DOCKET NO. DTE-0020 **PATENT**

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In Re Application of:

Mark G. Katko, Frank R. Koperda and
Arnold W. Kwong

Group Art Unit: Unknown

Examiner: Unknown

For: AN INDEPENDENT CENTRAL OFFICE CONNECTED TO THE PUBLIC SWITCHED TELEPHONE NETWORK VIA ALTERNATIVE MAN TRANSPORT SYSTEMS

DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name; and

I believe that I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a

☒ Utility Patent ☐ Design Patent

is sought on the invention, whose title appears above, the specification of which:

☐ is attached hereto.

☒ was filed on April 19, 2000 as Serial No. 09/552,055 .

☐ said application having been amended on ____________________ .

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the U.S. Patent and Trademark Office all information

AN INDEPENDENT CENTRAL OFFICE CONNECTED TO THE PUBLIC SWITCHED TELEPHONE NETWORK VIA ALTERNATIVE MAN TRANSPORT SYSTEMS

CROSS-REFERENCE TO RELATED APPLICATIONS

The present application is a continuation-in-part application of U.S. Patent Application Serial No. 09/390,730, filed September 7, 1999, which is, in turn, a continuation application of U.S. Patent Application Serial No. 08/933,545, filed September 19, 1997 (now U.S. Patent No. 5,790,130), which is, in turn, a continuation-in-part application of U.S. Patent Application Serial No. 08/890,589, filed July 9, 1997 (now U.S. Patent No. 5,991,310), which is, in turn, a continuation-in-part application of U.S. Patent Application Serial No. 08/806,471, filed February 26, 1997, the contents of all of these applications hereby being incorporated by reference. The present application also claims priority from U.S. Provisional Patent Application No. 60/158,885, filed October 12, 1999, the contents of which are also incorporated herein by reference.

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates generally to a telecommunications system that provides a central office which is independent of the local exchange carriers and, in particular, to a system which uses existing alternative Metropolitan Area Network (MAN) technologies to connect such an Independent Central Office to the public switched telephone network so as to provide central office functions to residents of residential housing developments (single detached, attached, and multi-family) and tenants of commercial developments.

Description of the Prior Art

The divestiture of American Telephone & Telegraph (AT&T) in 1984 resulted in the creation of seven Regional Bell Operating Companies ("RBOCs"). Since AT&T remained as purely a long distance carrier, the business of providing local telephone services came under the control of these seven RBOCs. After divestiture, the seven RBOCs (the "Incumbent Local Exchange Carriers" or "LECS") owned all of the expensive "hardwire" infrastructure necessary to provide local telephone services and owned the local networks to which all of the long distance carriers ("IXCs") had to pay access fees in order to originate and terminate their customer's long distance calls. Since the RBOCs had not been required to freely allow competition for local telephone service in the local markets, to date no company has been successful in entering the estimated $90 billion Local Exchange Carrier ("LEC") market in the United States on a large scale, large scale being defined as including residential customers. Therefore, regarding the provision of local telephone services across the United States, the AT&T divestiture in 1984 basically replaced a national monopoly (AT&T) with seven geographic monopolies (RBOCs).

Despite the passage of the Telecommunications Act of 1996, the purpose of which was to effect significant competition in the LEC markets, the existing RBOCs, due to their overwhelming size and their ownership of the existing infrastructure, have to date been successful in inhibiting any significant competition in the LEC market since any new entrant into the market has only two options for the provisioning of local telephone services: (1) building new infrastructure which is prohibitively expensive, or (2) successfully negotiating contracts with the incumbent LECs which require the payment of excessive fees to the incumbent LECs in order to utilize the LEC infrastructure to resell local telephone services. Neither of these options is particularly appealing since either option substantially favors the RBOCs in the following ways:

1. There is currently no viable, cost effective alternative to the conventional "hardwire" platform to allow large scale competition in the LEC market on a national basis or even on a regional basis.

2. The costs to build a new infrastructure today are prohibitive. In a Wall Street Journal article dated February 12, 1996, the costs of building such an infrastructure were projected at $5 billion to "get started" and $20 billion to "extensively penetrate the market." It has since become clear to the entire telecommunications industry that these projected costs were very low. In 1996, both AT&T and MCI announced strategic plans calling for large scale (including residential customers) building of local networks to compete with the Incumbent LECs. However, neither AT&T nor MCI has pursued these plans and both have admitted that doing so, on a large scale, would not be economically feasible. On July 14, 1997, the Wall Street Journal reported MCI's projected loss of $800 million in its attempt to build local networks in a number of metropolitan markets to begin to compete for local commercial accounts. This news caused MCI to lose $5 billion of market value in one day! AT&T has also suffered significant losses in its attempt to enter the LEC market.

3. The RBOCs have enjoyed one of the highest operating cash flow margins of any U.S. industry, over double that of the IXCs. While the LEC business has remained "proprietary," the long distance business, with its increased competition, has become much more of a "commodity" business. AT&T has had its market share drop to 54% since 1984 and has had its average revenue per minute cut almost in half. Hence, AT&T and MCI are not in a position to "outspend" the RBOCs in infrastructure development.

4. The RBOCs have all filed to become long distance service providers ("IXCs"). In contrast to the plight

of AT&T and MCI in their attempts to enter the LEC market, there are no costly infrastructure obstacles blocking entry of the RBOCs into the IXC market: the RBOCs can buy ready made networks from IXC providers at wholesale rates for immediate deployment. The RBOCs initially announced that their initial strategies regarding the provision of long distance services would be to resell, where discounts usually run about 80%. However, in contrast, the resale discounts the RBOCs originally intended to offer the IXCs for resale of local services were closer to 10-15%.

To ensure their own competitive survival, the IXCs must make inroads into the profitable LEC market. However, to date no technology has been proposed which would enable a company independent of the RBOCs to provide local telephone services at a competitive cost. None of the previously available solutions is economically viable for the reasons noted above. There is thus a great need in the art for a system and method which would enable a company independent of the RBOCs to provide cost competitive local telephone services, and hence meaningful competition to the incumbent RBOCs in the LEC market, without requiring a cost prohibitive infrastructure investment.

Accordingly, a new telecommunications network platform is desired which permits cost effective competition with the Incumbent LECs in the local telephone market without requiring specialized customer premises equipment, without significant infrastructure investment, and without "deals" with the Incumbent LECs. Embodiments of the present invention have been designed to meet this great need in the art.

SUMMARY OF THE INVENTION

The present inventors have met the above-mentioned needs in the art by creating a new telecommunications network platform for providing local and long distance telecommunications services independent of the existing infrastructure managed by the LECs. Those skilled in the art will appreciate that the techniques described herein permit the cost effective creation of a hardwire platform of infrastructure and Central Offices (COs) in many areas throughout the United States.

In particular, the present invention relates to a telecommunications network platform that provides analog voice grade communications and other data services from a customer to an Independent Central Office (ICO) that provides local services, long distance services, and/or other data services by utilizing existing alternative Metropolitan Area Network (MAN) technologies to interconnect the ICO to the incumbent LEC switch, the long distance interexchange carrier (IXC), and/or the data service provider. Through the bundling of communications services such as dial tone, long distance, Internet access, and security system monitoring, a company independent of the incumbent LECs will be able, using the telecommunications network platform of the invention, to offer telecommunications services and data services in a bundled platform offering a 20% to 30% savings to the consumer over existing services of these types. As will be explained below, this may be accomplished in accordance with the invention without requiring the subscriber to purchase any new costly hardware. Instead, existing technology is utilized is in a cost-effective manner so as to permit a plurality of subscribers to share a MAN telecommunications network platform for Central Office and data services and long distance calling. Several embodiments of the invention described herein provide analog voice grade communications from a caller to the public switched telephone network by utilizing existing alternative MAN technologies to connect the ICO to the incumbent LEC switch. LEC bypass techniques of the type described in parent application serial number 08/806,471 may also be utilized to minimize LEC access fees; however, such LEC bypass techniques are not required for implementation of the present invention.

In preferred embodiments, the Independent Central Office of the invention comprises telephone switching equipment such as a private branch exchange ("PBX") connected between the subscriber premises and LEC switch at the LEC Central Office. Such switching equipment located at the Independent Central Office may comprise a data service unit (DSU) and/or channel service unit (CSU) connected to the LEC switch via one or more alternative MAN transport channels and a DS1 conversion card connected between the telephone switching equipment and the channel service unit. Alternatively, a D4 multiplexer may connect the channel service unit to at least one analog trunk within the telephone switching equipment, where the D4 multiplexer comprises a converter which converts analog voice signals from the analog trunk to digital signals for application to the channel service unit.

The telephone switching equipment of the ICO is preferably located in a residential housing development (single detached, attached, or multi-family) or a commercial development and used to provide local and long distance calling services, as well as Internet access and other telecommunications and data services, to the residents of the residential housing development or to the tenants of the commercial development. The long distance service and the local service within the development as well as local service via the public switched network are provided via alternative MAN interconnections outside the incumbent LEC infrastructure to interconnect to a CLEC, LEC, and/or IXC.

In accordance with the invention, the MAN interconnections between the ICO and the IXC and/or LEC switch at the LEC Central Office may include coaxial cable connections, T1/T3 wireline connections, ISDN/PRI wireline connections, SONET Ring fiber transports, optical fiber drops, IEEE 802.6 Dual Fiber Rings, cellular or PCS wireless connections, laser or infrared point to point connections, microwave transmissions, satellite point to point transmissions, power utility lines, DSL wireline connections, and the like.

Since the ICO platform of the invention is typically provided in new service areas not presently serviced by the Incumbent LECs, new infrastructure may be purchased which is not in direct competition with that provided by the incumbent LECs. Then, the alternative MAN transport technology of the invention permits the new infrastructure to be connected into the existing public switched network at tariffs substantially below the tariffs of conventional residential voice lines, thus permitting the cost savings for the community's residents which make the technique of the invention economically viable. Also, the cost structure of the telecommunications network platform of the invention makes it possible to extend the platform of the invention to include pre-existing residential and commercial developments that need to have all or part of their communications infrastructure replaced.

Thus, the present invention provides the first platform for the provision of a complete package of local and long distance services without having to negotiate cohabitation or resale agreements with the LECs. Moreover, since the ICOs of the invention may independently gather billing data and perform other conventional Central Office functions, the system of the invention is not dependent on the LECs for customer support or for the gathering of billing data.

BRIEF DESCRIPTION OF THE DRAWINGS

The objects and advantages of the invention will become more apparent and more readily appreciated from the following detailed description of the presently preferred exemplary embodiments of the invention taken in conjunction with the accompanying drawings of which:

FIGURE 1 illustrates the hardwire connection between an Independent Central Office in a residential housing development, the subscriber premises, and the incumbent LEC Central Office.

FIGURE 2 illustrates the flow of an outbound call from a subscriber's premise in the residential housing development of the embodiment of FIGURE 1.

FIGURE 3 illustrates the flow of an incoming call to a subscriber's premise in the residential housing development of the embodiment of FIGURE 1.

FIGURE 4 illustrates a presently preferred embodiment of the invention whereby the hardwire connection between the Independent Central Office, the incumbent LEC Central Office, and the long distance network comprises one or more Metropolitan Area Network (MAN) transport systems.

FIGURE 5 illustrates an embodiment of the invention whereby the Independent Central Office and the incumbent LEC Central Office are connected via a Metropolitan Area Network (MAN) transport system and the long distance network is connected to the Independent Central Office through the incumbent LEC Central Office.

FIGURE 6 illustrates an embodiment of the invention whereby the Independent Central Office and the long distance network are connected via a Metropolitan Area Network (MAN) transport system and the incumbent LEC Central Office is connected to the Independent Central Office through the long distance network.

FIGURE 7 illustrates a generic MAN transport connection between the Independent Central Office and the LEC.

FIGURE 8 illustrates a satellite MAN transport connection between the Independent Central Office and the LEC.

FIGURE 9 illustrates a microwave MAN transport connection between the Independent Central Office and the LEC.

FIGURE 10 illustrates a laser/infrared MAN transport connection between the Independent Central Office and the LEC.

FIGURE 11 illustrates a cellular/PCS wireless MAN transport connection between the Independent Central Office and the LEC.

FIGURE 12 illustrates a point to point fiber drop MAN transport connection between the Independent Central Office and the LEC.

FIGURE 13 illustrates an IEEE 802.6 DQDB Dual Bus fiber MAN transport connection between the Independent Central Office and the LEC.

FIGURE 14 illustrates a T1/T3 point to point fiber MAN transport connection between the Independent Central Office and the LEC.

FIGURE 15 illustrates a SONET ring fiber MAN transport connection between the Independent Central Office and the LEC.

FIGURE 16 illustrates an ISDN MAN transport connection between the Independent Central Office and the LEC.

FIGURE 17 illustrates a T1/T3 wireline MAN transport connection between the Independent Central Office and the LEC.

FIGURE 18 illustrates a frame relay wireline MAN transport connection between the Independent Central Office and the LEC.

FIGURE 19 illustrates a frame relay ring point to point fiber MAN transport connection between the Independent Central Office and the LEC.

FIGURE 20 illustrates a power/utility line MAN transport connection between the Independent Central Office and the LEC.

FIGURE 21 illustrates a cable or hybrid fiber-cable MAN transport connection between the Independent Central Office and the LEC.

FIGURE 22 illustrates a Digital Subscriber Line (DSL) MAN transport embodiment in which digital subscriber lines are used for the MAN transport between the Independent Central Office and the LEC.

FIGURE 23 illustrates how MAN transport connections to a plurality of telephony and data services may be implemented using an Independent Central Office in accordance with the techniques of the invention.

FIGURE 24 illustrates the MAN transport selection process for planning an Independent Central Office installation in accordance with the techniques of the invention.

DETAILED DESCRIPTION OF PRESENTLY PREFERRED EMBODIMENTS

A method and system for providing local and long distance calling services and for creating an Independent Central Office ("ICO") telecommunications platform in a residential housing development or commercial development in accordance with the presently preferred exemplary embodiments of the invention will be described below with reference to FIGURES 1-24. It will be appreciated by those of ordinary skill in the art that the description given herein with respect to those figures is for exemplary purposes only and is not intended in any way to limit the scope of the invention. All questions regarding the scope of the invention may be resolved by referring to the appended claims.

INDEPENDENT CENTRAL OFFICE

An Independent Central Office as described herein is set forth in detail U.S. Patent No. 5,790,130 and U.S. Patent No. 5,991,310, the contents of which are incorporated by reference above. As described therein, voice services are provided to a caller via an Independent Central Office (ICO) by utilizing existing tariffed network data services. LEC bypass techniques may or may not be used to interconnect the ICO to the Incumbent LEC Central Office; however, such techniques are generally preferred as they avoid payment of the LEC access fees for long distance services.

TELEPHONE SERVICES PLATFORM FOR DEVELOPMENTS

In the embodiments described in the afore-mentioned parent applications, it was assumed that the D4 multiplexer was provided as part of the Central Office equipment owned and operated by the incumbent LEC. However, in the embodiment of the invention described herein, the D4 multiplexer need not be owned and operated by the incumbent LEC. Instead, as illustrated in FIGURE 1, the D4 multiplexers of the Central Office may be replaced by privately owned stand alone D4 multiplexers 58 not provided by the LEC 14 as part of the Central Office equipment. In FIGURE 1, the lines 60 connecting the customer premise 10 to the D4 multiplexer 58 are private copper wire cable instead of the LEC provided analog data lines 18 described in the parent applications. In the embodiment of FIGURE 1, the privately owned D4 multiplexer 58 may be provided outside in a weatherproof housing 62 with an uninterruptible power source (UPS) so as to provide a simple Independent Central Office capability in accordance with the invention which is free of most right of way concerns.

The privately owned D4 multiplexers 58 are placed in new or existing residential housing developments (single detached, attached, or multi-family) or commercial developments 64 as indicated by dotted line in FIGURE 1. In accordance with the invention, new copper wire or twisted pair cable 60 is laid from the D4 multiplexers 58 to each new home during construction but control of these lines is not relinquished to the Incumbent LEC when construction is completed. Alternatively, the copper wire or twisted pair cable 60 may be laid in existing neighborhoods if cost-effective.

The D4 multiplexer 58 is preferably contained in an environmentally protected, climate controlled, vandal proof housing 62 suitable for outdoor use on the premises of the residential or commercial development 64. The housing 62 preferably contains two RJ-48S interfaces, two CSU cards, and up to forty-eight Nx56/64 voice/data card slots. The slot types are preferably universal in nature and adapted to accommodate FXS, E&M, Office Channel Unit Data Port (OCUDP), OPX, and NT1 interfaces. Housing 62 preferably mounts directly onto a concrete slab with two one inch conduit ducts (Network Interface and 120 VAC) and one four inch conduit duct (Customer Side Interface). The Customer Side Interface (CSI) preferably has an access panel allowing easy access to two 48 pin punchdown blocks. A fully redundant Uninterruptible Power Supply (UPS) system with at least a four hour backup is also provided.

The D4 multiplexer 58 may be independently controlled by an independent telecommunications service company to provide long distance services to development 64 via T1 line 22, DEXCS frame 24, and T1 line 27 using conventional techniques or the LEC bypass techniques described in the parent applications. On the other hand, when the development 64 is in close proximity to the development 73, the T1 line 22 could be connected directly into the ICO 70 and bypass the DEXCS frame 24. Access to the public switched network for local service could continue to be provided by the Incumbent LEC Central Office 14 by connecting the DEXCS frame 24 directly to the Incumbent LECs switch 66, such as the 5ESS or DMS100 tariffed for voice services, via T1 line 68. However, in this case, the customer only receives cost savings for long distance services; LEC local service charges would continue to be charged for access to the LEC switch 66.

On the other hand, savings for local as well as long distance services may be provided to the customers of the development 64 by further providing an Independent Central Office facility 70 of the type illustrated in FIGURE 1. As in the embodiments described in the afore-mentioned parent applications, Independent Central Office 70 is preferably, though not necessarily, accessed by the customer via the DEXCS frame 24 and T1 line 26 and contains a switch 42 such as a private branch exchange ("PBX") including Channel Service Unit cards 48 and DS1 cards 50. Access to the long distance network is preferably provided by the switch 42 by connecting an incoming call on incoming T1 line 26 to outgoing T1 line 46 for connection to the long distance network via DEXCS frame 24 and T1 line 27. However, access to local services may also be provided without payment of conventional LEC local service charges for residential voice service by providing Direct Inward Dialing (DID) across digital high capacity trunk lines 72 and Direct Outbound Dialing (DOD) across digital high capacity trunk lines 44 purchased by the Independent Central Office 70 from the Incumbent LEC Central Office 14.

Those skilled in the art will appreciate that DID and DOD across digital high capacity lines provides an 8:1 ratio of subscribers to lines. DID numbers are assigned Automatic Number Identification (ANI) codes from the Incumbent LEC, which is currently a tariffed commercial service, substantially less per minute than tariffed residential customer voice service. When a DID number is dialed from within the public switched network, it is routed to an available channel on the PBX 42 via trunk lines 72, and PBX 42 picks up the ANI code and switches the call to the terminating station line (subscriber), who may be a subscriber in development 64 or a subscriber in development 73 (described in more detail below). On the other hand, calls originating within the subscriber houses 10 serviced by the Independent Central Office 70 are provided to the LEC switch 66 via DOD trunk lines 44. Those skilled in the art will appreciate that this arrangement is similar to a corporate PBX environment where such a ratio of lines to subscribers is commonly used. However, those skilled in the art will further appreciate that such facilities have not previously been provided to residential customers in a residential neighborhood as proposed herein with the substantial cost savings to residential subscribers.

To put the cost savings in perspective, it is noted that 150 residential subscribers may be serviced by 150/8 = 19 inbound/outbound lines, whereby the Independent Central Office 70 need only purchase 19 inbound/outbound lines from the Incumbent LEC 14 but may sell 150. Moreover, the 19 inbound/outbound lines purchased from the Incumbent LEC 14 are tariffed at the lower commercial DID/DOD rate than the typical residential voice rate, resulting in significant additional cost savings.

Conventionally, DID/DOD digital trunk service purchased from the Incumbent LEC 14 allows a customer (in this case, the Independent Central Office 70) to use a DS1 (1.544 Mbps) facility to transport PBX type services, including Direct Inward Dialing (DID), Direct Outward Dialing (DOD), Wide Area Telecommunications Service (WATS), or Custom 800 service from a wire center (Incumbent LEC 14) specified by the customer to their premises. The wire center must be within the same Local Access and Transport Area (LATA) as the customer location but does not have to be the normal serving wire center. As noted above, this service provides a cost effective method of delivering switched exchange access service via a DS1 facility. It also provides the subscriber with a digital handoff of the many PBX type services previously unavailable to residential subscribers, which services can terminate directly into the PBX 42 of the Independent Central Office 70. This direct interface provides the customer with significant customer premise equipment cost savings while also providing the many PBX features at little or no additional cost.

Typically, a DID/DOD arrangement provides for the equivalent of 24 exchange access lines between a wire center and the PBX 42 of the Independent Central Office 70. These 24 channels may be used as trunk lines to PBX equipment 42 as proposed, and may provide DID, DOD, WATS, or Custom 800 service. Typically, the monthly charge for such Digital Trunk Service includes 24 services; however, the Independent Central Office 70 does not have to turn on all 24 services at the same time. In addition, all DID and DOD service may be provided directly from the trunk side of a digital Incumbent LEC Central Office switch 66. In an analog Incumbent LEC Central Office 14, on the other hand, a multiplexer must be used to convert the analog signals to digital signals. The use of the

DS1 to transport the DID service to the customer end does not change the way DID works without the DS1, nor does it allow other features that would not be currently offered under the tariff.

Those skilled in the art will appreciate that DID service allows incoming calls to PBX 42 from the public switched network to go directly to a specific station line at a subscriber residence so that a PBX attendant is unnecessary. Such DID service, without outward dialing capability, uses one-way, incoming trunks. DID phone numbers must be ordered in multiples of 100, where each station is assigned an individual telephone number.

In the embodiment of FIGURE 1, the D4 Multiplexer 58 and the Independent Central Office 70 are preferably built in new residential developments and commercial developments while the developments are under construction so that it is not necessary to obtain additional telephone right-of-ways and the like for laying phone lines or cables. As shown in FIGURE 1, a small housing development in a particular LATA may simply use a D4 multiplexer 58, while a larger housing or commercial development 73 in that same LATA may instead include an Independent Central Office 70. Generally, at least one Independent Central Office 70 is required per LATA. In this fashion, a particular developer who is active in a given LATA will not have to build more Independent Central Offices 70 than is necessary to service the housing units built by that developer in that LATA. Similar arrangements may be provided in existing neighborhoods except that the wiring into the homes 10 is maintained unless faulty.

The D4 Multiplexer 58 allows T1 lines purchased from the Incumbent LECs to be used to connect small developments 64 to the Independent Central Office 70 without having to run cable to, or buy a switch for, the small developments. In effect, the D4 Multiplexer 58 allows the switching services of the Independent Central Office 70 to be extended using tariffed T1 service so that it remains cost effective to service small developments using the techniques of the invention. On the other hand, large housing development 73 may be served directly by on-site Independent Central Office 70, where local service is provided from the Incumbent LEC Central Office 14 via DID trunk 72 and DOD trunk 44 as in a conventional office environment. Long distance service, on the other hand, is provided via DEXCS frame 24 with or without the afore-mentioned LEC bypass techniques for avoiding the LEC origination fees.

The Independent Central Office 70 connects to the homes 10 within the residential housing (single detached, attached, or multi-family) development 73 via punch down blocks or wiring terminals 74, which function to separate out the respective twisted pairs of a 100 pair backbone cable 75 servicing the development 73 and to connect the respective twisted pairs to respective ports 76 of the PBX 42. 100 pair backbone cable 75 connects respective outdoor weatherproof wiring pedestals 78 within the housing development 73, which, in turn, terminate a plurality of twisted pairs 80 into respective subscriber homes 10. As noted above, backbone cable 75 and twisted pairs 80 are preferably, but not necessarily, laid in the virgin ground during the building of the housing development 73 so as to eliminate all right-of-way concerns and to minimize infrastructure costs.

The Independent Central Office 70 is preferably built during the building of the housing development 73 and subsequently used to manage, in addition to local and long distance calling services, cable television and other data and/or media services provided to the housing development 73 via coaxial cable backbone or other media connection 82 and any other high capacity data line laid in the telephone lines right-of-way. For example, the coaxial cable backbone or other media connection 82 can be laid using the same right-of-ways as the telephone lines and similarly terminate at the Independent Central Office 70 for connection to a cable television network via a video bridge (amplified splitter) 84.

In this fashion, the developer, via the Independent Central Office 70, may maintain control of all cable television and telephone services provided to housing development 73. Also, media connection 82 may include a high capacity data line laid in the same right-of-way and managed by the Independent Central Office 70 to provide a plurality of data services to the residential housing development 73. Of course, a commercial development would be wired in similar fashion.

Once the residential housing (or commercial) development 73 with Independent Central Office 70 is wired as shown in FIGURE 1, local telephone service is ordered from the Incumbent LEC Central Office 14 as follows.

Step 1: Identify the location of the Independent Central Office 70 and the location of the serving wire center (Incumbent LEC Central Office 14) for the DS1 facility.

Step 2: Identify the type of Central Office the DS1 will terminate in. An analog Central Office will require a multiplexer, while a digital Central Office requires a multiplexer except for DID.

Step 3: Identify the type and quantity of services to be ordered (DID/DOD).

Step 4: Determine the channel number assignments (blocks of 100).

Step 5: Identify the type of PBX used (*e.g.*, Lucent Definity G3 PBX) and the terminating equipment at the Independent Central Office 70 (*e.g.*, CSU 48).

Step 6: Provide the information gathered in steps 1-5 to the Incumbent LEC to place the order for DID/DOD service.

Step 7: When the T1 line is installed by the Incumbent LEC, install the DS1 card into the PBX 42.

Step 8: Program the PBX's translation table to assign the telephone numbers to the subscriber lines (DID), including subscribers serviced via certain D4 multiplexers 58 in that LATA.

Step 9: Program all local outbound traffic to route through the T1 (DOD) line 44.

Outbound calls from and inbound calls to subscribers 10 in residential community 73 via Independent Central Office 70 will now be described with respect to FIGURES 2 and 3, respectively.

As shown in FIGURE 2, subscriber 10 in residential community 73 begins a call at step 86 by lifting a hand set and creating an off hook condition on a port 76 of PBX 42. The PBX 42 then sends an analog dial tone to the subscriber's hand set at step 88. Upon receipt of dial tone, the subscriber enters the desired phone number at step 90 as a series of DTMF tones to originate the telephone call. At step 92, the PBX 42 receives the DTMF tones and translates them to binary digits in a conventional manner. The binary digits are then compared to the pre-programmed route table in the PBX 42, and at step 94, the route table identifies the call as a local call within the development, as a local call outside the development, or as a long distance call. If the call is a local call within the development, the PBX 42 routes the call at step 96 to the analog port 76 assigned to the designated subscriber as in a conventional PBX office setup. On the other hand, if the call is a local call outside the development, at step 98 the PBX 42 routes the call to the DS1 card provided for DOD, where the DS1 digitizes and formats the call for common carrier service at step 100. The call is then forwarded at step 102 to the Incumbent LEC switch 66, such as a 5ESS, via T1 trunk line 44 for delivery to the Public Switched Network. However, if the route table identifies the call at step 94 to be a long distance call, at step 104 the PBX 42 routes the call to the DS1 card provided for long distance, where that DS1 digitizes and formats the call for common carrier service at step 106. The call is then forwarded at step 108 to the DEXCS frame 24 at the Incumbent LEC Central Office 14 via T1 line 46 for delivery to the Long Distance Network.

Incoming calls to a subscriber 10 in new housing development 73 are handled as illustrated in FIGURE 3. In particular, a call originated within the Public Switched Network designating the prefix for Incumbent LEC switch 66 is delivered at step 110 to Incumbent LEC switch 66 in a conventional manner. At step 112, the Incumbent LEC switch 66 identifies the called number as a DID telephone number, adds station coding numbers, and sends the call to an available channel of the T1 trunk line 72 to the PBX 42. At step 114, PBX 42 receives the call, strips off the coding numbers, and compares them with the pre-programmed route table in the PBX 42. At step 116, the PBX 42 converts the call to analog carrier, switches the call to the corresponding subscriber station, and sends a ring down pulse. Then, at step 118, the ring down pulse continues until it either times out or an off-hook condition occurs.

In a preferred embodiment, calls to a subscriber 10 in new housing development 64 are routed using the bypass techniques described in the parent applications. Once the call is received via T1 line (DID) 72 by the PBX 42, the call is evaluated as described above with respect to steps 94-108 and routed to the subscriber 10 via outgoing T1 line 46, DEXCS frame 24, T1 line 22, D4 Multiplexer 58, and lines 60 to subscriber 10 in new development 64.

As so described, the hardwire telephone platform of the invention substantially differs from the prior art in that an Independent Central Office 70 is provided which can provide local and long distance services in competition with the Incumbent LECs while providing no infrastructure other than that for a new community, which would have to be added in any case. In particular, the wiring system of the invention uses twisted pair, coaxial cable, and/or another form of medium which is installed during an early phase of construction in a new residential housing (single detached, attached, or multi-family) or a new commercial development. For large developments, the Independent Central Office 70 is provided in a building or some other facility erected within the development to house the head end electronics and to provide an interface to the public switched network. For smaller developments, a private D4 multiplexer is provided which connects into an Independent Central Office 70 within that LATA.

At present, it is contemplated that an IXC may utilize the Central Office platform of the invention to provide local services including originating access without payment of LEC access fees. The access fees would instead be under the control of a telecommunications service company for the developer who put the Central Office into the new or existing residential or commercial development. Since the access fees would thereby be removed from LEC control, the IXC could negotiate a separate deal with the developer's telecommunications service company at rates which would, through natural competition, dramatically lower the per minute cost of long distance service, thereby yielding a tremendous competitive advantage over existing long distance competitors required to continue to pay the relatively high access fees to the Incumbent LECs. Alternatively, the local and long distance service could be provided solely by the telecommunications service company for the developer. Also, since local service would be provided via tariffed commercial DID/DOD services rather than tariffed residential voice services, local access to the public switched network could be provided by the telecommunications services company with increased functions and lower costs.

Utilizing a wire line or wireless tele-communications platform, a plurality of services including local, long distance, Internet access, security monitoring, and other data services can be provided. Additionally, those skilled in the art will appreciate that this ICO platform, in conjunction with a coaxial cable backbone or in conjunction with an additional high capacity data line laid in the same right-of-way, may provide these additional services:

pay-per-view movies, interactive video games, interactive education, video telephony, video conferencing, electronic banking, environmental monitoring, utility monitoring, video surveillance, card access monitoring, bulletin board services, fax services, printing services, and customized electronic news. Further cost savings in implementing these features may be obtained by fully automating each Independent Central Office monitoring facility and remotely controlling the Independent Central Office monitoring facility from a regional monitoring facility. In addition, all data for billing and service charges may be captured by the on-site electronics in a conventional manner and forwarded to a central processing point for dissemination and bill generation.

The private PBX platform described with respect to FIGURES 1-3 permits a number of system enhancements. For example, the PBX 42 may incorporate an enterprise communications server application which will allow voice, data, video, wireless, and other types of communications between end-points such as voice terminals, data terminals, computers, transceivers, and the like. The PBX 42 may also support both analog and digital formats in both voice and data applications. Moreover, through the use of standard protocols, such as those commonly used on Local Area Networks (LANs) and Metropolitan Area Networks (MANs) (described in detail below) to connect nodes to an enterprise network, a wireless connection can be established such as described in U.S. Patent No. 5,446,736 to allow the extension of the communication platform of the invention beyond the range of the new developments as described herein to include existing developments. In addition to station connectivity, the PBX 42 may also support a wide number of interfaces including X.25, RS-232, Contact interfaces (analog line circuits for connecting the system to analog devices), and Network Interfaces (analog or digital interfaces, such as central office DID, DOD, common trunking, analog measured service, and ISDN basic and primary rate interfaces).

Similarly, the private D4 multiplexer platform 58 of the invention permits a number of system enhancements. For example, a D4 multiplexer may be used by Incumbent LECs to provide additional facilities. As an example, if an RBOC had a commercial development or industrial park in which it had a 100 pair cable running to the park, and it had already sold 100 trunk lines to the industrial park's customers, and one of those customers ordered 10 more new lines, today the RBOC would have to string a new 100 pair cable to the park to meet the 10 line demand. This process is very expensive and very labor intensive even though the RBOC owns the conduits and right-of-ways. The use of a D4 multiplexer would be much cheaper since the RBOC could install a D4 multiplexer on-site, take 2 pair from the existing 100 and convert those 2 pairs to a DS1 signal for termination on the D4 multiplexer. Since the T1 line can handle 24 DS0 lines, this creates a new net capacity of 22 pairs (24 new pairs minus 2 old pairs) at the industrial park. Moreover, Competitive LECs (CLECs) could use the D4 multiplexer to pick up small residential or commercial developments without running additional cabling.

INDEPENDENT CO USING MAN TRANSPORT INTERCONNECTIONS

Description of MAN Transport

A MAN (Metropolitan Area Network) is a network that interconnects users with computer resources in a geographic area or region larger than that covered by even a large Local Area Network (LAN) but smaller than the area covered by a Wide Area Network (WAN). The term is applied to the interconnection of networks in a city into a single larger network (which may then also offer efficient connection to a wide area network). As explained in more detail below, the definition of "MAN" in accordance with the invention is extended to include the interconnection of several local area networks by bridging them with backbone lines. The latter usage is also sometimes referred to as a campus network.

The MAN transport of LEC telephony functions covers multiple levels of central office to peer (tandem) and carrier level interfacing. MAN transport also covers the transport of billing, call management, messaging, call status, directory, ANI, and other voice and data traffic. The transport of all levels of telephony traffic can either be transparent (not perceptible) or visible (presented to a customer premise interface) as is required to meet customer demands. As customer demands for telephony functions in a residential/mixed setting increase both in volume and sophistication, the economic advantages of areas serviced by Independent Central Offices 70 increases. Examples of applications enabled by single or multiple MAN transport capabilities include advanced telecommuting, remote data presence, remote residential monitoring, environmental monitoring, and very high reliability and availability. Just as past residential areas emphasized good road or water access, close proximity to work or education, the residential/mixed areas utilizing the ICO 70 of the invention will emphasize good telephony infrastructures that connect residents to local area business, education, government, and service infrastructures.

As used herein, MAN transport specifically includes the connection of the Independent Central Office (ICO) 70 with an external exchange carrier such as a Local Exchange Carrier (LEC) or Inter-Exchange Carrier (IXC) for purposes of conveying telephony traffic between the two logical locations. The telephony traffic may include signaling data, call management, traffic management, rate information, billing information, ANI/CLID information, network management, addressing management, switch management, performance/capacity measurements, facilities information, provisioning information, directory information, quality management, service configuration, rule-bases/rule sets/updates, intelligent objects, parametrics, diagnostics, message traffic, and other traffic that manages, operates, or supports the MAN Transport. An example of this traffic is the out-of-band data passed by ISDN or SS-7 transports.

Sample MAN Transport Embodiments

In FIGURES 4-22, where like numbers represent like elements from the above embodiments, the DID/DOD services of the embodiment of FIGURES 1-3 are replaced by one or more of any of a number of alternative Metropolitan Area Network (MAN) transport systems. In particular, in FIGURE 4, the DID/DOD connections of FIGURE 1 are replaced by a media converter 120, a MAN transport system 122 interconnecting the ICO 70 to the LEC switch 66 of the public switched telephone network via links 124 and 126, and a MAN transport system 127 interconnecting the ICO 70 to the long distance network via links 128 and 129. Of course, only MAN transport system 122 needs to be used (FIGURE 5) to connect the ICO 70 to the LEC switch 66 and the long distance network where the IXC is accessible via the LEC switch 66 via connection 27 as in FIGURE 1. Similarly, only MAN transport system 127 needs to be used (FIGURE 6) to connect the ICO 70 to the LEC switch 66 and the long distance network where the public switched telephone network is accessible via the IXC. Accordingly, in the following discussion of the MAN transport systems, it will be assumed that the MAN transport systems so described may be used as MAN transport system 122 and/or MAN transport system 127 in the embodiments of FIGURES 4, 5, or 6.

In the embodiments of FIGURES 4-6, it is recognized that the CSU 48 can be either a stand-alone unit or can be incorporated into other equipment (such as multiplexers, network interface cards, routers, and telephone switching equipment 42). As illustrated in FIGURES 7-22, other MAN transport technologies may be utilized, such as passive optical networks, voice over IP, SONET, etc. The DS1 card 50, on the other hand, functions in effectively the same manner as a D4 multiplexer described above by breaking down DS1 channels into DS0 channels and allowing the usable bandwidth to interact directly with the telephone switching equipment 42 at the Independent Central Office 70. In particular, DS1 card 50 functions as a line-side T1 interface which provides communications to remote locations by providing off-premise extensions to remote locations. Analog telephone functionality is extended over DS1 facilities and channel bank units to provide the telephone at the remote site with full access to 2500-type line functionality. In accordance with the invention, the software of the telephone switching equipment 42 is optioned to condition the DS1 channels of the DS1 card 50 as an FXO. Thus, the telephone switching equipment 42 could replace the IXC as the terminating point of the local network.

The telephone switching equipment 42 also may be used to extend conventional LEC Central Office services, such as Public Dial Tone, Call Waiting, Call Forwarding, Three Way Calling, Caller ID, Internet access, security system monitoring, and the like to the customer premise 10. The telephone switching equipment 42 may be a Lucent Technologies Definity G3 PBX or 5ESS CDX system that further provides access to long distance service via CSUs 28 and media converter 120 as will be described in more detail below. Additionally, those skilled in the art will appreciate that all of the conventional land line transport systems described herein can be eliminated by utilizing wireless cable or microwave connections.

The interfacing of the long distance network to the ICO 70 may be performed in a manner similar to extant installations where the Point of Presence of the long distance carrier is channeled via Channel Service Units 48 that multiplex and demultiplex from traffic originating from within the ICO service premises 70 and from the outside long distance network. However, the Independent Central Office 70 is not constrained when MAN transport technology is instead used to connect the CSUs 48 with the long distance carrier. For example, when the call originates within customer premises 10, it is processed through the ICO 70 and CSU 48 to provide outputs on T1 lines 27 to media converter 120. As shown in FIGURE 7 by way of example, the call may then be routed through media transmission cards 130/132 over media 134 and delivered to the LEC or IXC carrier backbone.

As illustrated in FIGURE 7, in all MAN transport embodiments in accordance with the invention, the PBX 42, data network, and other ICO terminations of the LEC transport services are architected as a network interface 130 at the ICO 70 and a network interface 132 at the LEC premise connected to the network interface 130 via network media 134, where the details of the network interfaces and media vary in the respective MAN embodiments.

Examples of LEC/IXC MAN transport mechanisms will now be described with respect to FIGURES 8-22. While the MAN transport mechanisms are shown to interconnect the ICO 70 to the public switched telephone network, those skilled in the art will appreciate that the MAN transport mechanisms described below may also be used to interconnect the ICO 70 to the long distance network (IXC) using one or more of the configurations in FIGURES 4-6.

As shown in FIGURE 8, the ICO 70 may be interconnected with the LEC switch 66 via satellite transponder linkage. Connections via satellite are usually not necessary but do meet the needs of geographically isolated or remote areas such as skiing areas in high mountain country. The MAN transport vehicle of FIGURE 8 can support multiple types of satellite-bandwidth transport from high ISDN-compatible bandwidth to low data rate TCP/IP telephony or specialized compressed voice transport. Both VSAT and larger dishes can be used depending on satellite transponder frequency and utilization. Related facility connections using Low Earth Orbit Satellites (LEOs) IP transport or using proprietary connection protocols may be used. Satellite transport also may be used as a MAN Transport for data traffic as well with a variety of multiplexing techniques including TDM, SDM, FDM, and channel multiplexing. Multiple types of interface protocols are supported by satellite transceivers including SNA SDLC, HDLC, and other International Telecommunications Union (ITU) Protocols. All of these techniques can be used as MAN Transport for data, voice, or other signal traffic in accordance with the embodiment of FIGURE 8.

In FIGURE 8, the interconnection between the ICO premises 70 and the LEC switch 66 includes a PBX network interface card 136 that connects to the local PBX 42 in the ICO 70, a coaxial/wiring cable 138 from the PBX network interface card 136 to the uplink/downlink dish 140, a satellite 142, a downlink/uplink dish 144, and a coaxial/wiring cable 146 from the downlink/uplink dish 144 to LEC interface card 148. The operation of such devices is believed to be well known to those skilled in the art and thus will not be further elaborated upon here.

As shown in FIGURE 9, the ICO 70 alternatively may be interconnected with the LEC switch 66 via point to point microwave linkages. Point to point microwave linkages have traditionally been used for long distance traffic networks until more recently replaced by fiber optic cable routes. The point to point microwave linkages are used to transport T-carrier compatible telephony traffic that is then converted to normal central office switch compatible signaling. The facilities of the ICO 70 then perform normal telephony based transforms to switch, deliver information, process call management, or perform other functions. Alternate protocols can be hosted across the microwave media such as TCP/IP or ITU X-protocols. Also, other microwave techniques (such as LMDS or MMDS) or radio carrier transmission (FM, etc.) may be used to broadcast or otherwise transport the telephony traffic.

In FIGURE 9, the interconnection between the ICO premises 70 and the LEC switch 66 includes wireless transceiver interface 150, coaxial/wiring cable 152, MAN microwave tower 154 which communicates via microwave/maser transmission 156 to microwave tower 158, coaxial/wiring cable

160, and wireless LEC transceiver interface 162. The operation of such devices is believed to be well known to those skilled in the art and thus will not be further elaborated upon here.

As shown in FIGURE 10, the ICO 70 alternatively may be interconnected with the LEC switch 66 via point to point laser/infrared linkages. Point to point laser or infrared linkages act like the point to point microwave relays of FIGURE 9; however, instead of using a microwave carrier/signal that carries a signal using PCM or APCM, the laser or infrared beam in the embodiment of FIGURE 10 is modulated optically to carry the PCM or APCM signals. In the specific case of fiber optic cables, the laser or other light source is physically transported along a glass fiber instead of through atmosphere or space.

Services connecting an ICO 70 to the LEC switch 66 or long distance carrier using these methods may choose one or more methods depending on site specific criteria such as:

1) How far is the ICO 70 from the LEC point of presence, and hence how expensive is the connection?

2) What is the quantity of bandwidth, and quality of service, that is required to service the customer population of the ICO 70?

3) Are there regulatory or engineering standards that force specific types of connectivity between the ICO 70 and the LEC point of presence?

4) What considerations of time-to-market factors compel selection of one technology over another so that services can be delivered to the customers of ICO 70 when required?

Thus, even when a single technology (say, fiber optic media transmission over fiber) may be preferred, there are selection criteria that may suggest selecting a non-preferred embodiment such that market factors can be met. Moreover, quality of service issues may compel deployment of multiple types of connectivity to meet fault tolerant engineering requirements, bandwidth on demand, or for specific types of customer desired connectivity.

In FIGURE 10, the interconnection between the ICO premises 70 and the LEC switch 66 includes laser/infrared transceiver interface card 164, coaxial/wiring cable 166, laser/infrared transmitter/receiver 168 which communicates over transmission media 170 to laser/infrared transmitter/receiver 172 (typically one channel is transmitted in each direction for point to point laser or infrared transmitters), coaxial/wiring cable 174, and laser/infrared LEC transceiver interface card 176. The operation of such devices is believed to be well known to those skilled in the art and thus will not be further elaborated upon here.

As shown in FIGURE 11, the ICO 70 alternatively may be interconnected with the LEC switch 66 via a wireless/PCS linkage. As noted above, a key innovation in the ICO 70 of the invention is the capability to utilize one or more MAN transports to interconnect local customers served by direct connections to the ICO 70 to LEC services and facilities. Wireless switching (supported by standard cellular telephone and PCS facilities) may use wireline/switched "landline" interfaces to back or replace the standard connection between the ICO 70 and the LEC switch 66 or the long distance network point of presence. The interfaces to such wireless services have a different economic profile, justification, and application. In the event of land-based connection failure (cable cut, facilities failure, natural disaster, etc.), standby access, by consumer selected choice, or by auto-switching in the ICO 70, may be used to provide wireless bandwidth to continue connectivity. Alternate routing, via automated rate arbitrage, by consumer selected choice, or by automated switching can also be used to take advantage of specific rate situations (such as international routings, short-distance but inter-LATA traffic in border situations, or negotiated long distance carrier access). For very isolated (*e.g.*, rural) areas the use of wireless transmission may also be used to permit the ICO facilities 70 to serve as wireless LEC exchange facilities. In certain cases, the wireless interface may actually be a satellite based telephone interface (such as IntelSat) that provides exchange carrier services to the consumers serviced by connection to the ICO 70. Thus, the ICO 70 can connect via multiple wireless technologies (TDMA, CDMA, FDMA, etc.) to wireless exchange providers.

In FIGURE 11, the interconnection between the ICO premises 70 and the LEC switch 66 includes wireless transceiver interface 184, coaxial/wiring cable 186, radio tower 188 which communicates over cellular/PCS link 190 to radio tower 192, coaxial/wiring cable 194, and wireless LEC transceiver interface 196. The operation of such devices is believed to be well known to those skilled in the art and thus will not be further elaborated upon here.

Those skilled in the art will appreciate that fiber also can be used as the physical media to transport many different types of data. Besides TDM telephony traffic, the fiber may also transport network management protocols, local data content being transported across the metropolitan area, packetized voice, multimedia data, and signaling protocols. These techniques, and others, are considered to be within the scope of this invention.

Examples of local data content being transported across the MAN include Local Area Network (LAN) protocols. LANs typically are used to transport data over geographically short distance and will not readily extend to wide area transport. However, access agents typically provide the conversion required to properly interconnect segments of LANs across large geographic distances over fiber or wires while continuing to offer LAN transport management capabilities. Examples of this LAN emulation include LAN over ATM (LANE) and RFC 1394 encapsulation.

Examples of interconnected LAN protocols that might be enabled by this technique include, but are not limited to, FDDI (Fiber Distributed Data Interface) (ANSI X3T12) and FDDI-II (although named 'Fiber' FDDI can also run across metallic wires and is sometimes designated CDDI(copper)), IBM ESCON (Enterprise Systems Connection) and FICON (Fiber Connectivity), serial SCSI (Small Computer Systems Interface) and SCSI-II (ANSI X3.131, ANSI X3T9.2, etc.), Fibre Channel (ANSI X.3230-1994), Serial HIPPI FP (High Performance Parallel Interface framing protocol) (ANSI T11.1), FOIRL (Fiber Optic Inter Repeater Link, now IEEE 10Base-FL), and IEEE 802.3 for fiber (such as IEEE 802.3d, 802.3j, and 802.3z).

The use of the fiber also allows for emerging interconnect possibilities, including, but not limited to, converged network bypass, near/collocated facilities, and transport method price arbitrage. A variety of physical or logical topologies (star, ring, bus, etc.) can be applied without changing the functionality of the resultant effective MAN transport of the invention.

As shown in FIGURE 12, the ICO 70 alternatively may be interconnected with the LEC switch 66 via a fiber link including a point to point fiber transceiver interface card 178 (either single or multimode), fiber media 180, and point to point LEC fiber transceiver interface card 182. Although not shown, additional fiber multiplexing and transmission processing (such as DWDM concentration/multiplexing) may occur between the ICO 70 and LEC premises. At the LEC premises, the interface card 182 to the fiber media 180 delivers the traffic to the LEC switch 66. Conversely, at the ICO premises 70, the interface card 178 delivers the traffic to the PBX 42. The operation of such devices is believed to be well known to those skilled in the art and thus will not be further elaborated upon here.

As shown in FIGURE 13, the ICO 70 alternatively may be interconnected with the LEC switch 66 via dual-bus fiber optic media based networks. Land-based carriers have deployed IEEE 802.6 DQDB (Distributed Queue Dual Bus) based dual ring fiber optic media based networks to serve customers requiring large bandwidths in extended metropolitan service areas. In like fashion, SMDS (Switched Megabit Data Service) access is provided such that intra-LATA (as promoted by Bellcore) service, for metropolitan wide transport of data services, can extend customer based Local Area Networks and provide ATM-like service capabilities to customers connected to the ICO 70. Because of the cell-based nature of the transport and the high available bandwidth (comparable to T3 capacities), voice traffic can be transported across available bandwidth using congestion management capabilities inherent in the DQDB media management to provide quality of service attributes desirable in voice/video/data conferencing and other enhanced services.

In the embodiment of FIGURE 13, the ICO 70 has the capability of providing leased line (*i.e.*, T1/T3/MDS) data traffic as well as voice to the customers of the ICO 70. Those skilled in the art will appreciate that the data traffic may be used to provide mixed use services for home offices, telecommuting, and the like. Although residential services are typically provided by 2B+D ISDN, leased line, and DSL and used for a variety of home-based businesses, residential entertainment, distance education, disability enabled access, personal videoconferencing, and the like, an ICO 70 interconnected to the LEC switch 66 or long distance network in accordance with this embodiment of the invention retains the capability to provide these types of non-1FR (*i.e.*, USOC 1FB, *etc.*) tariff level services as well.

In FIGURE 13, the interconnection between the ICO premises 70 and the LEC switch 66 includes an IEEE 802.6 dual-fiber interface card 198 connected to the dual independent fiber bus media 200 and then to the LEC IEEE 802.6 dual-fiber interface card 202. The data traffic, or encapsulated services, carried across this connection are examples of the intra-LATA transport capabilities in the ICO 70 of the invention.

As shown in FIGURE 14, the ICO 70 alternatively may be interconnected with the LEC switch 66 via MAN transport IP (fiber) or T1/T3 point to point linkages. Those skilled in the art will appreciate that traditional carrier services have used CLASS level switch-to-switch, or extender, connections to provide central office functionality to remote PBX or service cabinets. New capabilities from carriers include the use of Frame Relay based or IP based connections to transport telephony service connections. The MAN transport of telephony services in accordance with the invention includes both such private network and exchange carrier connections. TCP/IP connections can also transport the encapsulated telephony protocol traffic and, in turn, may be embedded in transmission structures such as ATM (Asynchronous Transfer Method), SMDS (Switched Megabit Digital Service), or SONET (Synchronous Optical Network). Thus, higher level telephony protocols may be transported via MAN transport where the major administration and operations interface is via TCP/IP management facilities such as those provided by Sun/HP Open/View, IBM Tivoli, Computer Associates, and others. Effectiveness of bandwidth management as well as non-circuit switching providers exchange carriers with efficiencies and cost advantages that can be passed to serviced customers. In this fashion, the ICO 70 can service both Internet access and telephony access across an IP-hosted connection from the ICO 70 to a LEC switch 66 that also shares facilities with an Internet access carrier. The actual transmission of IP data may be across an ATM, SMDS, or SONET interface, but this is transparent to upper level management and administration tools.

In FIGURE 14, the interconnection between the ICO premises 70 and the LEC switch 66 includes a point to point fiber interface card 204 connected to the fiber media 206 and then to the LEC point to point fiber interface card 208.

Additional fiber multiplexing may of course be used between the facilities besides that shown in the simplified diagram of FIGURE 14. The point to point fiber interface card 204 may also be housed in an additional routing/switching device that separates IP data and telephony traffic and supports virtual or direct routed connections using IP based connection management. In like fashion, the LEC facility may use alternate embodiments to support routing/switching of IP based traffic prior to presentation of the encapsulated, or directed, telephony functionality hosted across the MAN transport using techniques known in the art.

As shown in FIGURE 15, the ICO 70 alternatively may be interconnected with the LEC switch 66 via a MAN transport SONET ring fiber link. In this embodiment, telephony interfaces (DS1/DS3) are provided across a Synchronous Optical NETwork (SONET) fiber-optic media network. As known to those skilled in the art, the characteristics of SONET include fiber redundancy and ring topology interfaces such that physical transport redundancy is handled at a SONET level so as not to affect higher levels of telephony administration and management. The inherent high data rates (OC-1 bandwidth of 51.84 Mbits) of this MAN transport also provide for multiple service access across single connections (either single or multimode fiber) that are provisioned between an exchange carrier and the ICO 70. MAN transport for additional bandwidth can be by unused fiber pairs (dark fiber) and connected fiber pairs active only on a demand, fall-back, or dynamically provisioned basis. Additional fiber transport multiplexing and switching functions further extend the SONET functionality for MAN transport connectivity.

In FIGURE 15, the interconnection between the ICO premises 70 and the LEC switch 66 includes a SONET ring (fiber) transport 212 interfaced to SONET fiber ring termination cards 210 and 214. The illustrated interconnection has been simplified and details of multiple fiber connections and multiple SONET interface layer equipment devices have not been shown. Alternate topologies (other than ring) are also possible dependent on carriers' facilities, geography, and market factors. The operation of such devices is believed to be well known to those skilled in the art and thus will not be further elaborated upon here.

As shown in FIGURE 16, the ICO 70 alternatively may be interconnected with the LEC switch 66 via a MAN transport ISDN connection. As known by those skilled in the art, Integrated Services Digital Network (ISDN) is a set of standards that defines many telephony services from the physical connector (ISO 8877), connection interface ("S" and "U" wire interfaces), bandwidth configuration (Primary Rate Interface for example), and telephony protocols (ITU SS7 using Bellcore standards TR444, TR448, TR317, TR394 and others) to provide comprehensive services support for voice, data, and telephony functions across an all-digital interfaced network. PRI connections service multiple functions within the ICO 70 to LEC facility as well as allowing for transport of higher level digital connections that can be used for Internet, private data, video, or other applications. Specific vendors support ISDN interfaces to central office or PBX switches such as those that can be applied to provision the ICO 70 (such as the ISDN/AP interface from Northern Telecom).

Because ISDN provides support for transport and user-presentation of multiple telephony functions (such as AIN, rapid call setup/take down, call switching, call management, call dispatch, etc.), residential/commercial mixed use developments may desire ISDN services to support telephony and data applications that are highly attractive to customers. Examples of ISDN deployments in the current marketplace include telecommuting (work at home), teleconferencing (voice/video/data), distributed call centers, and LAN extensions. The maturity of ISDN functionality, evident in support by multiple vendors, carriers, and standardization also provides for high levels of ICO functionality that can be delivered to customers, including Advanced Intelligent Network

(AIN), Calling Line ID (CLI), data services, and the like. Transformation and translation of these presentation interfaces within the ICO PBX/switching/processing capabilities can allow for presentation within the service area of the ICO 70 on multiple media and devices. For example, AIN or CLI data could be presented on PC based workstations equipped with appropriate software for voice conference presentation or data services aggregated from multiple ICO customers can be serviced via ISDN data linkages to connect to Internet service providers, video conferencing, or other data services.

Availability of multiple voice and data circuits with availability of switch management allows significant economic advantages for the ICO 70 to switch consumer demand across high bandwidth connections without requiring dedicated circuits, trunks, exchange cards, or services. Shared facilities via ISDN can include dynamic bandwidth allocation and switching to support prioritization of functions and to reflect consumer quality of service attributes.

In FIGURE 16, the interconnection between the ICO premises 70 and the LEC switch 66 includes the ISDN Network Interface 216, PRI wireline 218, and ISDN Network Interface 220 at the LEC premises. These elements are schematic in nature and describe multiple possibilities for MAN transport using ISDN Network Interfaces that are standards conforming. Depending on the ICO embodiment and LEC embodiment, the actual network interfaces may be multiplexing single cards, cabinets containing multiple devices, router interfaces, switch interface cards, or other devices known to those skilled in the art.

As shown in FIGURE 17, the ICO 70 alternatively may be interconnected with the LEC switch 66 via a MAN transport T1/T3 wireline connection. In FIGURE 17, the connection between the ICO 70 and LEC facilities is shown in simplified representation as a data service unit/channel service unit (DSU/CSU) termination 222 supporting the T1/T3 wireline media

224 that is also connected to a DSU/CSU termination 226 at the LEC facility. Preferably, the CSU 222/226 interfaces with the T1 line 224 and provides the line power and a place for the carrier to loop back the T1 line 224 for line inspection. CSU 222/226 also provides the correct physical network termination for the T1 line 224, as well as isolation and physical line protection. The CSU 222/226 further provides a combination of two functions defined by the public network carriers: (1) correct T1 framing and (2) synchronous protocol translation. As known to those skilled in the art, the CSU 222/226 can be either a stand-alone unit or can be incorporated into other equipment (such as multiplexers, network interface cards, routers, and telephone switching equipment such as PBX 42.

In FIGURE 17, the choice of fiber topology and the like is dependent on specifics of the equipment at the ICO 70 and LEC facility. The quantity of T1/T3 connections needed to support the ICO customer population will depend on their utilization characteristics and other requirements (such as media or data bandwidth consumption). Channel management for T1/T3 connections is primarily static, although extension of the ICO virtual channel assignments can be applied. The tools for managing and administering the DS1/DS3 channels actually used for LEC connectivity are those typically used in the central office PBX administration (including CCS reporting, channel based error rates, peak/average channel utilization, and other span metrics).

Those skilled in the art will appreciate that T1/T3 (or embodiments with larger multiples) can be employed as MAN transports regardless of the PCM coding, time slotting (such as the 32 time slots in the CEPT (European PT Administration Standard) or other methods), or transparent physical substitutions (such as direct fiber for wire, or other mediums including wireless). In like manner, the MAN transport may encounter transparent transport hierarchy techniques such as channel aggregation (inverse multiplexing and its obvious reversal), virtualization, dynamic channel reallocation and expansion by means of multiplexing or other assignment strategies, and corresponding reconstitution of T-type interfaces at either the ICO 70 or LEC premises 14 as required. In the event of bandwidth criteria from business or regulatory requirements (as just two examples), the fragmentation of T1/Tx capacities could be used without changing the character of this MAN transport. In like manner MAN transport can occur across bandwidth that has been divided, and reconstituted, or concentrated, and then split, across transports that are constrained, channelized, or otherwise divided. Thus, traffic that has been concentrated (such as, but not limited to, fractional-T1 over SDSL), or split across bonded channels (such as, but not limited to, bonded-B channels ISDN), is considered to be within the scope of the invention. Thus, the static or dynamic handling by the ICO 70 of T-type interfaces, the management strategies for allocation and utilization, the error and fault control mechanisms, and the physical media in the intervening space (wire, fiber, or radio as just three examples among others) point to the delivery of a T-type interface as the end-result of T1/T3 MAN transport as a specific demonstration of its embodiment. In a directly analogous manner, embodiments of ISDN MAN transport are also incorporated herein by reference.

As shown in FIGURE 18, the ICO 70 alternatively may be interconnected with the LEC switch 66 via a frame relay wireline network where the private virtual channel mapping constructed within the functionality of the ICO 70 is passed across an unchannelized (or channel mapped) frame relay network and then passed on to the LEC. The use of frame relay for transport is similar to analogous use of frame relay private networks (or AT&T Managed Multi-Service Network) for voice transport. In addition to serving as transport from an ICO 70 to the LEC, this allows multiple-ICO facilities within a LATA to be connected without incurring toll charges for toll-intra-LATA calling. The use of a frame relay network also uses different media connections that may have desirable economic impacts depending on LEC connection costs.

In FIGURE 18, the ICO facility 70 is provisioned with a Frame Relay Network interface FRAD 228 connected across unchannelized wireline media 230 to a compatible FRAD 232 at the LEC premises. The topology of the frame relay network is left to the specific characteristics of the ICO switch 42, LEC carrier, and localized economic characteristics.

On the other hand, as shown in FIGURE 19, the ICO 70 may be provisioned with a Frame Relay Network Interface FRAD 234 connected across a fiber media 236 to a compatible FRAD 238 at the LEC premises. The topology of the frame relay network in this embodiment is also left to the specific characteristics of the ICO switch 42, LEC carrier, and localized economic characteristics. In the case of a shared frame relay network with explicit or implicit virtual circuit allocation where different quality of service management may exist (such as Committed Information Rate/Committed Bit Rate, etc.), the actual transport bandwidth of the MAN transport for originating or terminating traffic at ICO 70 may be well in excess of that provided by T1/T3 wireline connections.

Those skilled in the art will appreciate that the application of framing-techniques (even to the extent of proprietary protocols used by many manufacturers and devices) can be used to encapsulate any number of communications protocols for transport. Thus, framing-techniques can be used to transport both extant communications and interfacing protocol types encoding information content and management data, and also to protocol types (versions or variants) that are still being defined. The extent of framing techniques includes that of encapsulated channelization, virtualization, abstractions, and embedding strategies such that the specific information/data content supported by the MAN transport may include abstractions and instantiations of interfaces, protocols, objects, and either concurrent or serial streams of ICO/LEC supported instances of any or all of these. Inherent in any deployment of the MAN transport mechanisms (whether specifically frame or other as defined herein) is the capability to transport framing techniques traffic between the ICO/LEC using one or more methods concurrently or separately. Therefore, the bandwidth deployed in specific support of a MAN transport capable of support framing techniques is not necessarily bound to that of the underlying MAN transport mechanism, but can reflect either static (design) allocation or dynamic handling of the ICO/LEC traffic.

FIGURE 20 illustrates a power and utility line MAN transport system that supports the transport of cell/packet based network traffic. The bandwidth in such a MAN transport system is comparable to that used to transport both voice and data on a variety of conditioned lines. In the simplest form, a public utility (usually electrical power, but possibly a private network provider) supplies unloaded wire (*i.e.* copper) pair(s) across which a MAN transport occurs. Fiber optics media may also be provisioned by private organizations not tariffed as telephony carriers so as to provide a MAN transport media substantially equivalent to that illustrated in FIGURE 14. In more complex situations, a variety of value added network services (such as operations, administration, and maintenance support, network monitoring, physical media repairs, etc.) may also accompany the provisioning of power/utility line media.

The transport of both voice and data traffic across a power/utility line MAN transport has been shown to be feasible in products delivered by Intellon, Adaptive Networks, and others. Intellon has demonstrated bandwidths of 10 Mpbs with an increase to 20-30 Mpbs or more, which is sufficient CIR/CBR to assure transport of telephony traffic via such a MAN transport. Commercially available products also provide choices of LAN multiplexed analog component (MAC) style interfacing that is practical for incorporation in router/hub/switch interface cards. Thus, support for either telephony-voice or telephony-data traffic is possible using the MAN transport of FIGURE 20. However, limitations of power line/utility line media (wireline) relative to fiber include distance, effective conditioning level (constraining CIR/CBR), high RFI/EMI environments, and bandwidth constraints. Application of the power line/utility line media transport hosting is thus restricted to specific circumstances, but may still be a clear economic choice.

In FIGURE 20, the ICO switching/distribution facility 70 interfaces to either or both of a media interface including ICO resident data router/hub/switch 240 or a telephony interface including power line to telephony media interface 242. Data router/hub/switch 240 connects to a power line to telephony media transceiver 244 that passes data to/from power line to telephony media transceiver 246 via power line media 248. Power line telephony media transceiver 246 in turn interfaces to router/hub/switch 250 at the LEC premises. Power line to telephony media interface 242, on the other hand, transmits data to/from power line to telephony media interface 252 via power line media 254. In turn, power line to telephony media interface 252 interfaces with DSU/CSU 256 and through the DSU/CSU 256 to the LEC premises equipment. The operation of such devices is believed to be well known to those skilled in the art and thus will not be further elaborated upon here.

Hybrid Fiber/Coax (HFC) access technologies have been developed to transport broadband video and data services to and from residential and commercial customers. Existing HFC systems can provide full duplex (*i.e.* bi-directional) digital communications services at high data rates that allow common carrier type services (*e.g.* T1, T3, etc.) or direct interconnect to be provided as a transport medium between the ICO 70 and the LEC, CLEC or IXC. As illustrated in FIGURE 21, the provisioning of telephony services over the cable or HFC can be transported as digital telephony signaling, as IP based telephony, or other techniques known to the those skilled in the art. The cabling between the LEC, CLEC or IXC and the ICO

70 may be traditional coaxial cable, twisted pair cable, optical fiber, or combinations thereof.

In FIGURE 21, the ICO telephony facilities 70 are accessed via a DSU/CSU 258 that is interfaced to the HFC or Coax Cable media 260 via an Interface Card 262. MAN transport between the interface card 262 at the ICO 70 and the interface card 264 at the LEC premises may be transformed, switched, or otherwise routed, but the presentation to the LEC is in the form compatible with a DSU/CSU 266 in this example. In such an embodiment, traffic in the upstream direction from the ICO 70 may use available reverse channel spectrum in the high band, mid band, or low band areas using techniques known in the art. By using appropriate modulation techniques, those skilled in the art will appreciate that it is possible to create an upstream channel with sufficient capacity to meet the needs of the ICO 70. The downstream capacity is easily expandable by allocating more frequency bands, or channels, for data delivery. Those skilled in the art will further appreciate that other means of provisioning using the HFC or analog or digital coaxial cable media are possible and therefore not shown. The operation of these devices is believed to be well known to those skilled in the art and thus will not be further elaborated upon here.

FIGURE 22 illustrates a Digital Subscriber Line (DSL) MAN transport embodiment in which digital subscriber lines are used for MAN transport between the Independent Central Office (ICO) 70 and a carrier (LEC or IXC) location. The DSL MAN transport illustrated in FIGURE 22 can be used to carry either packet/cell based traffic or telephony traffic depending on interface terminations. As known to those skilled in the art, DSL connections are typically constrained by actual distances between locations, but their selection as an embodiment for the ICO 70 may be related to local tariff conditions and economic considerations that make the DSL MAN transport a desirable linkage. DSL connections can be made with speeds above those of a T1 connection such that the traffic carried across the transport is sufficient to service multiple types of connections to switches, data traffic, or other requirements.

In FIGURE 22, the LEC Digital Subscriber Line (DSL) MAN transport connects the Independent Central Office switching/distribution facility 70 to the LEC or IXC via a switch interface 268 connected to a DSL access module 270 and then via a DSL wireline 272 to a compatible transport transceiver 274 connected to a switch interface 276 at the LEC (or IXC) premise equipment. The operation of such devices is believed to be well known to those skilled in the art and thus will not be further elaborated upon here.

Numerous embodiments of MAN transport mechanisms for use in connecting the ICO 70 to the LEC switch 66 have been described in detail above with respect to FIGURES 7-22. As noted above, those skilled in the art will appreciate that the same MAN transport mechanisms may be used to connect the ICO 70 to the IXC. Other MAN transport systems, such as audio wave based technologies, current loop, or other signaling technologies, may also be used. The appropriate MAN transport mechanism in each case will depend on the economic advantage of each choice. Such advantages include the ability of MAN transports to provide a variety of carrier services in situations where hardline wiring (due to right-of-way or environmental problems for example) is not rapidly accessible. Additional advantages are the ability to transport customer and external traffic and connect with an IXC where the closest IXC point of presence may be economically inconvenient (for example a fiber loop that is a short distance away or where a specialized fiber carrier is operating on a nearby right of way). In addition to providing services across a variety of MAN transport mediums, a wider range of carriers beyond those extant in most areas in the 1990s (AT&T, MCI, Sprint, etc.) can be used as the long distance network provider in accordance with the invention by supporting converged network services. Newly emerging carriers (Qwest, Level 3, Williams, Enron, etc.) do not have fully deployed networks and the present invention provides the opportunity to rapidly connect with their fiber plants.

Those skilled in the art will appreciate that the Independent Central Office (ICO) 70 of the invention provides connectivity for customers (residential, mixed use, or businesses) for a full breadth of telecommunications and media products and services. The ICO 70 provides connectivity inclusive, but not limited to, services such as:

1) ICO (local) provided telephone exchange services (such as those provided by ESS and other advanced Private Branch Exchange installations, voice mail, messaging, facsimile, TDD, etc.);
2) Public Switched Telephone Network Local Exchange Carrier (local and non-interexchange calling) services;
3) Interexchange Carrier (IXC) Long Distance (voice and enhanced calling services such as messaging, third-party pay, etc.);
4) Data Transmission Services (including value added network access, Virtual Private Networks, frame relay, packet network, Private Virtual Circuit, multi-drop circuit, messaging, paging, Public Access Virtual Circuit, ISDN accessed data connections, fractional to multi-T carrier point to point data services, private SONET, private DQDB, SMDS, and others);
5) Internet Access (and other TCP/IP based services); and
6) Media Access Services (including services such as cable TV, interactive media, local media, media translations, pay-per-view, and others).

The MAN Transport mechanisms of the invention, with appropriate implementation, can provide services to end customers of the ICO 70 with transparency for many services. For example, internal-ICO, local, and long distance voice services are available whether the transport is via wire/fiber media or wireless. As an additional example, remote telecommuting access to a corporate network could be provided to a residential customer using high bandwidth local ICO connection (to another customer of the ICO 70), Internet Access, ISDN, data transmission, dial-up analog modem, or two-way dedicated video.

As shown in FIGURE 23, the end customers 10 connect to the ICO 70 via a primary service connection media path including wiring pedestals 78 and twisted pair lines 80; or via an additional media service connection path 82. The ICO 70 is then used to provide connections to MAN transport connected facilities in accordance with the techniques of the invention. Such MAN transported facilities may include:

Media, TV, and other delivery services 280;

Public Switched Telephone Network Local Exchange Carrier (LEC) 282;

Internet Access Carrier 284;

Data Transmission and Data Services Carrier 286;

Long Distance (Interexchange Carrier-IXC) 288; and

Wireless carrier 289.

Depending on the connection type (demand, virtual, permanent, switched, etc.) and corresponding customer premises equipment, the end-user's connection processing may occur in different fashions. Demand-type connections are originated by customers (such as a long distance voice call) and may be subject to blocking depending on provisioning capacities (services subject to blocking or allocation availability). Virtual-type connections (such as virtual private network connections) present the appearance of dedicated services while actually being provisioned using a shared, switched, or other interface. Permanent-type connections that provision the customer service are based on a reused/reusable implementation that provides specific services and operating characteristics where resource allocations are usually made at the time of the first connection establishment (such as a point-to-point dedicated permanent voice circuit). A switched-type connection (such as an Internet connection) provides access on a circuit, packet, or message basis to connect to a non-ICO service. Other connection types, such as hybrids using ICO-supplied services with services from facilities across the MAN transport(s), may also be used.

Internal operations of the ICO 70 to support monitoring, performance/capacity management, administrative, facilities management, billing, resource management, and other functions are also supported across the MAN transport(s) for economies of scale for centralized business process functions. The connection processing for these capabilities may include in-band, out-of-band, separate network, parallel network, and discrete media (such as tapes, compact disc, DVD, digital audio tape, etc.).

FIGURE 24 shows the MAN transport selection process for planning an ICO installation 70 in accordance with the techniques of the invention. As shown, at step 290, the ICO installer chooses one or more of the available long distance service providers (IXCs) to be supported by the ICO 70 and chooses one or more MAN transport mechanism (two or more for redundancy) for each IXC service provider. The ICO installer chooses at step 292 zero or more Internet service providers and chooses one or more MAN transport mechanism for each Internet service provider. At step 294, the ICO installer chooses zero or more wireline (local exchange carrier) providers and chooses one or more MAN transport for each LEC. The ICO installer then chooses zero or more broadcast media, advertising, etc. service provider and chooses one or more MAN transports for this service at step 296. The ICO installer then chooses zero or more data transmission carriers (VAN, PVC, VPN, dedicated data transmission, etc.) at step 298, zero or more wireless service providers for the Local exchange carrier and private area services at step 300, zero or more wireless service providers for the long distance carrier (IXC) at step 302, zero or more wireless service providers for the data carrier at step 304, and one or more options for multiple MAN transport to each service or multiple services at step 306. Once these services are selected and established, each service is implemented through the ICO 70 in a conventional fashion, except for the afore-mentioned LEC bypass services. Of course, these services may be implemented in any order and in most any combination.

Those skilled in the art will appreciate that long distance (inter-exchange) carrier MAN transport from the ICO 70 has special characteristics that are not available to residential customers in other locations. The ICO 70 has accessibility of rate, transport rate, shared facility, and multiple modes (such as Internet telephony) that allow residential customers to selectively choose their level of quality (such as wired versus wireless, DSL or Internet based voice communications versus traditional wire/fiber, Internet store-and-forward facsimile versus direct call, movie-on-demand instead of scheduled, or high-bandwidth FTP transfer versus normal consumer rate) on a static or dynamic basis. Such capabilities allow for unique customer profile/ personalization, rule/agent/dynamic based selection criteria, or two-way feedback to the residential customer. For example, the system may issue statements such as `you have 10 minutes of wireless time left on this billing plan,' `you have paid for 10 movies so far this billing period,' `Internet faxing will require additional time,' `the movie has been running for 30 minutes already, would you like a personal direct feed on demand,' `the data transfer will take 10 hours on your data pricing plan, would you like a high speed access to be made that will only take an estimated 10 minutes?,' `would you like to avoid long distance charges by using an Internet telephone call?,' `would you like to access this on a seamless basis from your wireless service as you go out of the residential service area?,' `would you like to record this transaction/data transaction/media transfer on your personal storage area?,' `would you like to buy this background music?,' `would you like to select your music on hold while waiting for the called party?,' and the like. The ability to perform rate arbitrage, quality of service selection, multiple modal media selection, and specialized data/voice/media logging/archiving/recording are unique to the Independent Central Office 70 of the invention due to having combined facilities and interfaces present. The economies of scale and reuse for the interfaces, data transformations, and ICO resident data reuse provide clear economic benefits for the ICO 70 as compared to independent, co-located, co-resident, or separated facilitated services.

Long Distance Carrier MAN transport using the techniques of the invention also has significant economic implications as a result of the 1996 Telecommunications Act. In scenarios where the ILEC/RBOC carriers become long distance carriers, the MAN transport to the LEC 14 in accordance with the invention becomes a path to IXC Inter-LATA services in addition to their carrying intra-LATA (toll) charge voice calls. In scenarios where the ILEC/RBOC carrier does not have long distance authority from the Federal Communications Commission, the need to have arrangements for IXC Inter-LATA services can accrue significant benefits (whether access charges or other fee arrangements) to the ICO 70. In accordance with the invention, ICO functionality for long distance can include significant other services besides customer originated voice calling, including:

1) "800/888/877" Toll Free services;
2) "900" Toll Services;
3) International Calling;
4) Inter-LATA Call Center Delivery;
5) Inter-LATA ISDN;
6) Caller Pays Wireless (Inter-LATA);
7) AIN Routing;
8) Calling Card;
9) Dial-around/alternate carrier access;
10) Long distance multi-media conferencing;
11) Long distance follow-me;
12) Ring-again, store-and-forward messaging;

13) Long distance FAX, FAX store-and-forward messaging; and

14) Toll plan monitoring.

Those skilled in the art will further appreciate that once the MAN transport of circuit, call management, call content, call detail, SMDR (station message detail reporting), billing, and call notification data occurs, the LAN transport and alternate routings to the house from the ICO 70 are fully enabled by the functionality described herein. A significant advantage of the ICO 70 of the invention is the availability of transport protocols, such as H.323, that allow multi-media and multi-transport conferencing, messaging, and media translation. The ICO operator has a significant opportunity to supply these services without incurring co-location, establishment, overbuild or re-siting costs, retroactive provisioning, or access fees in order to generate a revenue stream.

Just as concentration of circuit switching for consolidation of customer access may occur in the ICO 70 to avoid LEC charges, the availability of multiple MAN transport options at the ICO 70 can also be used to avoid significant LEC/IXC charges in developments served by the ICO 70. These significant charges would be incurred to a LEC/IXC for extensive FX-exchange costs (for a development that is just across a LATA or governmental border), preferential costs for DID/DOD number assignment, availability of call management/call control data at the consumer location, dynamic/static carrier rate arbitrage, and others as known to those skilled in the art.

In addition to the advantages of redundancy, fault tolerance, and customer perceived quality from multiple paths to long distance carriers, the availability of large numbers of customers available to long distance carriers with a single location drop, and the potential ability to support value-added services (*i.e.* long distance ISDN, video-conferencing, etc.) provide a strong incentive for long distance carriers to support the multiple MAN transport modes of the ICO 70 in accordance with the invention.

Those skilled in the art will further appreciate that the use of MAN transport permits unified operations and administration in the ICO (LEC, IXC, Internet, Wireless, Messaging, etc.) to manage the bandwidth capacity, deliverable services, and alternate service delivery modes to meet customer perceptions and requirements. Efficient administration is enabled by automated operational views of multiple transport media and demands from the residential/mixed usage customers. The capability to provide the high levels of service to residential customers across multiple MAN transport media has other advantages obvious to those skilled in the art when contrasted with many existing examples where even coordination, let alone seamless service management, is impossible or prohibitively expensive in existing multiple, geographically spread, central provisioning facilities.

By extension, the capability of relating MAN traffic demand from the residential side to specific providers also considerably reduces the expense to maintain records, bill, and administer delivery of complex multi-modal product offerings. An example of this is the reduction in facilities needed to service messaging devices. Instead of parallel equipment required to support TAPI (telephony applications programming interface), proprietary, telephony based digital messaging services, and CDPD (cellular digital packet data) e-mail gateways, all of these services can be hosted on a single PC-technology based server that interacts with the appropriate radio technology. By extension, enhanced messaging services such as concurrent Internet or proprietary e-mail delivery, message archiving, high volume rule-based broadcast services, concurrent multi-device messaging (cellular, PCS, pager, web appliance, satellite telephone, etc.) can be supported with little incremental equipment and facilities costs. Two way messaging service costs are also reduced by an embodiment using shared messaging infrastructure or web-mail delivery using pre-existing Independent Central Office facilities 70.

In accordance with the invention, the process that builds and makes operational an ICO 70 is distinct from both existing construction processes and the long lead times inherent in multiple, sometimes geographically distinct, facilities. Both incremental and "big bang" approaches can be used to create initial operating conditions, and are described below. Certain of the process components have been used in traditional construction and development methods, but their specific integration into a process to serve residential/mixed developments is both innovative and economically advantageous.

For example, the MAN transport mechanisms to the ICO 70 permit integration of multiple modes of MAN transport into a single facility as a normal operating mode. Also, MAN transport mechanisms permit integration of multiple modes of wireless capability as a design characteristic of a central office facility. MAN transport mechanisms also permit integration of administration, operations, maintenance, technology migration, and security management as key components of central office construction and initial operations. Those skilled in the art will also appreciate that by providing for MAN transport transformations on both a dynamic and static basis that it is possible to deliver single or multi-modal services.

The economic advantages from using MAN transport mechanisms in accordance with the invention include the capability to integrate multiple transport MAN functionalities in minimal spaces so as to reduce land requirements and thereby land and construction costs. As an example, separate co-located, physically distinct spaces, are not required to support multiple MAN transports to multiple carriers and suppliers of transport or related enhanced services. The reduction in internal floor space requirements, racking, additional cabling, facilities provisioning (power, HVAC, environmental, security, etc.) reduces both operating expense and initial build out costs for the ICO 70. MAN transport mechanisms also provide the capability to integrate wireless capabilities into the initial design and build out of the ICO facility 70 so as to reduce permitting, land/elevation costs, structural modifications to support antennas or towers, and reduces problems with connectivity from wireline/alternate wireless transports to the specific carrier MAN wireless transport. Existing facilities often incur significant and ongoing leasing, security, connectivity, and ongoing provisioning costs avoided in the design for wireless MAN transport support in an ICO 70 in accordance with the invention.

The MAN transport mechanisms further permit design reuse, integration of multiple MAN transports to service a residential/mixed development, and integration of automated/manual administration, operations, maintenance, technology modification, and other costs that are very significant and a key to build out and long term cost reductions in building an ICO 70 in accordance with the invention. Technology modifications as enhancements, higher quantities of links, and additional carriers are also facilitated by having these design considerations integrated into the ICO facility 70 from initiation. Transformation of MAN transport methods on both a static and dynamic basis also supports better packaging of services/products, support of new multi-modal services/products, operational management based on economic reuse, and enables the delivery of known services in a highly resource and cost efficient manner.

Design level reuse is another key economic advantage of construction build out and operational turn up of new Independent Central Office facilities 70 in accordance with the invention. Existing development of entertainment/cable head-end facilities, construction of telephony central offices, deployment of Internet connectivity/access, and deployment of wireless capabilities is highly fragmented and burdened by legacies of regulation and design requirement growth. Design reuse both provides known project templates for the process of build out and turn up, but can integrate the deployment of elements such as wireless antennas that are currently afterthought additions, when possible, to the ICO facilities 70. Integrated design for deployment of satellite dishes, wireless antennas, messaging equipment, and multiple modes of transport also reduces conflicts (such as RFI/EMI interference, power distribution problems, HVAC provisioning, structural positioning needs, etc.) but also can be designed for desired characteristics of maintainability, operational access, security, and aesthetics (such as hiding antennas) that are not accessible or possible with either existing or other design approaches.

The unique design characteristics of an Independent Central Office 70 also allow for a unified design that can be incrementally "turned up" for distinct types of MAN transport. As an example, satellite transport of long distance traffic might not be required initially, but design provisioning for aesthetics, pedestals, cable runs, and power distribution both significantly reduce incremental turn-up time, but also reduce or eliminate problems such as EMI/RFI interference and power distribution problems.

On the other hand, design reuse can be extended to cover rapid construction and turn-up to initial operating status by both process reuse and reuse of equipment planning based on a continued integration of pre-identified carriers and other suppliers. Instantiation of an ICO facility 70 repeating interactions with previous embodiments also allows continuous process improvements that further reduce time to operation, costs, and risks. Thus, design for multiple MAN transports and multiple embodiments that are used across multiple locations support a highly advantageous environment for deployment of the ICOs described herein. Those skilled in the art will appreciate that rapid deployment of multiple facilities will reduce technological and business risk since consistent design and facilities build outs allow consistent and efficient turn-up with multiple MAN transport facilities and administration leveraging provisioning processes.

An Independent Central Office 70 in accordance with the invention retains both market flexibility and innovative characteristics for services delivered in a Local Exchange Carrier service area by utilizing MAN transport and/or DACS facilities to reduce local intra-LATA toll charges, provision of FX capabilities with number portability, and support of advanced telephony functions that may not be available in less advanced telephony service areas. Innovative characteristics for service delivery include integrating wireless/cellular/PCS services without additional costs in a local residential area, providing sophisticated support for home-office/small-business residentially hosted operations, service delivery of multiline/high demand services (such as large family events) using soft dial-tone, and ICO switch based residential offerings such as `dial-it' services or `call a babysitter' based on local central office support.

Although exemplary embodiments of the invention have been described in detail above, those skilled in the art will readily appreciate that many additional modifications are possible in the exemplary embodiment without materially departing from the novel teachings and advantages of the invention. For example, those skilled in the art will appreciate that in each case the T1 data lines described may be T1 or greater high capacity data lines (*e.g.*, T3, OC3, OC12). Those skilled in the art will further appreciate that digital or analog signaling can be carried over various physical media and mediums, and versions thereof, such as, but not limited to, wiring, fiber optic cable, radio waves, coaxial cable, laser light, and audio. In addition, those skilled in the art will appreciate that other telephone equipment besides a PBX may be used to provide the switching and Central Office functions at the Independent Central Office 70. The Independent Central Office 70 may also house electronics in support of numerous other functions. Moreover, the switching equipment need not be analog but may be completely digital or optical. Furthermore, the Independent Central Office 70 need not be located within the residential housing development or commercial development but may be nearby or remote and connected to the wiring terminals using any of a number of wired or wireless protocols. Similarly, adjacent extant housing, industrial, or mixed use sites can be supported by either the service zone of the ICO 70 (in the case of wireless or direct connect interfacing), extension of MAN transport (comparable to FX services), or comparable handling of desirable opportunities (such as secondary LEC/suppliers point of presence, or customer demarcations) that are within the MAN transport service reach of the ICO 70 of the invention. Accordingly, these and all such modifications are intended to be included within the scope of this invention as defined in the following claims.

We claim:

1. A method of providing public switched telephone network access to residents/tenants of a residential housing/commercial development, comprising the steps of:

placing a telecommunications switch in or near the residential housing/commercial development in proximity to said residents/tenants, said telecommunications switch being maintained physically and financially independent of a central office switch at an incumbent local exchange carrier central office facility;

connecting telecommunications equipment of said residents/tenants to said telecommunications switch; and

providing a Metropolitan Area Network (MAN) transport communications connection between said telecommunications switch and said central office switch so as to provide full duplex communication of at least voice data between said telecommunications switch and said central office switch.

2. A method as in claim 1, wherein said step of placing the telecommunications switch comprises the step of building a housing structure for said telecommunications switch in a new residential housing/commercial development during construction of said new residential housing/commercial development and said step of connecting said telecommunications equipment to said telecommunications switch comprises the step of placing wires in telecommunications right-of-ways during construction of said new residential housing/commercial development.

3. A method of providing long distance telephone network access to residents/tenants of a residential housing/commercial development, comprising the steps of:

placing a telecommunications switch in or near the residential housing/commercial development in proximity to said residents/tenants, said telecommunications switch being maintained physically and financially independent of a central office switch at an incumbent local exchange carrier central office facility;

connecting telecommunications equipment of said residents/tenants to said telecommunications switch; and

providing a Metropolitan Area Network (MAN) transport communications connection between said telecommunications switch and a point of presence of the long distance telephone network so as to provide full duplex communication of at least voice data between said telecommunications switch and said point of presence.

4. A method as in claim 3, wherein said step of placing the telecommunications switch comprises the step of building a housing structure for said telecommunications switch in a new residential housing/commercial development during construction of said new residential housing/commercial development and said step of connecting said telecommunications equipment to said telecommunications switch comprises the step of placing wires in telecommunications right-of-ways during construction of said new residential housing/commercial development.

5. An Independent Central Office (ICO) facility that is maintained physically and financially independent of a central office switch at an incumbent local exchange carrier (LEC) central office facility, comprising:

a structure built in or near a residential housing/commercial development containing a plurality of customer premises;

a telecommunications switch located within said structure, said telecommunications switch including a plurality of customer side ports for connection to said customer premises and a plurality of LEC side ports for connection to said incumbent LEC central office facility; and

a MAN transport transceiver that connects at least some of said plurality of LEC side ports via a MAN transport media to at least one of (a) said central office switch at said incumbent LEC central office facility and (b) a point of presence of an interexchange carrier, so as to provide voice services to/from said customer premises.

6. An ICO facility as in claim 5, wherein said MAN transport media comprises a satellite transponder link and said MAN transport transceiver comprises a network interface that converts data from said telecommunications switch to/from a communications format of said satellite transponder link, a satellite dish transceiver connected to said satellite transponder link, and a cable that connects said network interface to said satellite dish transceiver.

7. An ICO facility as in claim 5, wherein said MAN transport media comprises a point to point microwave link and said MAN transport transceiver comprises a wireless transceiver interface that converts data from said telecommunications switch to/from a communications format of said point to point microwave link, a microwave transceiver connected to said point to point microwave link, and a cable that connects said wireless transceiver interface to said microwave transceiver.

8. An ICO facility as in claim 5, wherein said MAN transport media comprises a broadcast microwave link and said

MAN transport transceiver comprises a wireless transceiver interface that converts data from said telecommunications switch to/from a communications format of said broadcast microwave link, a microwave transceiver connected to said broadcast microwave link, and a cable that connects said wireless transceiver interface to said microwave transceiver.

9. An ICO facility as in claim 5, wherein said MAN transport media comprises a point to point laser/infrared link and said MAN transport transceiver comprises a laser/infrared transceiver interface that converts data from said telecommunications switch to/from a communications format of said point to point laser/infrared link, a laser/infrared transceiver connected to said point to point laser/infrared link, and a cable that connects said laser/infrared transceiver interface to said laser/infrared transceiver.

10. An ICO facility as in claim 5, wherein said MAN transport media comprises a cellular/PCS wireless link and said MAN transport transceiver comprises a wireless transceiver interface that converts data from said telecommunications switch to/from a communications format of said cellular/PCS wireless link, a radio transceiver connected to said cellular/PCS wireless link, and a cable that connects said wireless transceiver interface to said radio transceiver.

11. An ICO facility as in claim 5, wherein said MAN transport media comprises a point to point optical fiber link and said MAN transport transceiver comprises a point to point optical fiber transceiver interface that converts data from said telecommunications switch to/from a communications format of said point to point optical fiber link.

12. An ICO facility as in claim 11, wherein said point to point optical fiber link comprises an IEEE 802.6 distributed queue dual bus (DQDB) dual ring fiber optic link and said point to point optical fiber transceiver interface comprises an IEEE dual fiber interface.

13. An ICO facility as in claim 11, wherein said point to point optical fiber link comprises a DS1/DS3 point to point fiber optic link.

14. An ICO facility as in claim 11, wherein said point to point optical fiber link comprises a synchronous optical network (SONET) ring fiber optic link and said point to point optical fiber transceiver interface comprises a SONET fiber ring transceiver.

15. An ICO facility as in claim 5, wherein said MAN transport media comprises an ISDN wireline link and said MAN transport transceiver comprises an ISDN network transceiver interface that converts data from said telecommunications switch to/from a communications format of said ISDN wireline link.

16. An ICO facility as in claim 5, wherein said MAN transport media comprises a T1/T3 wireline link and said MAN transport transceiver comprises a data service unit/channel service unit (DSU/CSU) transceiver interface that converts data from said telecommunications switch to/from a communications format of said DS1/DS3 wireline link.

17. An ICO facility as in claim 5, wherein said MAN transport media comprises an unchannelized frame relay network T1/T3 link and said MAN transport transceiver comprises a

frame relay transceiver interface that converts data from said telecommunications switch to/from a communications format of said unchannelized frame relay network T1/T3 link.

18. An ICO facility as in claim 5, wherein said MAN transport media comprises an unchannelized frame relay network fiber optic link and said MAN transport transceiver comprises a frame relay fiber optic transceiver interface that converts data from said telecommunications switch to/from a communications format of said unchannelized frame relay network fiber optic link.

19. An ICO facility as in claim 5, wherein said MAN transport media comprises a power utility line and said MAN transport transceiver comprises a power line to telephony transceiver interface that converts data from said telecommunications switch to/from a communications format of said power line.

20. An ICO facility as in claim 19, wherein said MAN transport transceiver further comprises a data service unit/channel service unit (DSU/CSU) that interfaces said power line to telephony transceiver interface to said telecommunications switch.

21. An ICO facility as in claim 19, wherein said MAN transport transceiver further comprises a data router that interfaces said power line to telephony transceiver interface to said telecommunications switch.

22. An ICO facility as in claim 5, wherein said MAN transport media comprises a coaxial cable and said MAN transport transceiver comprises a coaxial cable interface that

converts data from said telecommunications switch to/from a communications format of said coaxial cable.

23. An ICO facility as in claim 22, wherein said MAN transport transceiver further comprises a data service unit/channel service unit (DSU/CSU) that interfaces said coaxial cable interface to said telecommunications switch.

24. An ICO facility as in claim 5, wherein said MAN transport media comprises a hybrid fiber coaxial cable and said MAN transport transceiver comprises a hybrid fiber coaxial cable interface that converts data from said telecommunications switch to/from a communications format of said hybrid fiber coaxial cable.

25. An ICO facility as in claim 24, wherein said MAN transport transceiver further comprises a data service unit/channel service unit (DSU/CSU) that interfaces said hybrid fiber coaxial cable interface to said telecommunications switch.

26. An ICO facility as in claim 5, wherein said MAN transport media comprises a digital subscriber loop (DSL) wireline and said MAN transport transceiver comprises a DSL interface that converts data from said telecommunications switch to/from a communications format of said DSL wireline.

27. A method of providing access by residents/tenants of a residential housing/commercial development to a plurality of data or telephony services, comprising the steps of:

placing a telecommunications switch in or near the residential housing/commercial development in proximity to said residents/tenants, said telecommunications switch being maintained physically and financially independent of a central office switch at an incumbent local exchange carrier central office facility;

connecting telecommunications equipment of said residents/tenants to said telecommunications switch; and

providing a Metropolitan Area Network (MAN) transport communications connection between said telecommunications switch and at least one of said data or telephony services desired by each resident/tenant.

28. The method of claim 27, wherein said step of providing a MAN transport communications connection comprises at least one of the following steps: providing a first MAN transport communications connection with at least one of a television and media service, providing a second MAN transport communications connection with a public switched telephone network local exchange carrier, providing a third MAN transport communications connection with an Internet access carrier, providing a fourth MAN transport communications connection with a data services carrier, providing a fifth MAN transport communications connection with a long distance telephone carrier, and providing a sixth MAN transport communications connection with a wireless carrier.

29. The method of claim 28, comprising the additional step of providing at least two MAN transport communications connections for each data or telephony service.

ABSTRACT

A system and method that provide analog voice grade communications from a caller to an Independent Central Office (ICO) for local services and/or to a long distance inter-exchange carrier (`IXC') for long distance services by utilizing one or more alternate Metropolitan Area Network (MAN) transport services between the ICO and the IXC and/or local service provider. The telephone switching equipment of an Independent Central Office is located in a residential housing development (single detached, attached, or multi-family) or a commercial development and used to provide local and long distance calling services, as well as Internet access and other telecommunications and data/media services, to the residents of the residential housing development or the tenants of the commercial development. The alternate MAN transport technologies connect the ICO to the public switched network and/or long distance network for the provisioning of voice and other communications services that may be managed and controlled at the ICO premises as opposed to the incumbent local exchange carrier (LEC) premises.

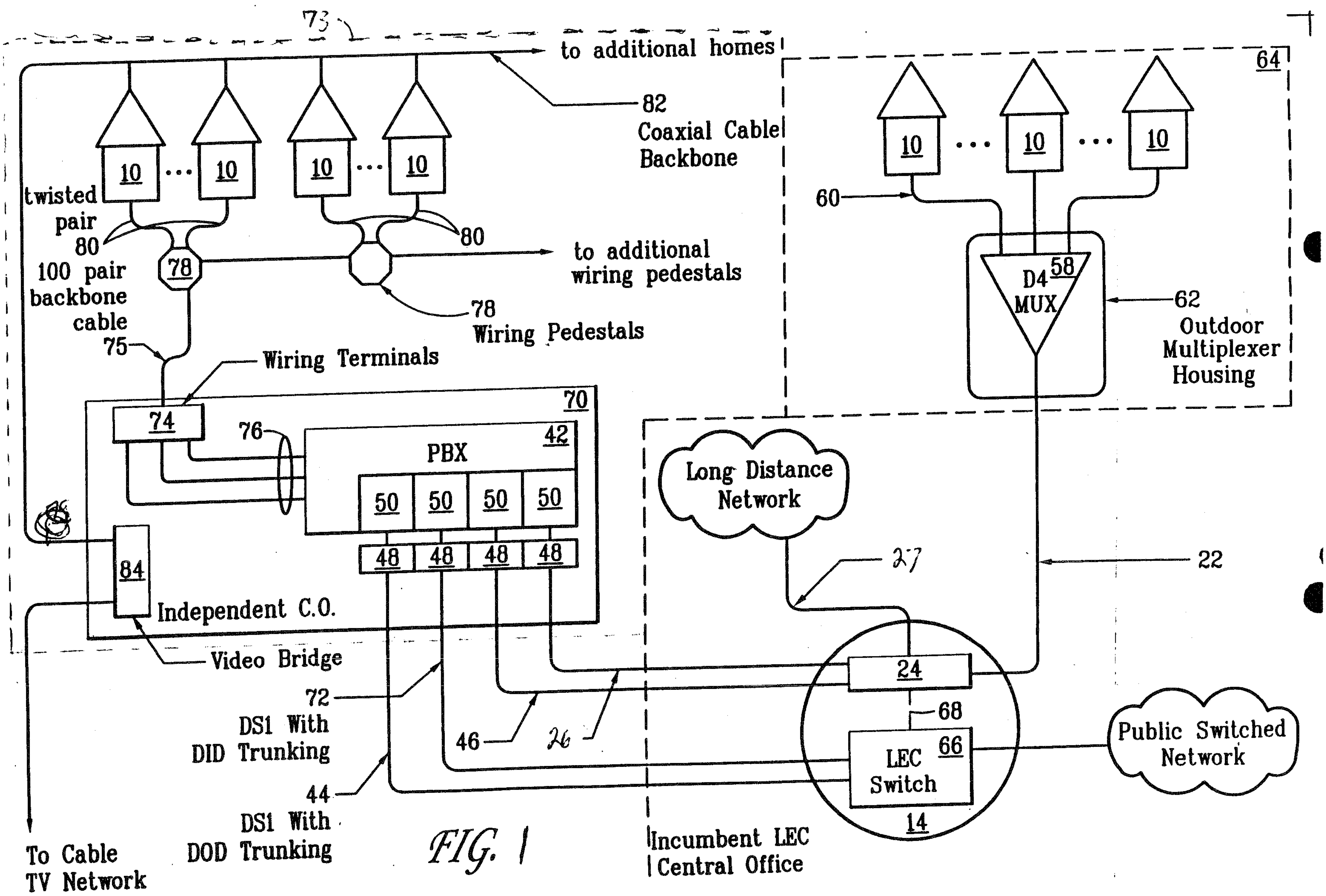

73
to additional homes
82
Coaxial Cable
Backbone
64
10
10
10
10
10
10
10
twisted
pair
80
100 pair
backbone
cable
75
78
80
to additional
wiring pedestals
78
Wiring Pedestals
60
D4
MUX
58
62
Outdoor
Multiplexer
Housing
Wiring Terminals
70
74
76
PBX
42
50
50
50
50
48
48
48
48
84
Independent C.O.
Video Bridge
Long Distance
Network
27
22
24
68
LEC
Switch
66
14
Public Switched
Network
72
DS1 With
DID Trunking
46
26
44
DS1 With
DOD Trunking
To Cable
TV Network
Incumbent LEC
Central Office

FIG. 1

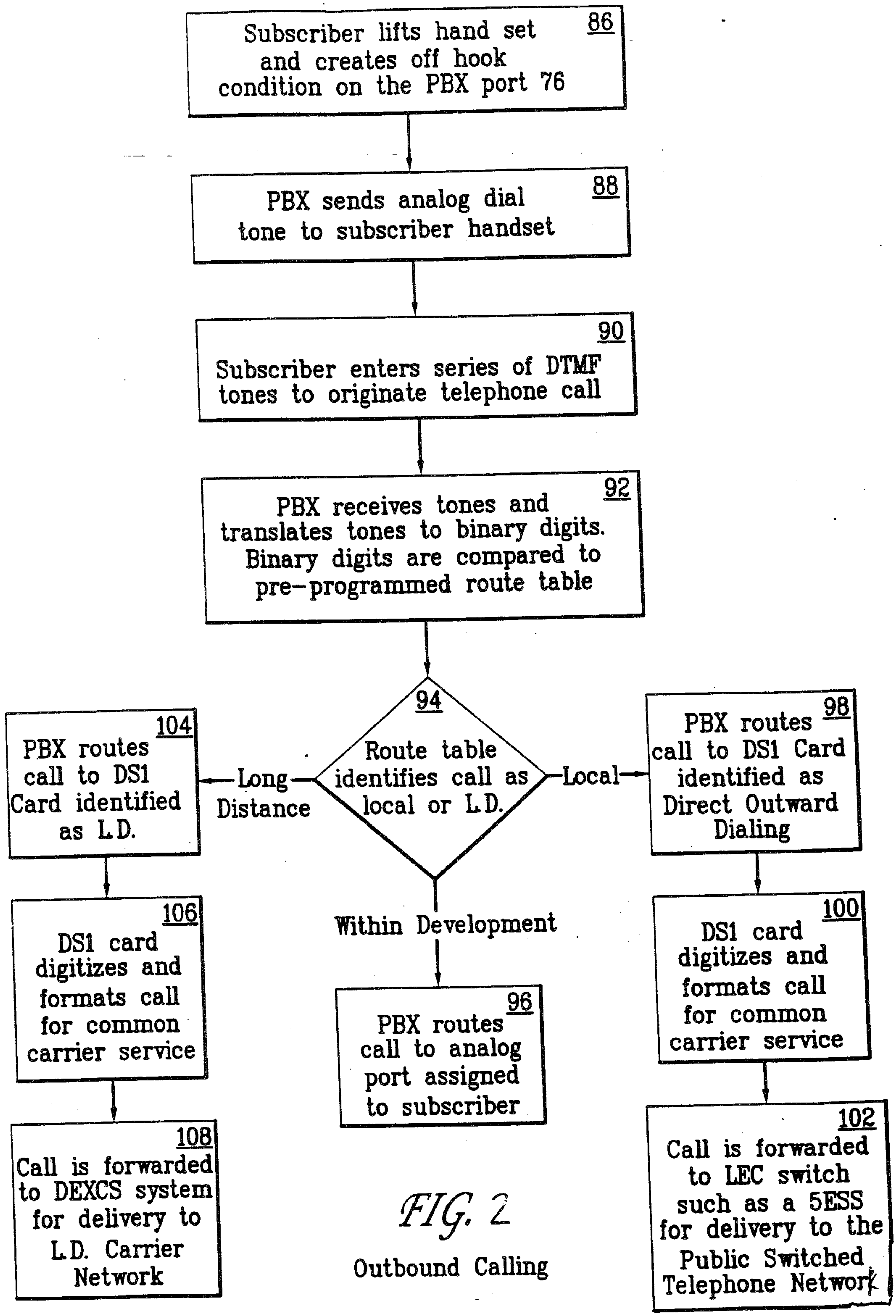
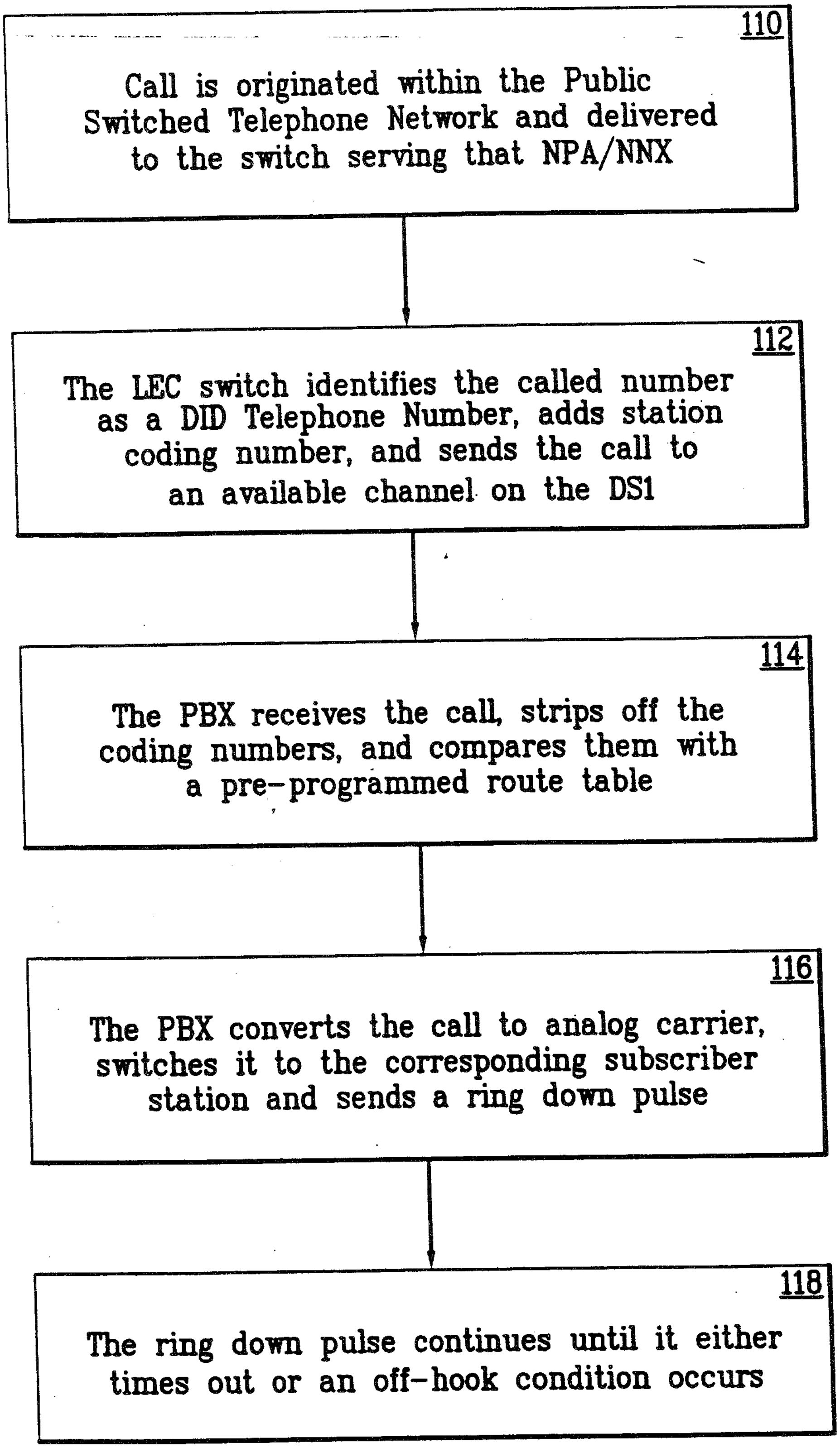


FIG. 2

Outbound Calling

FIG. 3

Incoming Calls



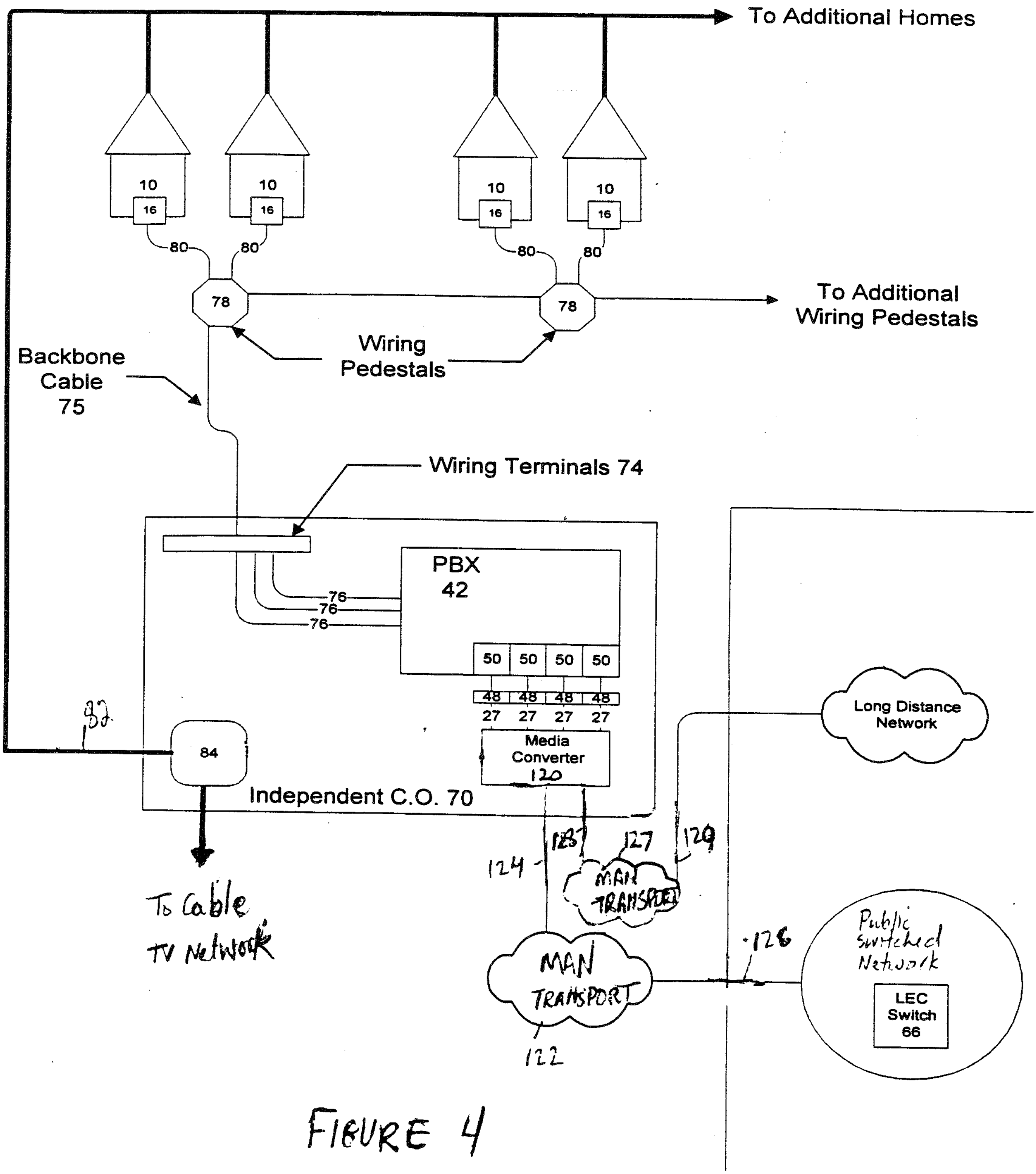
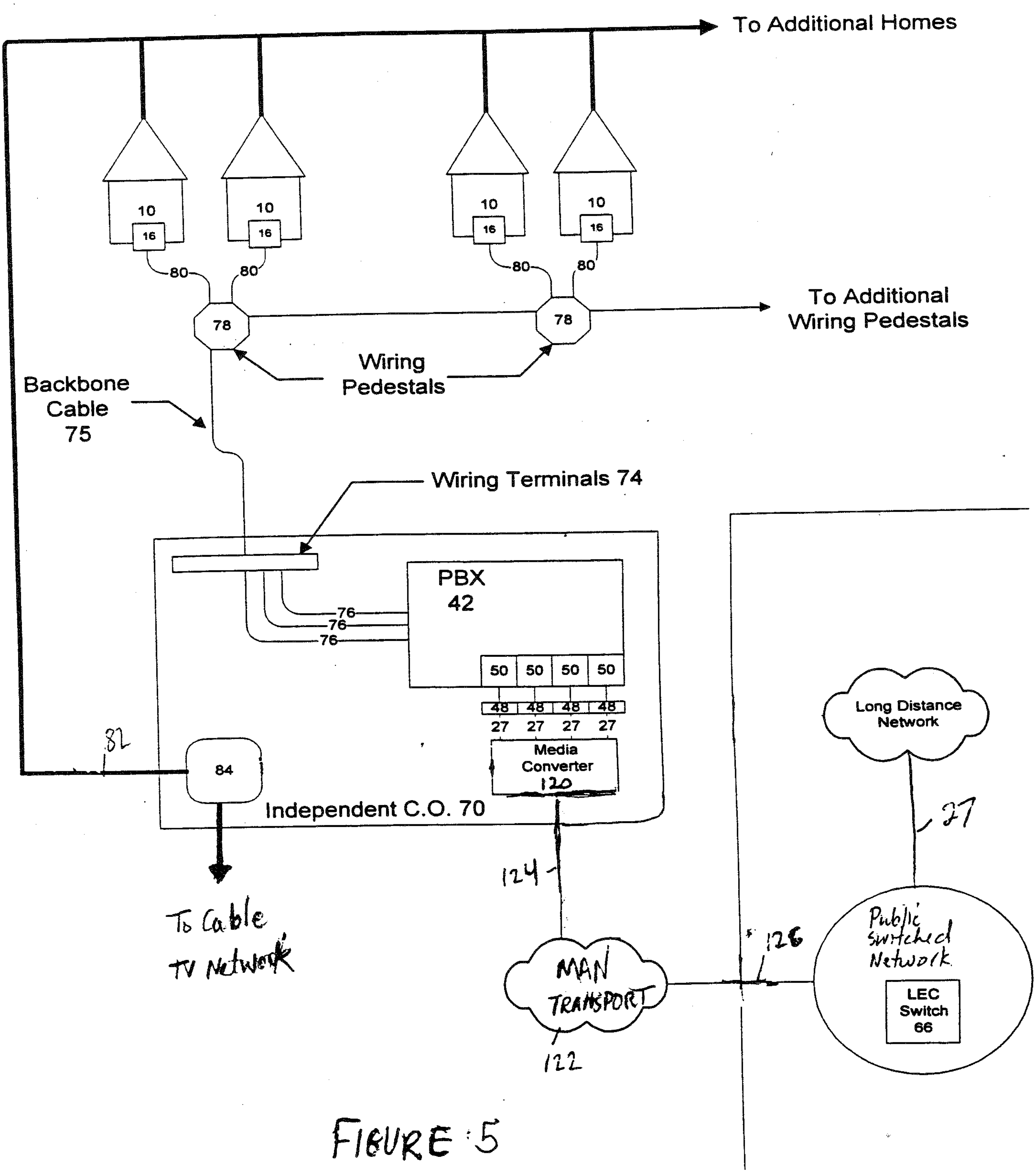

To Additional Homes
10
16
80
78
To Additional Wiring Pedestals
Wiring Pedestals
Backbone Cable 75
Wiring Terminals 74
PBX 42
76
50
48
27
Media Converter 120
84
82
Independent C.O. 70
To Cable TV Network
Long Distance Network
124
123
127
129
MAN TRANSPORT
128
Public Switched Network
LEC Switch 66
122

FIGURE 4



To Additional Homes
10
16
80
78
To Additional Wiring Pedestals
Wiring Pedestals
Backbone Cable 75
Wiring Terminals 74
PBX 42
76
50
48
27
Media Converter 120
82
84
Independent C.O. 70
To Cable TV Network
124
Long Distance Network
27
Public switched Network
LEC Switch 66
126
MAN TRANSPORT
122

FIGURE 5

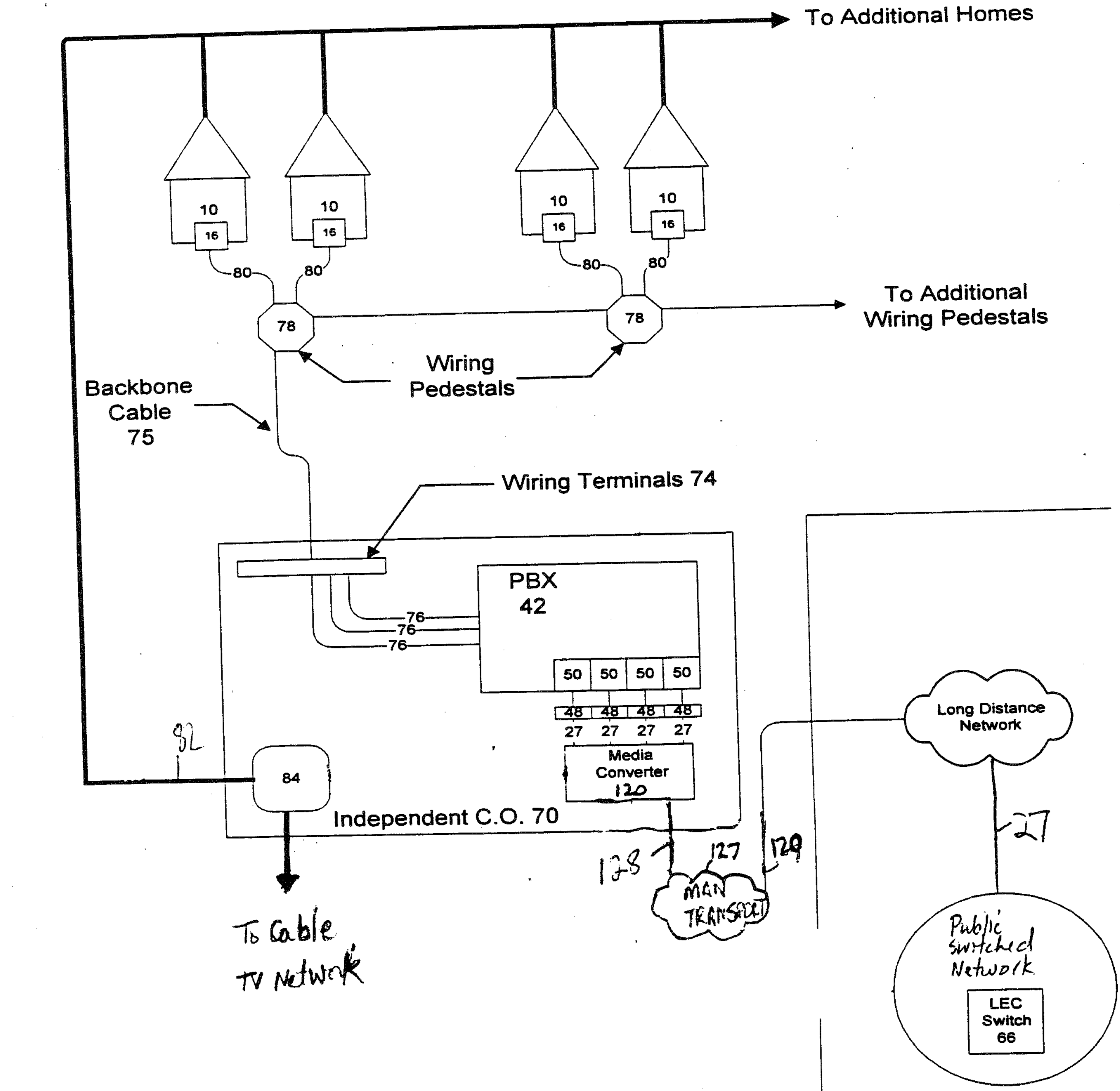

To Additional Homes
10
16
80
To Additional Wiring Pedestals
78
Wiring Pedestals
Backbone Cable 75
Wiring Terminals 74
PBX 42
76
50
48
27
Long Distance Network
82
84
Media Converter 120
Independent C.O. 70
128
127
129
MAN TRANSPORT
To Cable TV Network
Public Switched Network
LEC Switch 66

FIGURE 6

Local Exchange Carrier
Generic
MAN Transport

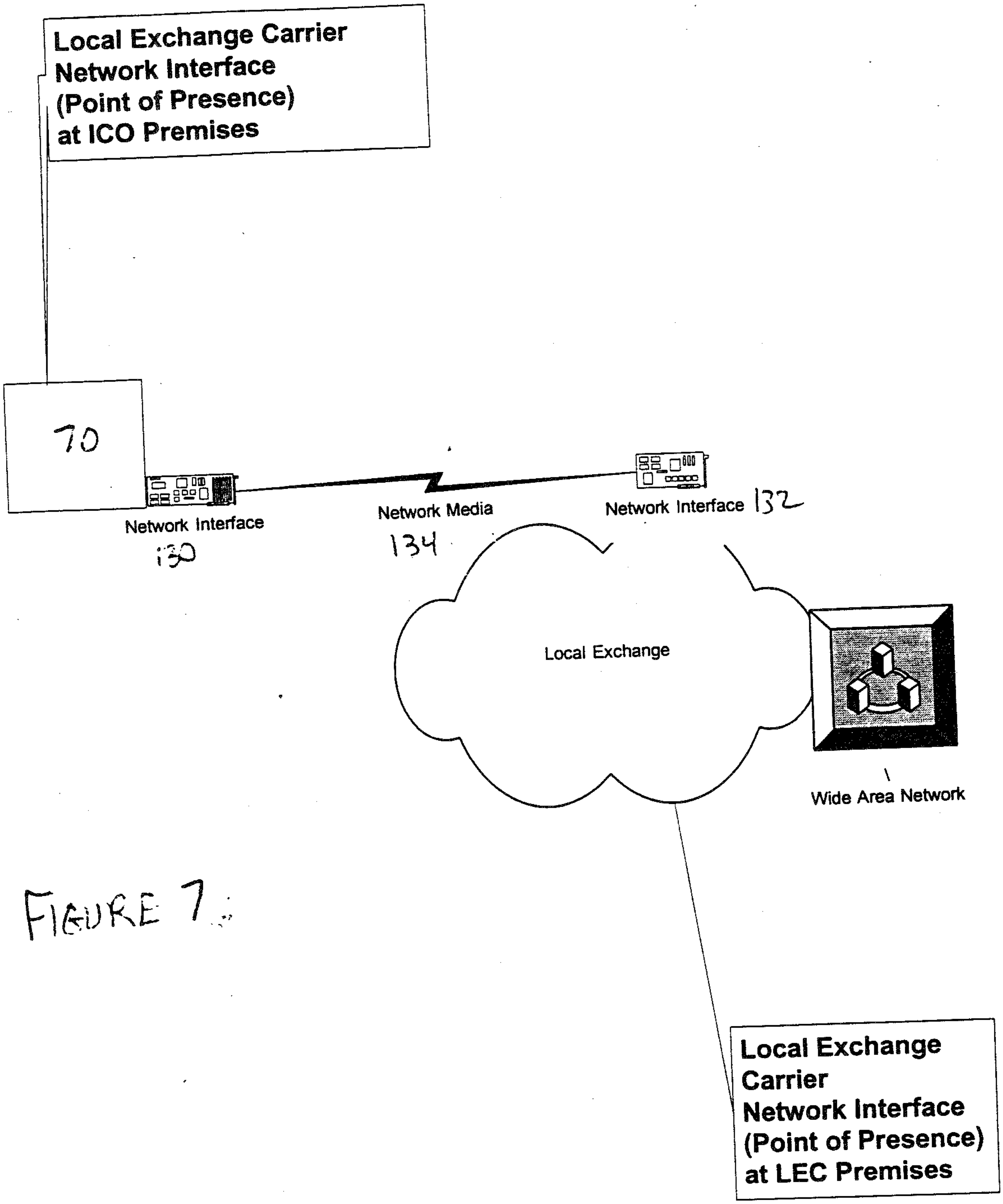


FIGURE 7

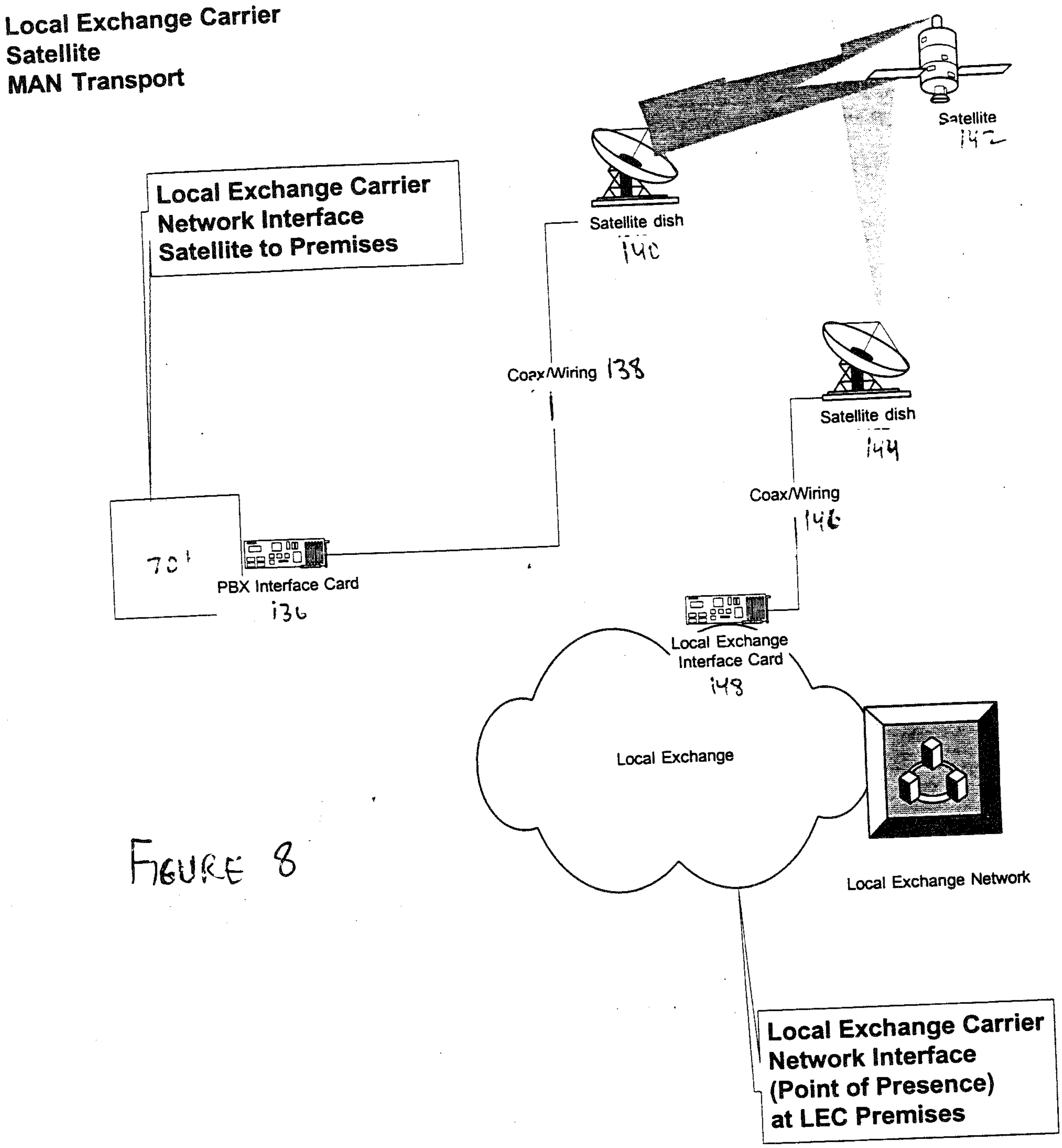

Local Exchange Carrier
Satellite
MAN Transport
Local Exchange Carrier
Network Interface
Satellite to Premises
Satellite
142
Satellite dish
140
Coax/Wiring 138
Satellite dish
144
Coax/Wiring
146
PBX Interface Card
136
Local Exchange
Interface Card
148
Local Exchange
Local Exchange Network
Local Exchange Carrier
Network Interface
(Point of Presence)
at LEC Premises

FIGURE 8

Local Exchange Carrier
Microwave
MAN Transport

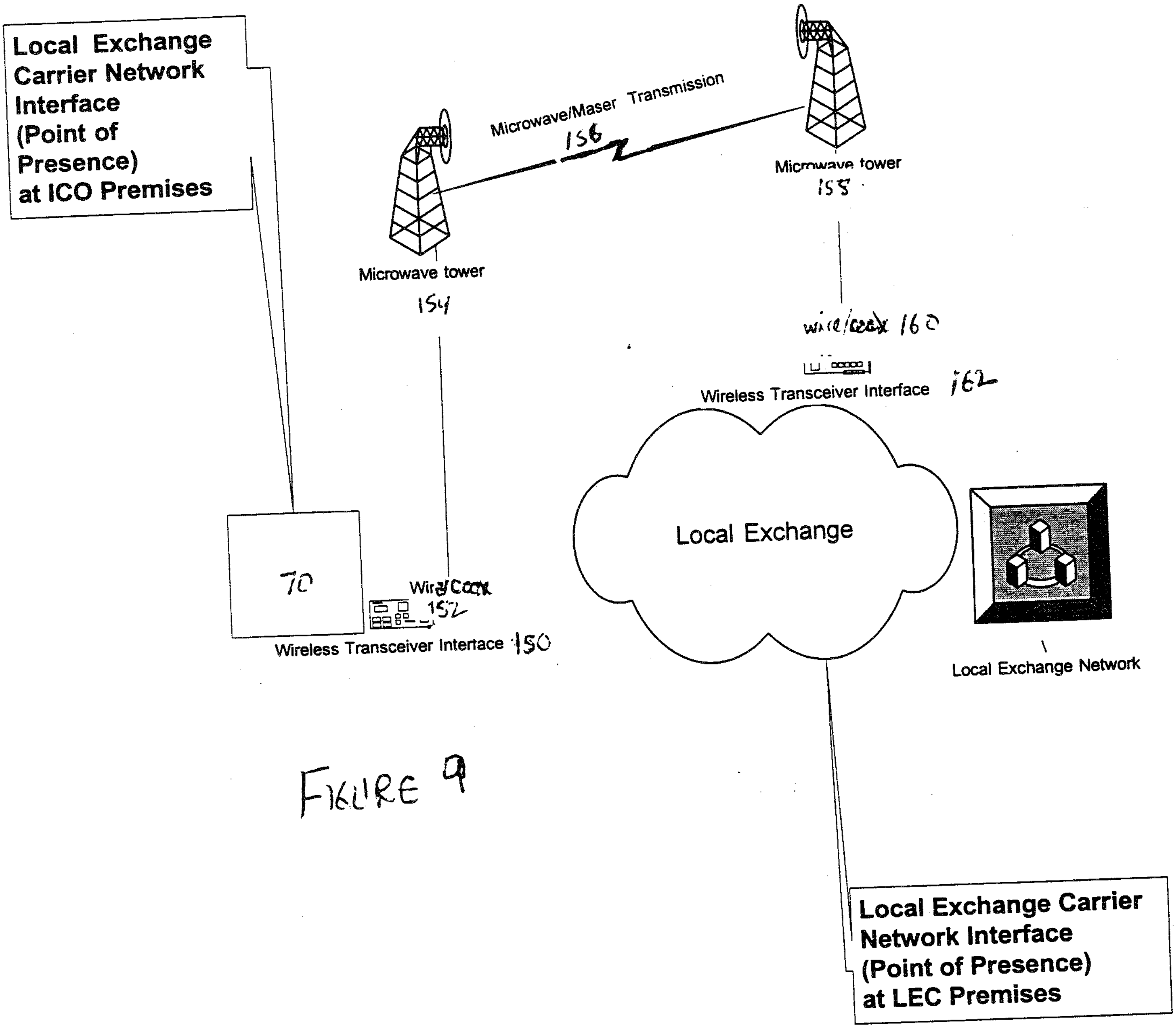


FIGURE 9

Local Exchange Carrier
Laser/Infrared
MAN Transport

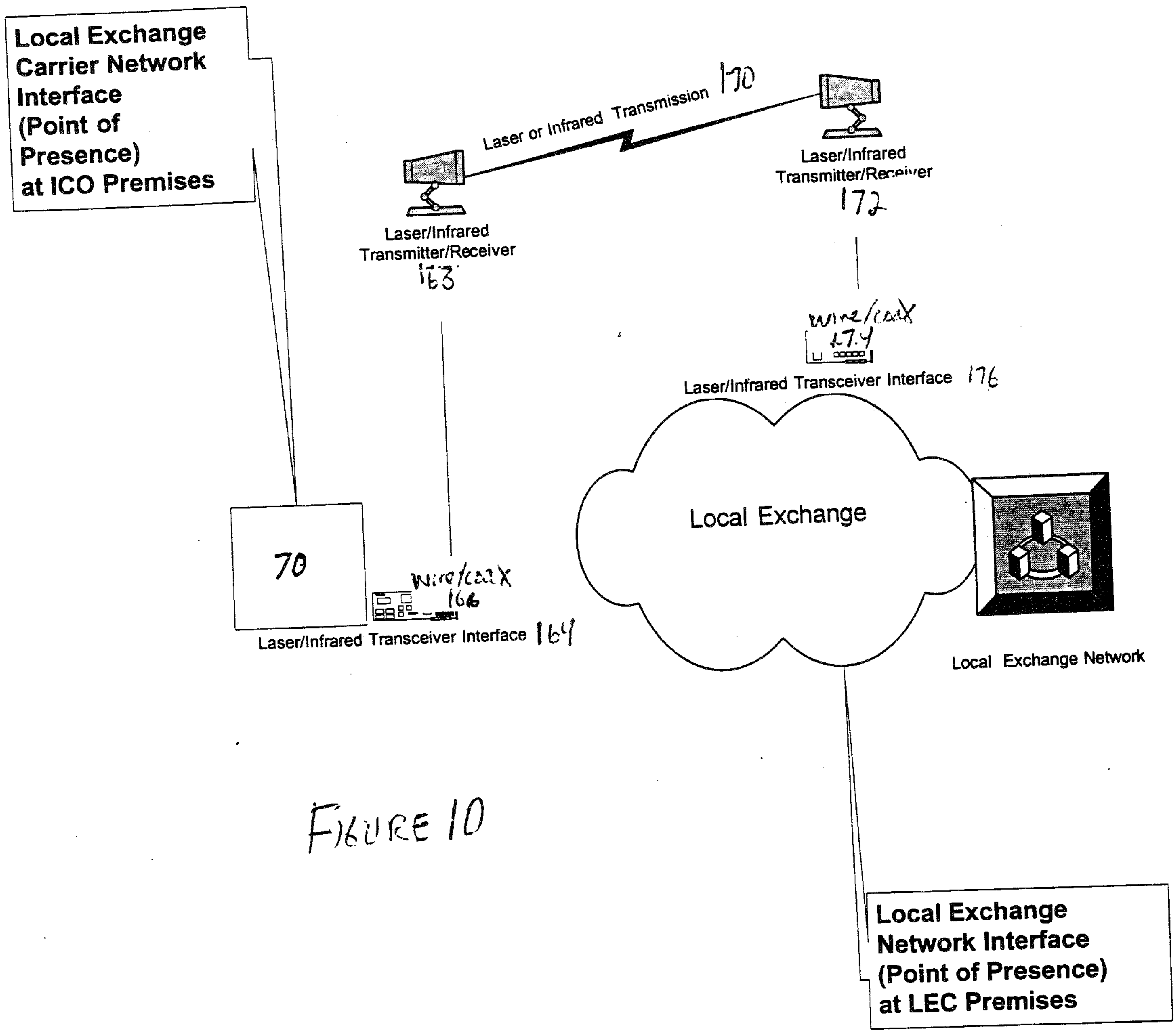


FIGURE 10

Local Exchange Carrier
Cellular/PCS Wireless
MAN Transport

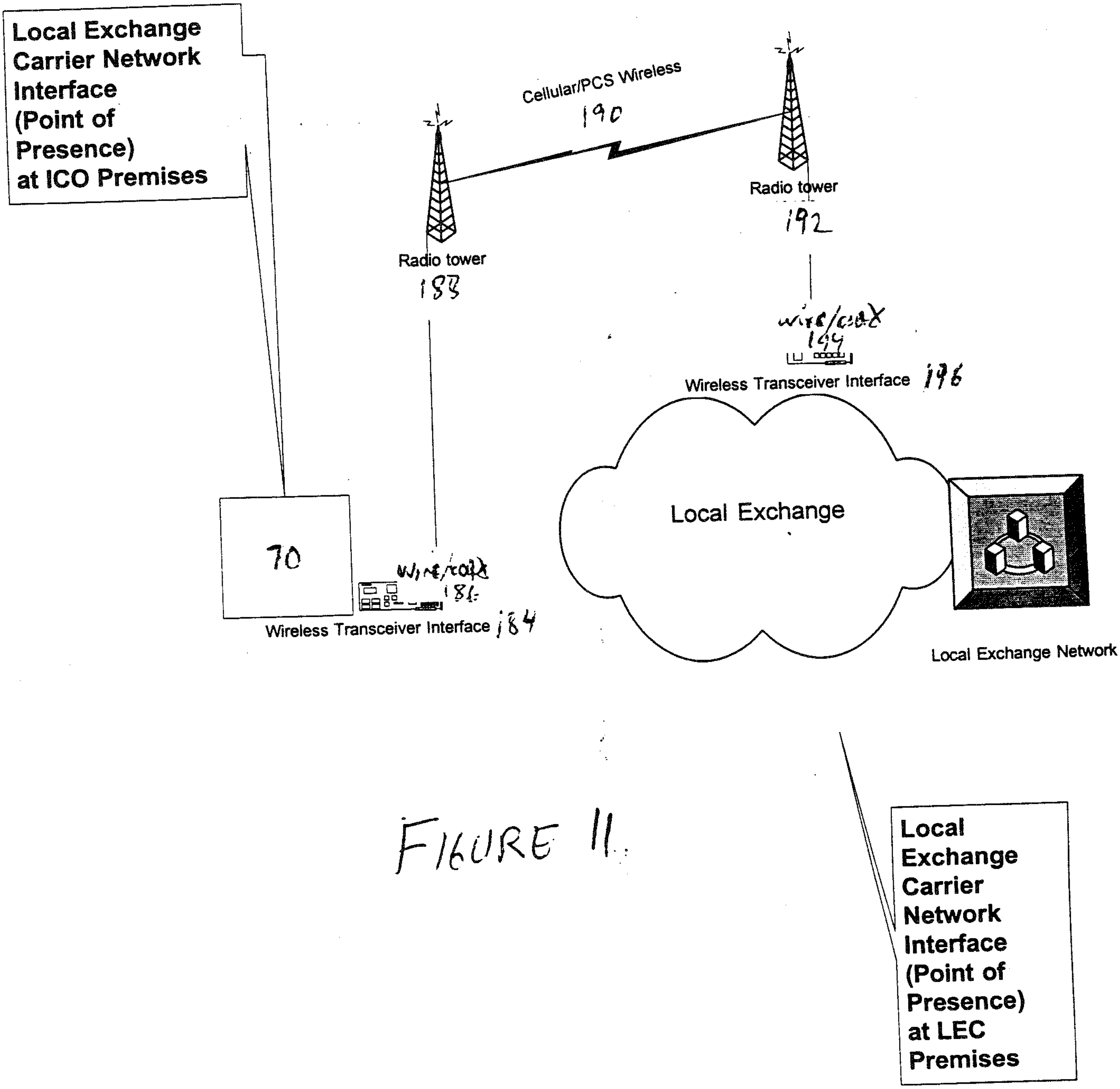


FIGURE 11.

Local Exchange Carrier
Carrier Point to Point (Fiber)
MAN Transport

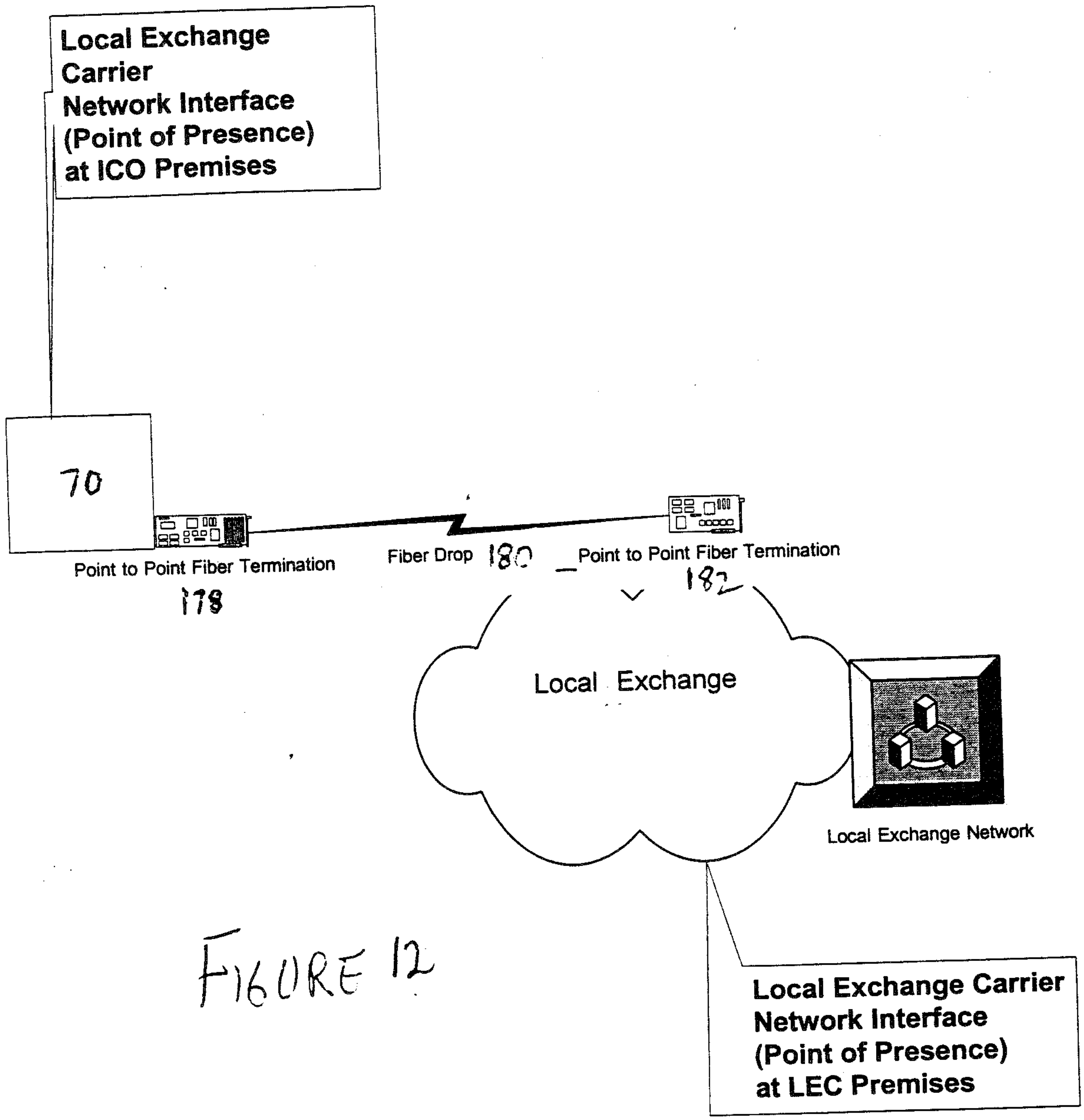


FIGURE 12

Local Exchange Carrier
IEEE 802.6 DQDB Dual Bus (Fiber)
MAN Transport

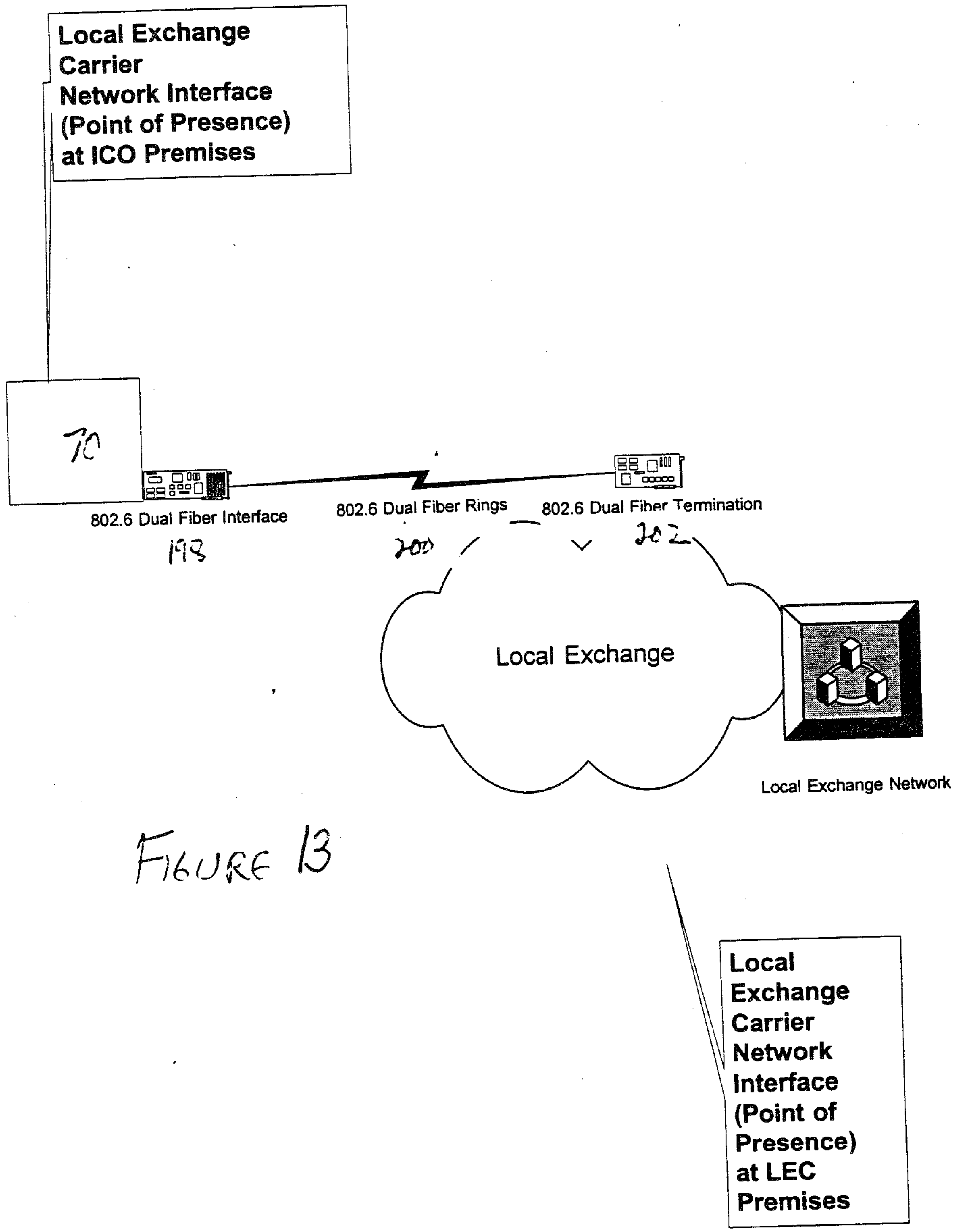


FIGURE 13

Local Exchange Carrier
T1/T3 Point to Point (Fiber)
MAN Transport

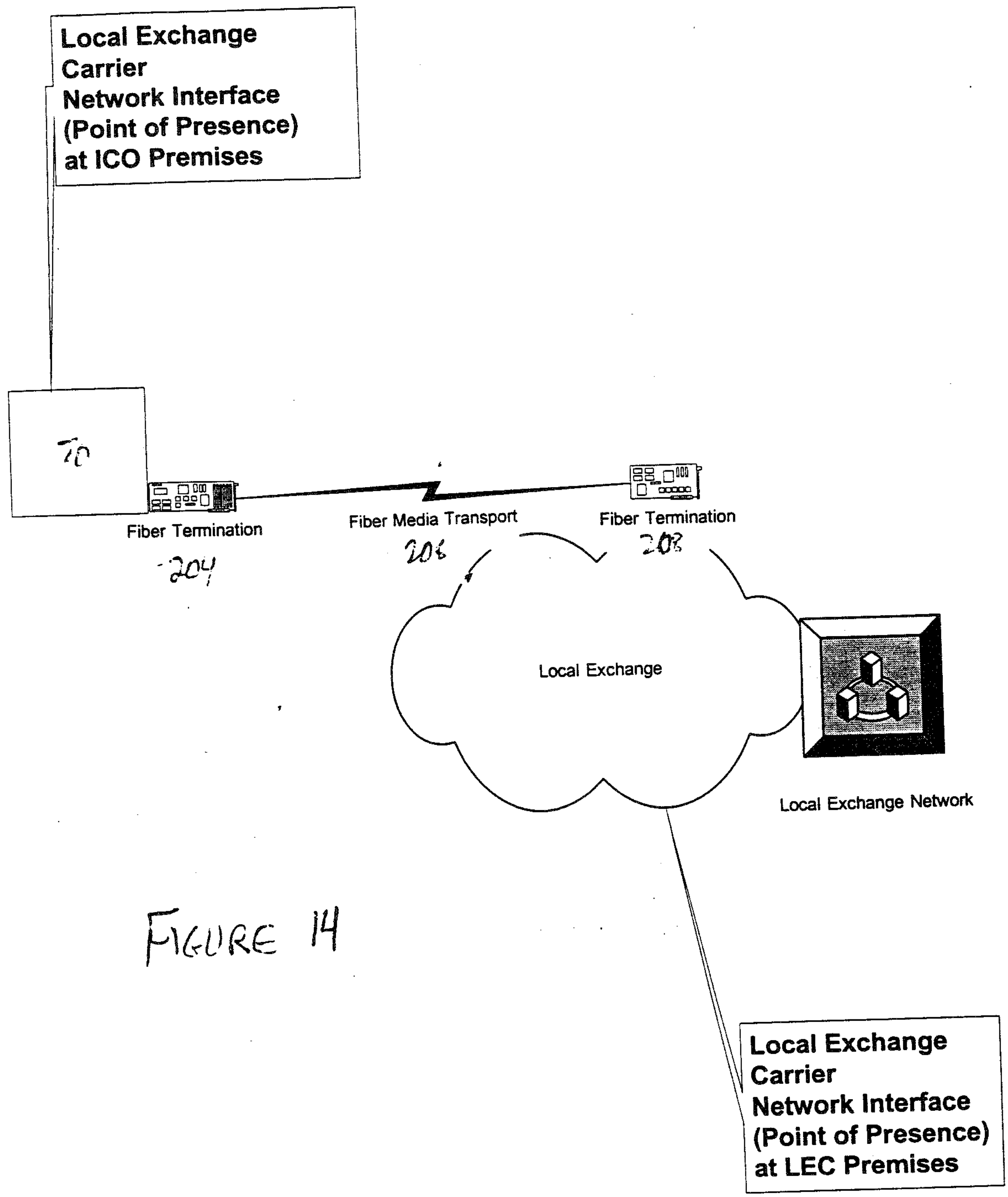
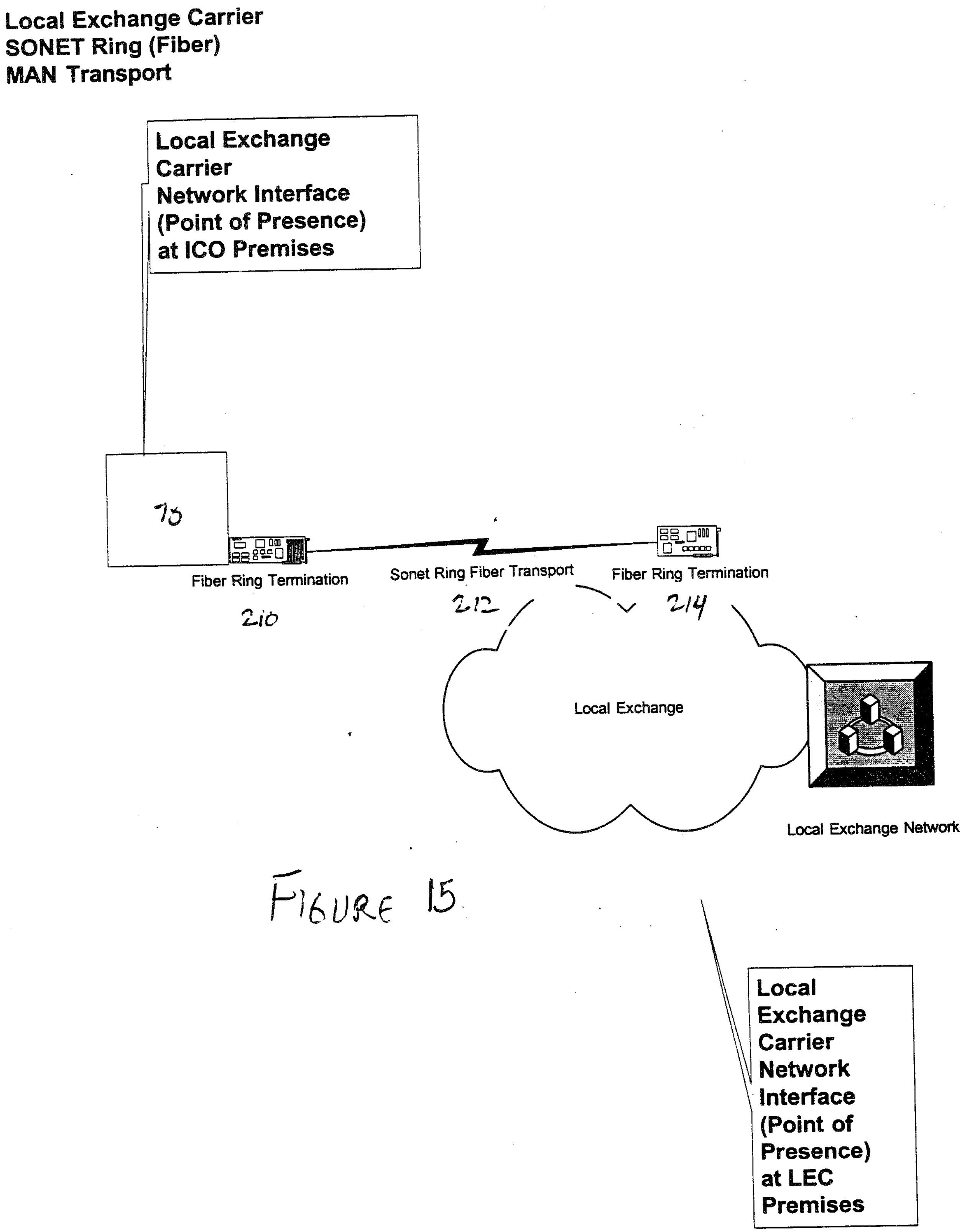


FIGURE 14



Local Exchange Carrier
SONET Ring (Fiber)
MAN Transport
Local Exchange Carrier Network Interface (Point of Presence) at ICO Premises
70
Fiber Ring Termination
210
Sonet Ring Fiber Transport
212
Fiber Ring Termination
214
Local Exchange
Local Exchange Network
Local Exchange Carrier Network Interface (Point of Presence) at LEC Premises

FIGURE 15

Local Exchange Carrier
ISDN
MAN Transport

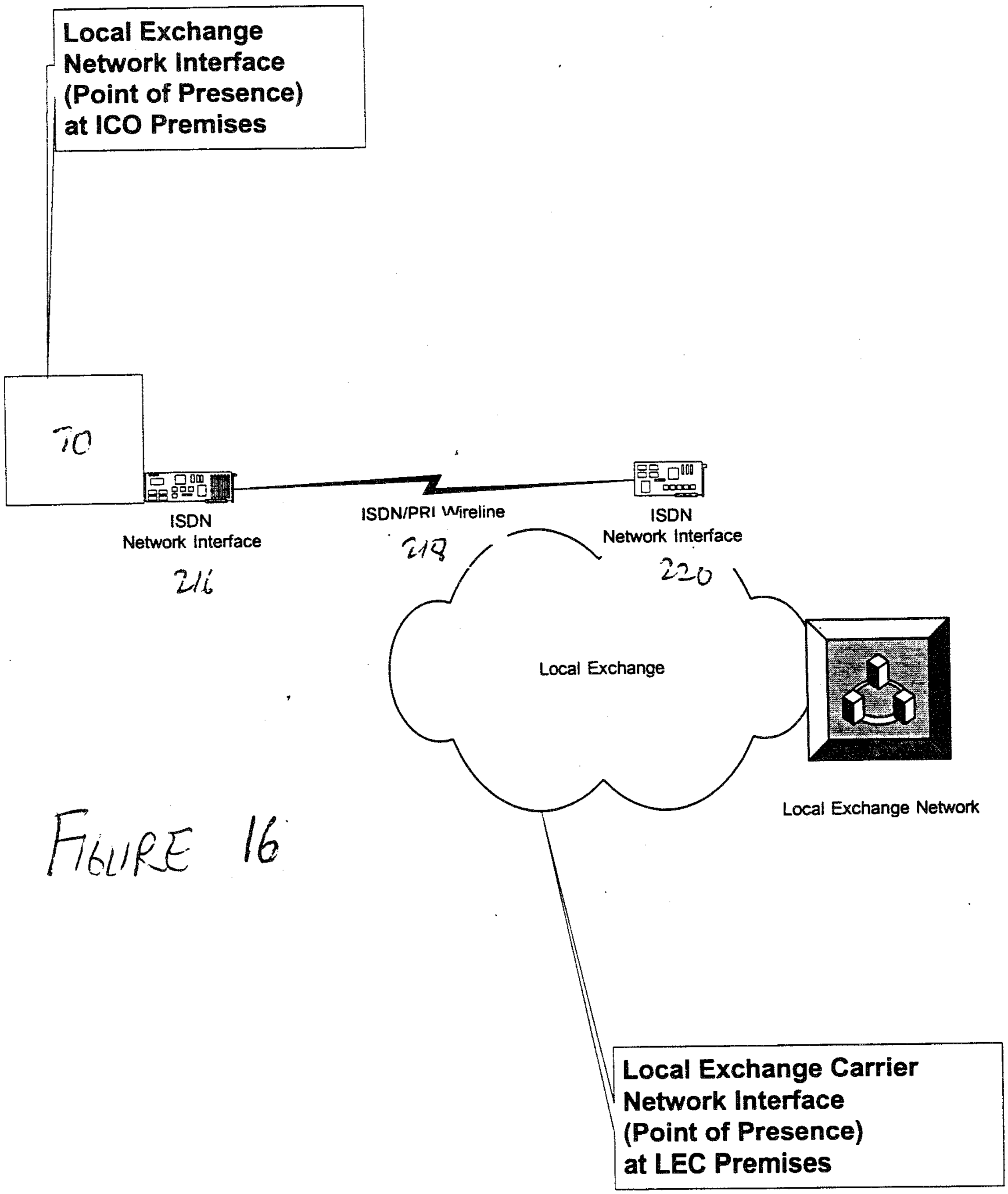


FIGURE 16

Local Exchange Carrier
T1/T3 Wireline
MAN Transport

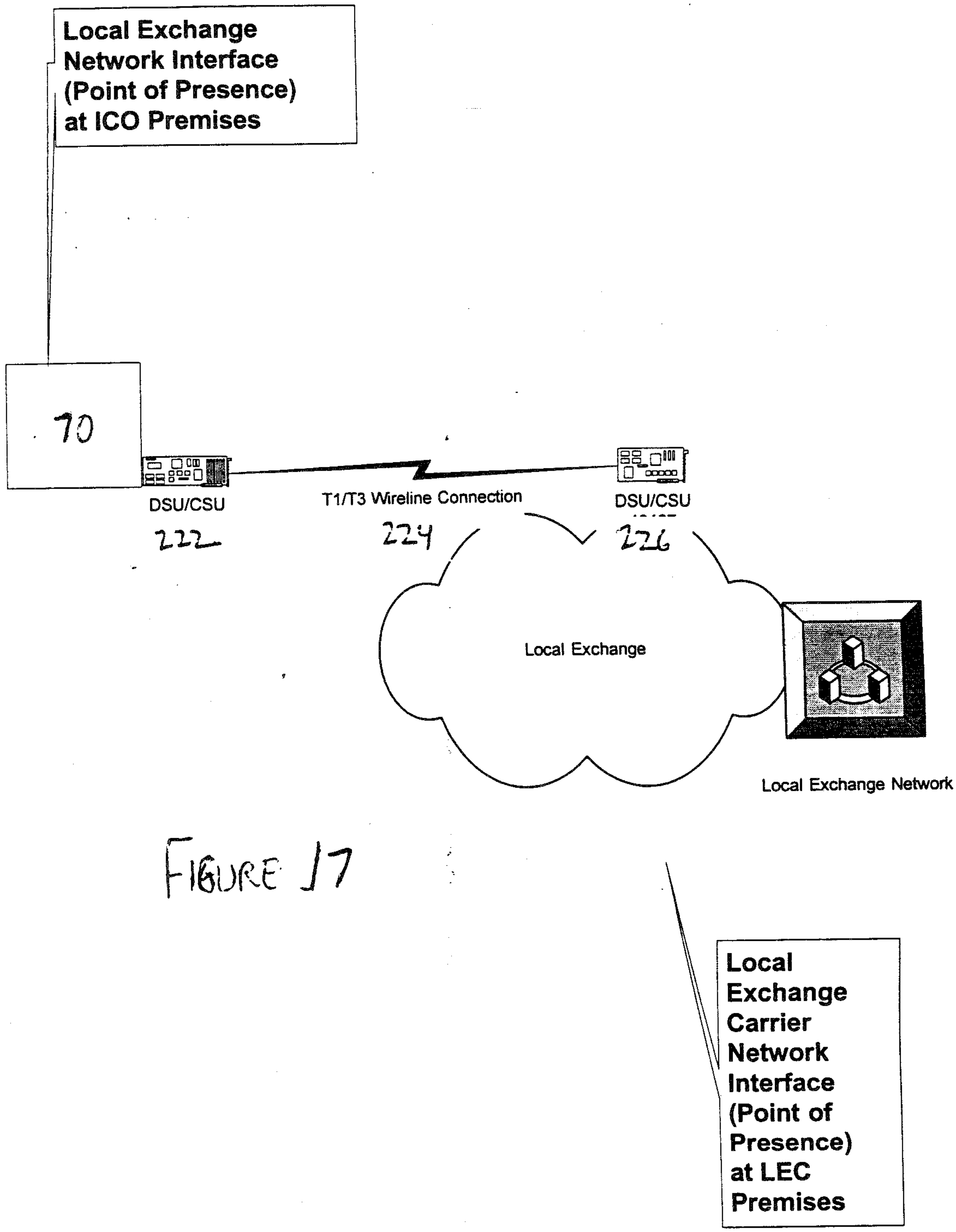


FIGURE 17

Local Exchange Carrier
Frame Relay Wireline
MAN Transport

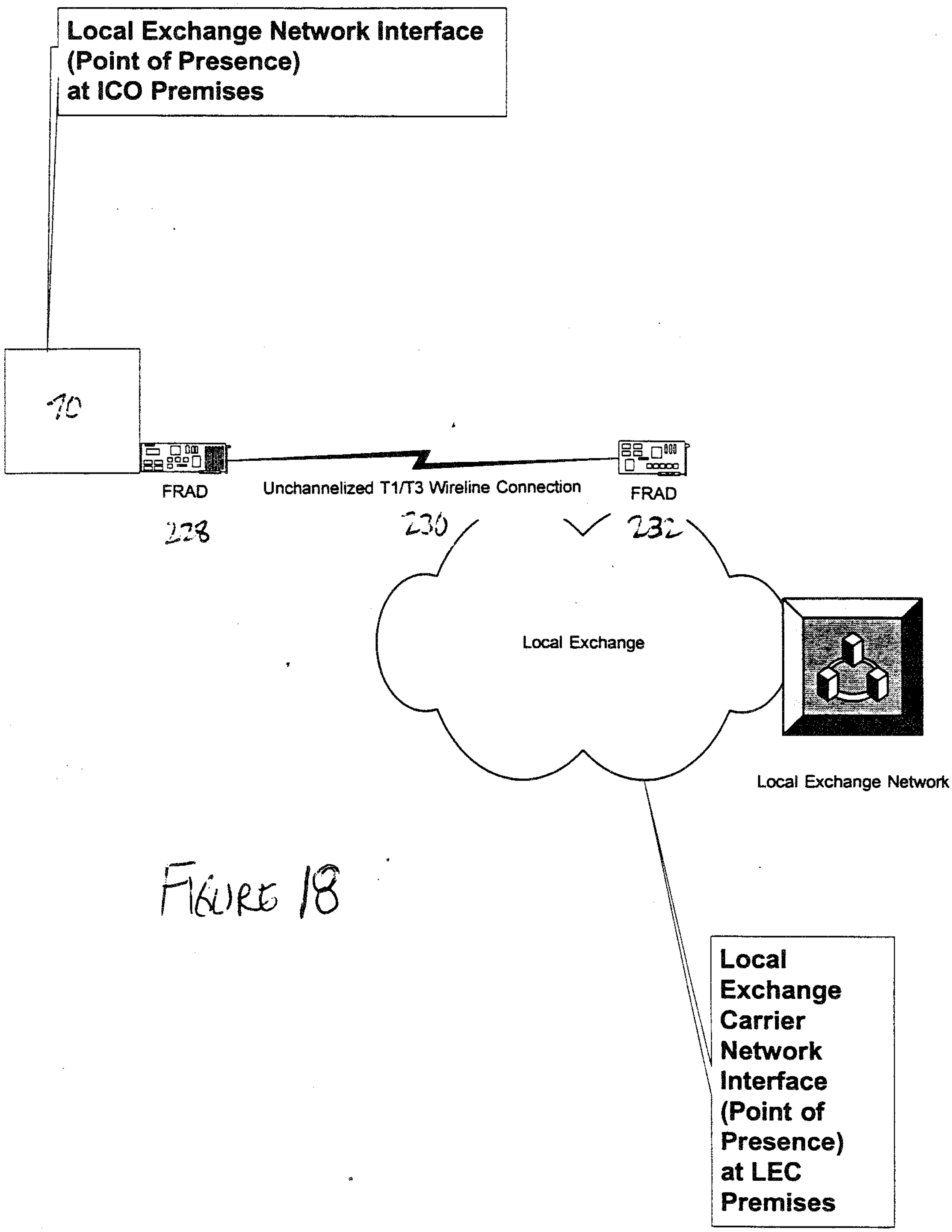


FIGURE 18

Local Exchange Carrier
Frame Relay Ring/Point to Point (Fiber)
MAN Transport

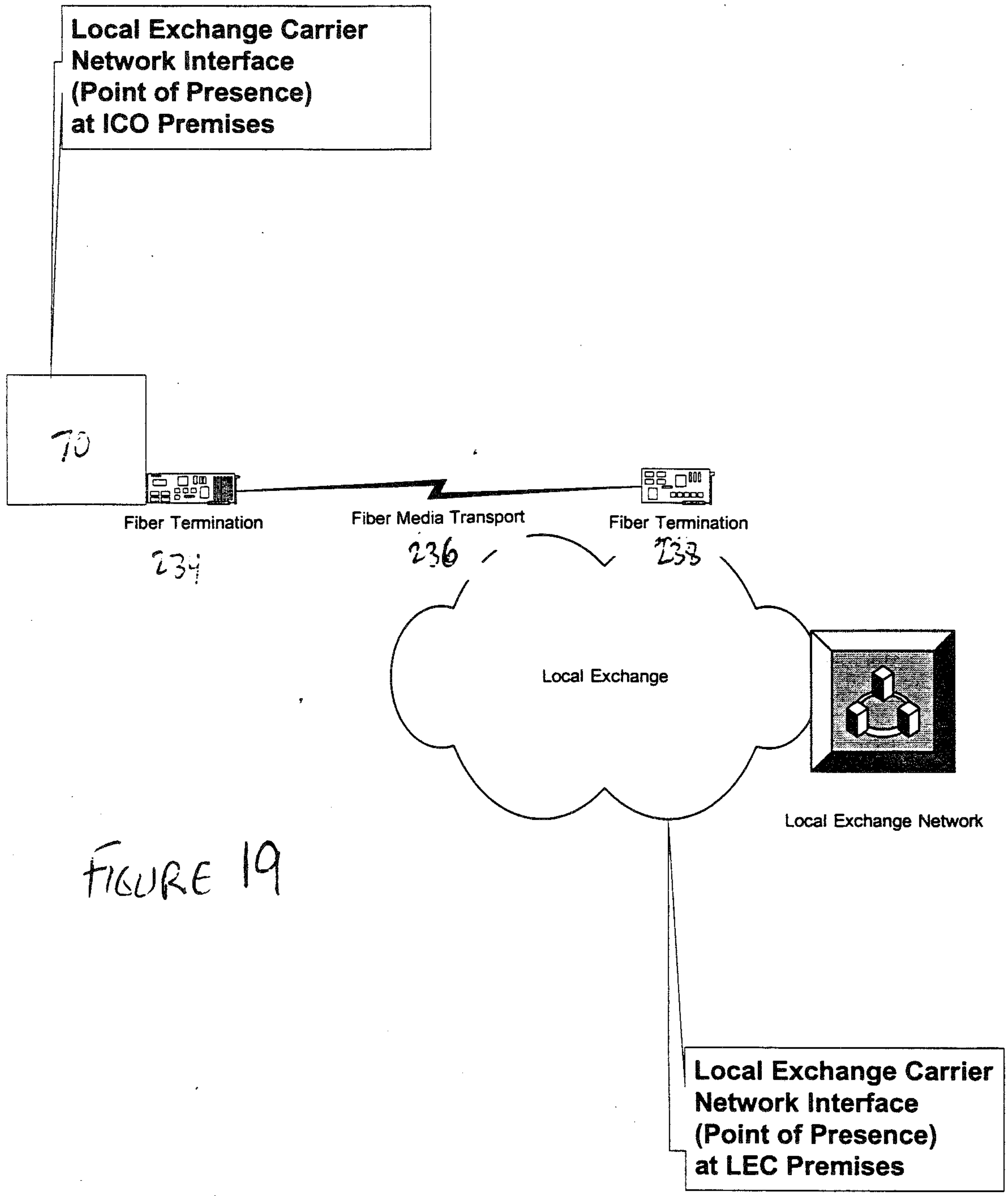


FIGURE 19

Local Exchange Carrier
Power/Utility Line MAN Transport
MAN Transport

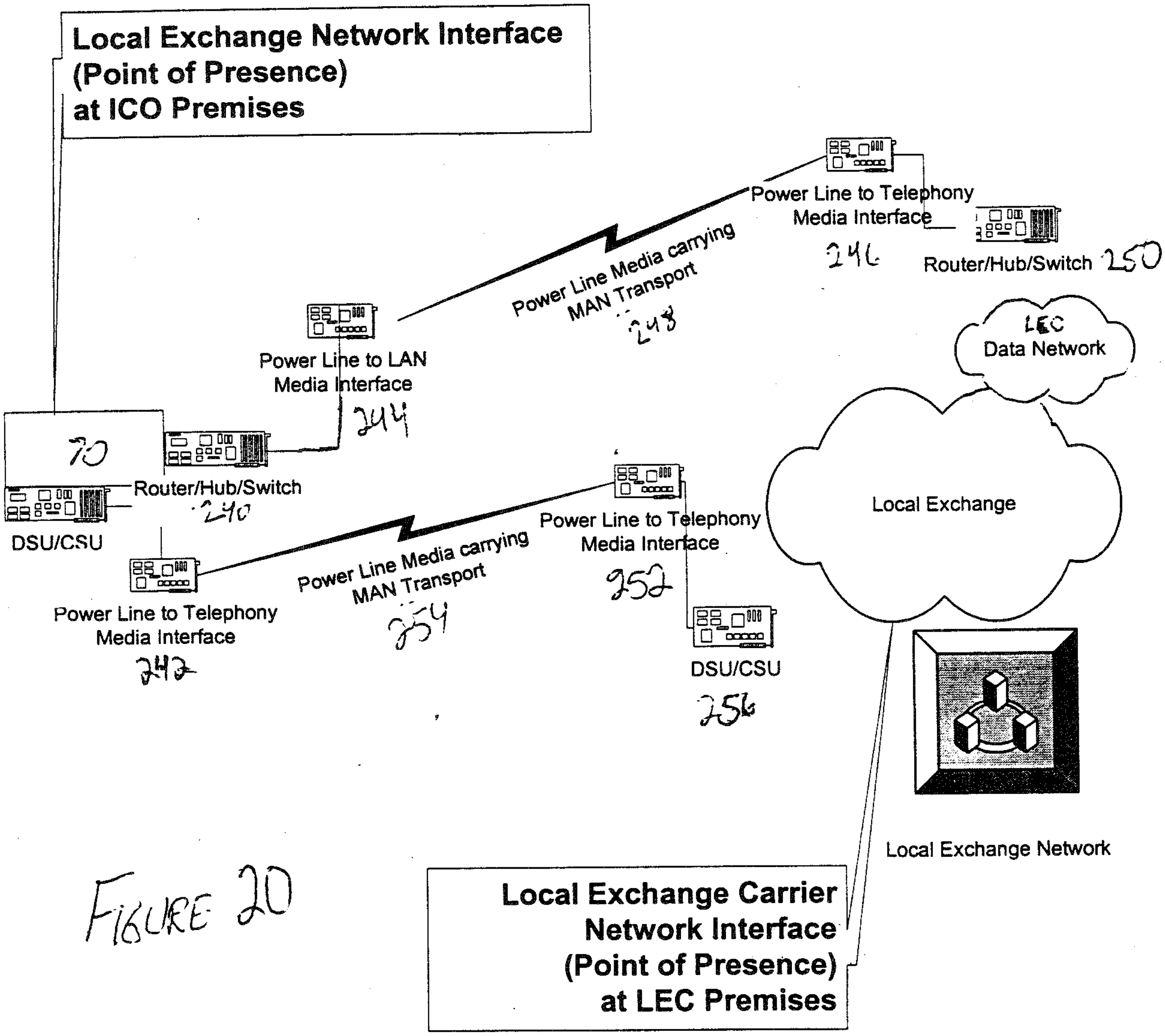


FIGURE 20

Local Exchange Carrier
Cable or Hybrid Fiber-Cable
MAN Transport

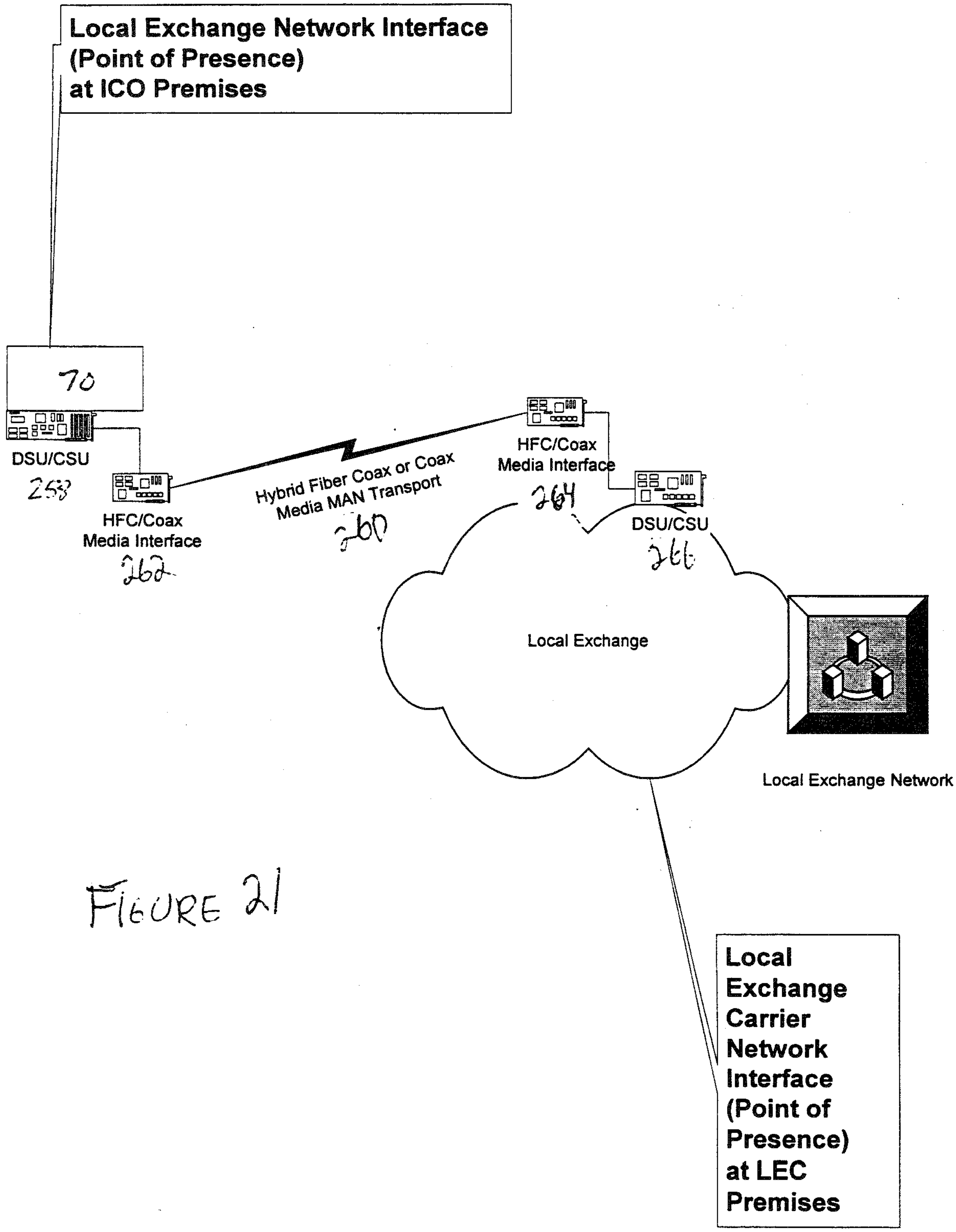


FIGURE 21

Local Exchange Carrier
Digital Subscriber Line
MAN Transport

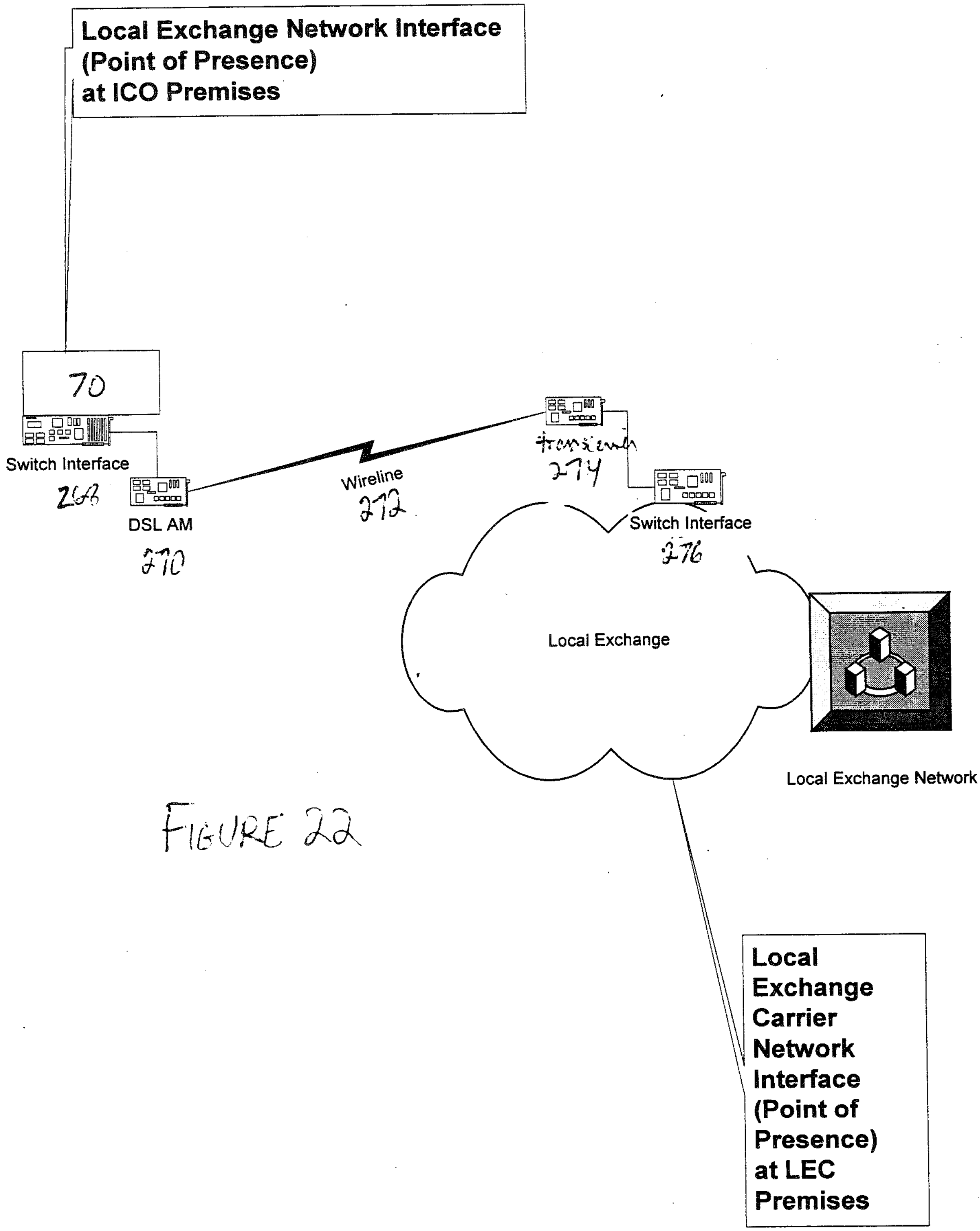


FIGURE 22

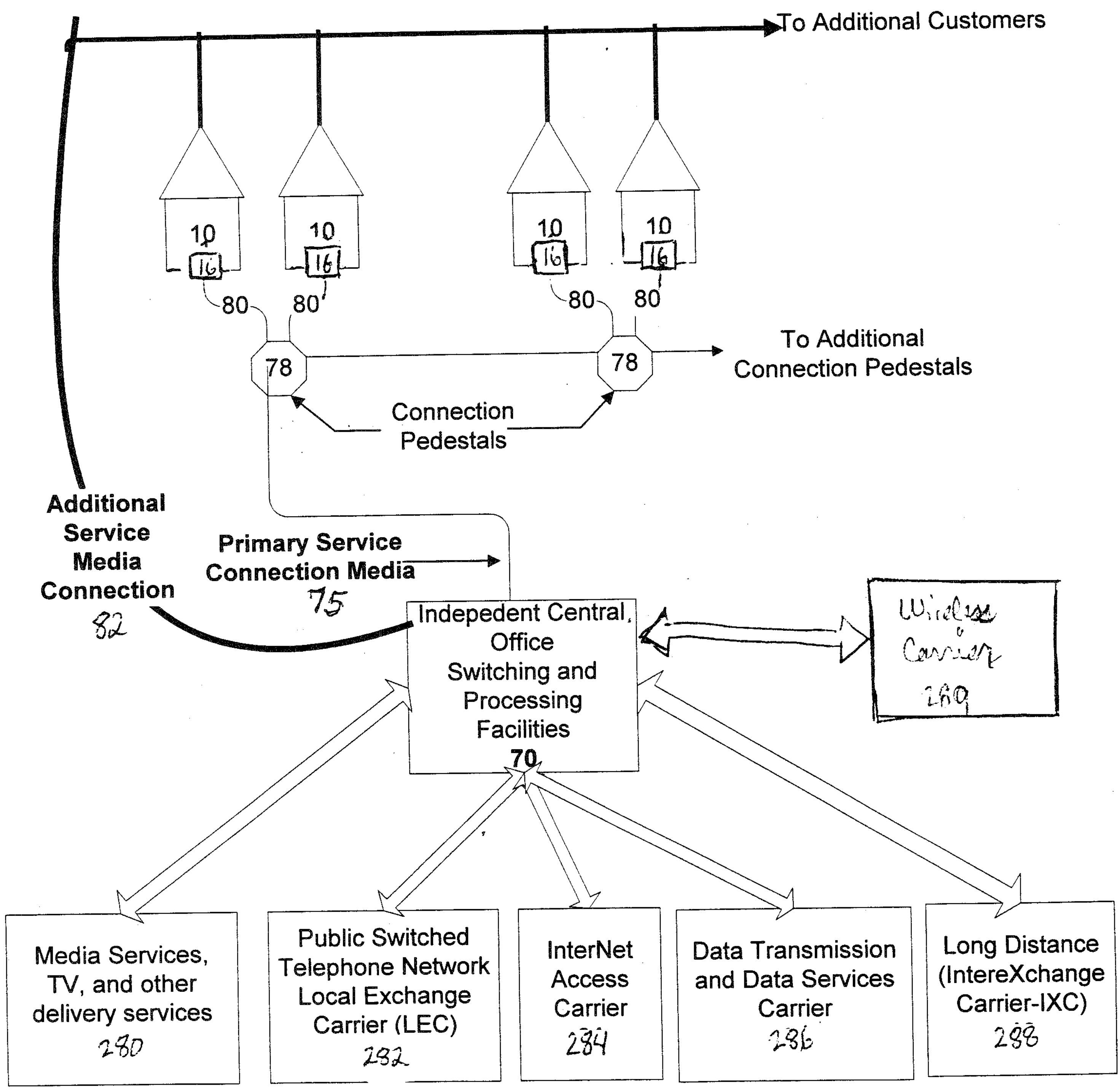
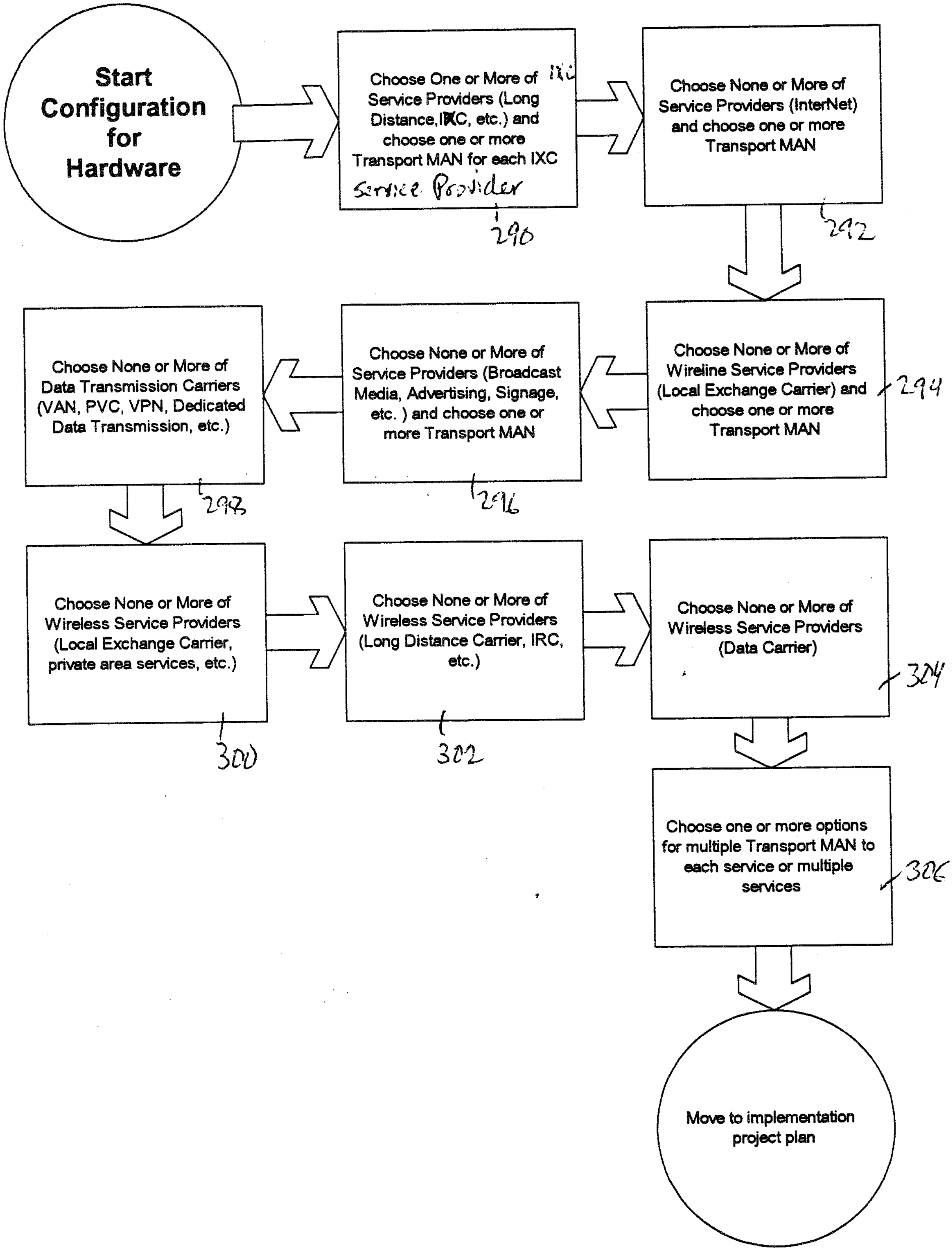

To Additional Customers
10
16
80
78
To Additional Connection Pedestals
Connection Pedestals
Additional Service Media Connection
82
Primary Service Connection Media
75
Indepedent Central Office Switching and Processing Facilities
70
Wireless Carrier
289
Media Services, TV, and other delivery services
280
Public Switched Telephone Network Local Exchange Carrier (LEC)
282
InterNet Access Carrier
284
Data Transmission and Data Services Carrier
286
Long Distance (IntereXchange Carrier-IXC)
288

FIGURE 23



MAN Transport Selection Process for ICO Installation Planning

FIGURE 24