routing of fiber cables 230 in the water pipeline 310.

In order to route the fiber cables 230 around the obstruction 340, an optical switch/repeater 320-2 is positioned in close proximity to the location of the obstruction 340. As such, the fiber cables 230 may be easily routed around the obstruction 340. It will be appreciated that, in some instances, more than one optical switch/repeater 320-2 may be necessary to bypass one or more closely located obstructions.

FIG. 4 illustrates routing of fiber cables 430, consistent with the present invention, in an exemplary water distribution system 400 in which a segment of the water pipeline 410 branches in different directions. As illustrated, the exemplary water distribution system 400 includes a water pipeline 410 having a segment that branches in different directions, a group of optical switches/repeaters 420-1 to 420-N, and fiber cables 430. The optical switches/repeaters 420-1 to 420-N and fiber cables 430 are similar to those described above with respect to FIG. 2.
In order to route the fiber cables 430 along multiple branches of the water pipeline 410, an optical switch/repeater 420-1 is positioned in close proximity to the location of the branch. Additional fiber cables 430 may be connected to the optical switch/repeater 420-1 for each branch in the water pipeline 410. As illustrated in FIG. 4, the optical switch/repeater 420-1 may transmit signals received via fiber cable 430C through fiber cables 430A and/or 430B, and vice versa. More than one optical switch/repeater 420-1 may be implemented at a particular water pipeline branch, if needed.

EXEMPLARY SYSTEM FOR DEPLOYING A FIBER OPTIC NETWORK

FIG. 5 illustrates an exemplary system 500, consistent with the present invention, for deploying a fiber optic network through a water distribution system. As illustrated, the exemplary system 500 includes a water pipeline 510 having an entry point 502 and an exit point 504, a cable spool 520, a fiber cable 530, a flotation device 540, and a capture device 550.

The water pipeline 510 and fiber cable 530 are similar to those describe above with respect to FIGS. 1 and 2. The entry point 502 includes an access area through which the fiber cable 530 may be inserted into the water pipeline 510. In a similar manner, the exit point 504 includes an access point through which the fiber cable 530 may exit the water pipeline 510.

The cable spool 520 includes a conventional spool, or other similar device, that holds the fiber cable 530 and facilitates the feeding of the cable 530 into the water pipeline 510 through the entry point 502. The flotation device 540 includes any type of conventional device to which the fiber cable 530 may be attached and capable of transporting the fiber cable 530 from the entry point 502 to the exit point 504. The capture device 550 may include a device, such as a small net, gripper, or any other type of device, that allows for capture of the flotation device 540 in
the water pipeline 510.

EXEMPLARY PROCESS FOR DEPLOYING A FIBER OPTIC NETWORK

FIG. 6 illustrates an exemplary process, consistent with the present invention, for deploying a fiber optic network in a water distribution system. The process begins with access points (i.e., an entry point 502 and an exit point 504) being created in the water pipeline 510 [step 610]. These access points 502 and 504 may be created via any conventional technique, such as drilling holes in the top surface of the water pipeline 510. The exit point 504 is positioned at a location downstream of the entry point 502 (i.e., the exit point 504 is positioned at a remote location in the water pipeline 510 in the direction of the flow of water in the pipeline 510). Alternatively, the process may utilize existing access points used by water distribution system personnel.

A cable spool 520 is then positioned in close proximity to the water pipeline entry point 502 [step 620]. As described above, the cable spool 520 holds the fiber cable 530 and facilitates the feeding of the cable 530 through the entry point 502 into the water pipeline 510.

A capture device 550 is inserted into the exit point 504 in the water pipeline 510 [step 630]. A flotation device 540 is then attached to the front end of the fiber cable 530 to be deployed [step 640]. This attachment may be made via any conventional technique that would allow for the fiber cable 530 to remain attached to the flotation device 540 once the flotation device 540 is inserted into the water pipeline 510. The flotation device 540 is then inserted into the water pipeline 510 through the entry point 502 [step 650]. Once inserted, the water current in the water pipeline 510 acts to unspool the cable 530 and carry the flotation device 540 and fiber cable 530 toward the exit point 504.

Once the flotation device 540 reaches the exit point 504, the capture device 550 captures the flotation device 540 or the cable 530 itself [step
The flotation device 540, along with the attached fiber cable 530, is pulled through the exit point 504 of the water pipeline 510 [step 670]. Thereafter, optical switches/repeaters (220-1 to 220-N) may be attached to the fiber cable 530 at the entry 502 and exit 504 points [step 680].

The above-described process can be quickly and inexpensively implemented. Contrary to conventional approaches, a process consistent with the present invention requires no extensive digging, no disruption to traffic, no disruption to businesses in the area of the network installation, etc. Since water distribution systems tend to conveniently cover metropolitan areas, a network built through these pipelines will act as a very useful "backbone" or "metro-area" connection for the locality that it serves. It will be apparent that this process involves obtaining a right of way with only a single entity (i.e., the water department). Since it will provide a useful source of extra funds to that entity, negotiation may be fairly simple.

It will be appreciated that the fiber optic cabling is easily durable enough to withstand the pipeline environment of a water distribution system. Moreover, since the fiber cabling is non-toxic and quite small, implementation of a fiber network in the manner described above will not interfere with the locality's water distribution.

CONCLUSION

Systems and methods consistent with the present invention provide a quick and inexpensive manner in which to deploy a fiber optic network. The process involves routing the fiber cables of the network through a locality's preexisting water distribution system. As such, a fiber optic network may easily be provided to residential and commercial areas in the locality.

The foregoing description of exemplary embodiments of the present invention provides illustration and description, but is not intended to be
exhaustive or to limit the invention to the precise form disclosed. Modifications and variations are possible in light of the above teachings or may be acquired from practice of the invention. For example, while a series of steps has been presented with respect to FIG. 6, the order of the steps may be altered in other implementations consistent with the present invention. Moreover, while the above description focused on implementation of a network in a water distribution system, it will be appreciated that a network consistent with the present invention may alternatively be implemented in other types of pipeline systems, such as oil pipelines. It will be further appreciated that the present invention is also applicable to implementation of other types of networks, such as wired networks.

The scope of the invention is defined by the following claims and their equivalents.
WHAT IS CLAIMED IS:

1. A system for installing a network link in a locality having an active pipeline system, the system comprising:
   a transporting device for transporting the network link from a first location to a second location in the active pipeline system; and
   a capture device for capturing the transporting device at the second location.

2. The system of claim 1 wherein the network link is a fiber optic cable.

3. The system of claim 2 further comprising:
   at least two network devices connected to the network link.

4. The system of claim 3 wherein the at least two network devices include:
   at least two optical devices, each optical device connected to a respective end of the fiber optic cable and positioned outside the active pipeline system.

5. The system of claim 1 wherein the active pipeline system includes an active underground water distribution system.

6. The system of claim 1 wherein the active pipeline system transports a liquid, and
wherein the second location is downstream of the first location.

7. The system of claim 6 wherein the transporting device includes a flotation device.

8. A method for installing at least one network link in a locality having an active pipeline, the method comprising:
   transporting the at least one network link from a first location to a second location in the active pipeline; and
   capturing the at least one network link at the second location.

9. The method of claim 8 wherein the active pipeline is an active water distribution system, and
   wherein the transporting includes:
   floating the at least one network link downstream to the second location.

10. The method of claim 8 wherein the transporting includes:
    transporting at least one fiber optic cable from the first location to the second location in the active pipeline.

11. The method of claim 8 further comprising:
    attaching the at least one network link to a transporting device.

12. The method of claim 11 wherein the attaching includes:
attaching the at least one network link to a flotation device.

13. The method of claim 8 further comprising:
   connecting the at least one network link to at least one network device at the first and second locations.

14. The method of claim 13 wherein the connecting includes:
   connecting the at least one network link to the at least one network device at a location outside the active pipeline.

15. A system for installing one or more network links in a locality having an active pipeline, the system comprising:
   means for transporting the one or more network links from a first location to a second location in the active pipeline; and
   means for capturing the one or more network links at the second location.

16. A network comprising:
   at least one network link located in an active pipeline of a locality;
   a first network device connected to the at least one network link and located at a first area of the active pipeline; and
   a second network device connected to the at least one network link and located at a second, different area of the active pipeline.

17. A network of claim 16 wherein the locality includes a metropolitan area.
18. The network of claim 17 wherein the active pipeline is an underground water pipeline.

19. The network of claim 16 wherein the at least one network link includes at least one fiber optic cable.

20. A method for installing a network in an active water distribution system, the method comprising:

    inserting at least one network link into a pipeline of the active water distribution system;

    transporting a first end of the at least one network link from a first location to a second location in the pipeline;

    connecting the first end to a first network device; and

    attaching a second end of the at least one network link to a second network device.

21. The method of claim 20 further comprising:

    creating an entry access point in the pipeline; and

    creating an exit access point in the pipeline.

22. The method of claim 20 further comprising:

    attaching the first end of the at least one network link to a flotation device.

23. The method of claim 22 wherein the transporting includes:
floating the flotation device from the first location to the second location.

24. The method of claim 23 further comprising:
capturing the at least one network link at the second location.

25. The method of claim 20 further comprising:
connecting at least one of the first and second network devices to a power supply located outside the active water distribution system.

26. A method for deploying a network in an active water distribution system, the method comprising:
routing a plurality of network links through the active water distribution system; and
connecting the plurality of links to network devices located outside the active water distribution system.
FIG. 3

OTHER PORTIONS OF OPTICAL NETWORK

FIBER CABLES

WATER PIPELINE

OBSTRUCTION

OS/R 320-1

OS/R 320-2

OS/R 320-3
FIG. 5
START

CREATE ENTRY AND EXIT POINTS IN WATER PIPELINE

POSITION CABLE SPOOL NEAR ENTRY POINT

INSERT CAPTURE DEVICE AT EXIT POINT

ATTACH FLOTATION DEVICE TO FRONT END OF FIBER CABLE

INSERT FLOTATION DEVICE AT ENTRY POINT

CAPTURE FLOTATION DEVICE BY CAPTURE DEVICE

PULL FLOTATION DEVICE THROUGH EXIT POINT

ATTACH OPTICAL DEVICE TO CABLE AT ENTRY AND EXIT POINTS

END

FIG. 6