Attachment B

ESTIMATING THE COST OF LOOP CONSTRUCTION

Introduction:

Loop facilities are one of the most basic components of a telecommunications network and are used in the provision of all services, whether switched or dedicated. These facilities provide the physical connection between the customer location and the network of the serving carrier. Because much of the investment is dedicated to one or a very small number of customers, and because the facilities have very high initial costs to deploy, only the very largest customer locations (in terms of service demand) can be economically reached through an over-build. The focus of this paper is upon such "large" customer locations. As shown below, a CLEC must have the potential to serve a large number of buildings (about 20) within a consolidated geographic area, with each building generating at least 3 DS3s of demand before a build is economic. Even then, serving the location will involve significant investment – approximately $6.7M for the building ring, plus approximately $3M for the premises and node equipment. And all of this analysis assumes that the CLEC considering the build can reach the buildings in the area with rights of way and building access comparable to the ILEC.

Before discussing the costs of building it is first important to share a common understanding of the general architecture of the outside plant employed by a CLEC. Figure 1 below provides a general representation of this plant:

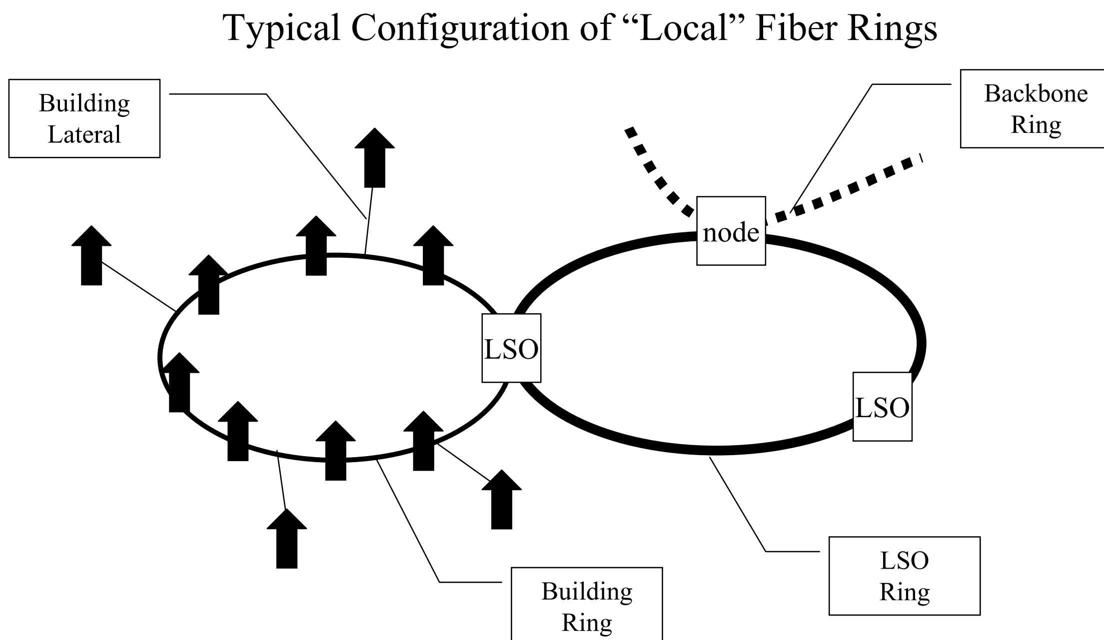

Figure 1.

A self-provided CLEC "loop" is actually composed of two to three interconnected facilities. The first is the LSO Ring. This ring connects the network locations (*e.g.*, facility/switch nodes and collocations) within a metropolitan area. The cost of connecting these locations is discussed in a related paper quantifying the costs of transport and will not be repeated here.[1] The LSO Ring interfaces with two other ring types: backbone rings and building rings. Because the loop is constructed to reach the service provider's network, which effectively starts and ends at the backbone ring (for dedicated services) or the switch connecting to the backbone ring (for switched services), the costs of the backbone ring are not relevant to the discussion of loop costs. On the other hand, the building rings are a significant consideration in quantifying loop costs. A Building Ring extends the CLEC network from a very aggregated demand point (*i.e.*, the facility-based collocation in an LSO) to (or near) customers' premises.

The final component of the loop infrastructure is the Customer Lateral. When a Building Ring is constructed, every effort is made to run the ring facility directly though critical buildings. In fact, Building Rings tend to be about 30 route miles long and tend to have 10 to 15 buildings on each.[2] Whether or not a building is placed on a ring is highly dependent upon factors such as the following: (1) whether the location was identified as a "high volume" location early enough in the planning to permit its inclusion, (2) whether access to the building could be secured from the landlord in a timeframe consistent with the overall project time line, and (3) whether building access costs were not judged prohibitive. If a building is not placed directly on the building ring as part of the initial build, it may still be possible to add a building at a later point. Such buildings are added by extending a short segment of fiber that is spliced to the ring and extends to the building. Because these segments are not shared with any other users other than the single building connected, and because the segment generally is not protected via diverse routing of redundant facilities, laterals tend to be very short.[3]

To recap: an LSO Ring is a highly aggregated facility that is shared among a wide variety of customer locations and services; a Building Ring is a facility whose use is shared among 10 to 15 buildings; a Customer Lateral is a facility useful only for the particular building connected.

In order to quantify the cost of these loops, a general understanding of the essential equipment components is important. The key components are shown in Figure 2:

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[1] See Attachment A to this Submission, referred to herein as the Transport *ex parte*.

[2] These characteristics tend to vary by specific metropolitan area. However, the AT&T Outside Plant Engineering organization believes these parameters reasonably reflect the conditions across its local markets. Other carriers may have different experiences due to different market strategies and less robust local fiber facility deployment.

[3] AT&T seeks to limit laterals to less than 500 feet in order to contain customer-dedicated investment and to reduce the risk of facility damage (*i.e.*, the longer the facility the greater the probability that some form of mechanical harm may be experienced).

Typical Configuration of An On-Net Building "Loop"

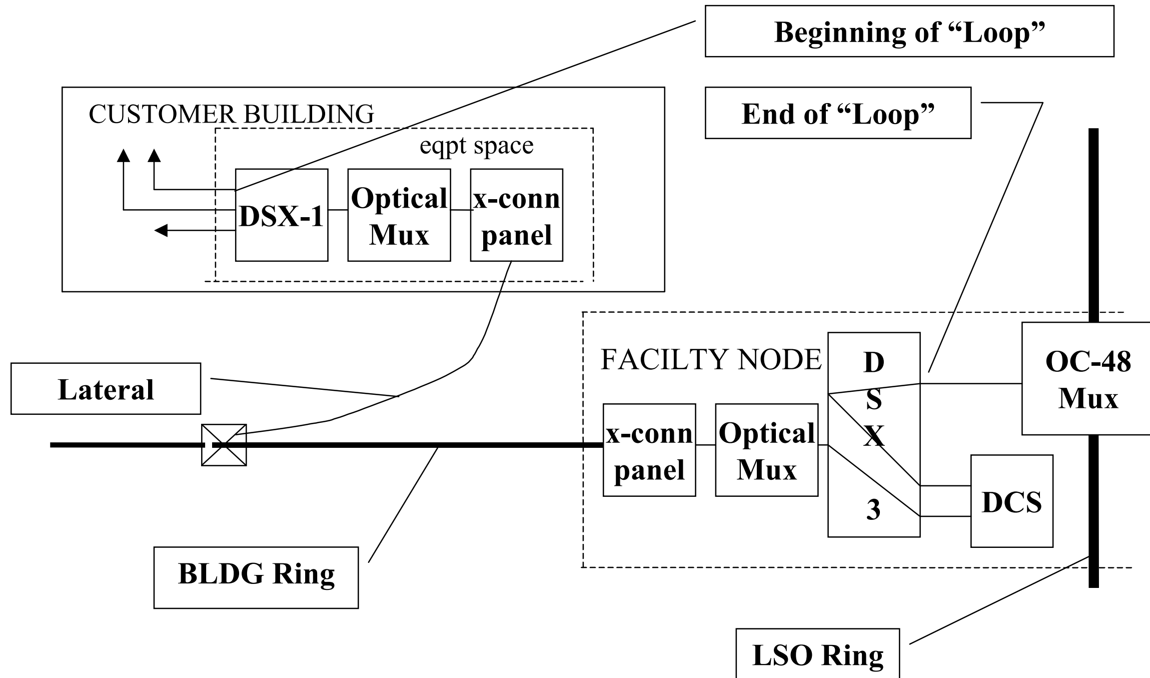

Figure 2

The functions of the individual components are relatively straightforward:

DSX-1 or DSX-3: Provides a cross-connection point between facilities operating at the DS1 level (DSX-1) or the DS3 level (DSX-3) without requiring that the facility be de-multiplexed to a lower bandwidth. The DSX frames allow relatively non-disruptive addition and removal of equipment, reasonable physical test access, and provide efficient means for cross-connecting circuits.

Optical Mux (and OC-48 Mux): Transmission equipment that aggregates (*i.e.*, multiplexes or "muxes") multiple lower bandwidth services onto a very high bandwidth facility. An Optical mux generally also supports signal conversions between optical and electrical based transmissions.

Digital Cross-Connection System (DCS): Provides for the grooming of facilities without the need to de-multiplex and re-multiplex the individual "channels" of the connecting facilities. For example, it permits the moving of DS1 #5 contained within DS3 #2 in facility segment A to DS1#17 within DS3 #3 on facility segment B. DCS allows improved utilization of very high capacity facilities.

X-conn Panel (or Fiber Distribution Panel): Provides a point of termination and cross-connection of a fiber facility to transmission equipment that manages the communications carrier within a fiber conductor.

Quantification of Cost of Self-provided Loops:

The cost of a self-provided loop can be conveniently analyzed based upon the following categories:

Lateral facility
Building Ring facility
LSO Ring transport
Building location costs
Node costs (interfacing between a Building Ring and an LSO Ring)

Each of these categories is reasonably subdivided into subcategories of investment costs, maintenance costs, and taxes.

Customer Lateral Facility:

As discussed above, the lateral facility is a short fiber that is dedicated to an individual building connected to a Building Ring. Because CLEC-provided loop facilities are typically placed in dense metropolitan areas, such facilities are virtually always placed in an underground structure. Consistent with the LSO Ring analysis, the building connected will be in one of the four most dense cells as defined in the HAI 5.2 model. Accordingly, the unit cost for the fiber lateral is the same as that underlying the analysis of the LSO Ring costs and is $40.99 per foot and $0.033 per strand foot. A twelve-strand fiber is assumed although this assumption does not materially impact the overall cost of the fiber lateral. Accordingly, the gross investment is $20,690[4] and converts to an investment cost of $342 per month.[5] As with the LSO transport model, a 0.61% per year per gross investment dollar maintenance assumption is applied, and 5% of investment and maintenance costs were added to cover non-income taxes. This results in a maintenance expense of about $11 and tax expense of $17 per month associated with the lateral. The total cost is $370 per month.[6]

[4] The actual calculation is as follows: 500 feet* ($40.99/foot+ 12 strands *($0.033/strand-foot)).

[5] The calculation is the same as employed in the LSO transport cost analysis in the Transport *ex parte* and employs the EXCEL PMT function. The actual calculation is PMT(cost of money, recovery period, gross investment*(1-salvage)). The cost of money employed in this analysis is based upon the pre-tax cost of money employed in the LSO transport cost analysis (*i.e.*, 14.24%) increased by 20% to account for the greater risk associated with the loop plant investment (*i.e.*, the actual cost of money employed is 17.09% per year). The recovery period for the building-dedicated investment is 6 years. Net salvage is the same as that used for fiber facilities and is identical to that underlying the LSO transport analysis for underground fiber (*i.e.*, -14.58%).

[6] If the lateral life is assumed to be the same as that of an underground fiber, the overall cost declines to $91 per month, distributed $76 for investment recovery, $11 for maintenance and $4 taxes. However, such a long life is unreasonably conservative given the volatile nature of demand from a single customer location (customer contracts typically run only 2 to 3 years). Accordingly, even the 6-year figure assumes at least one contract renewal, and the figure presented is this footnote is offered strictly for sensitivity analysis purposes.

Building Ring:

As stated above, Building Rings are typically about 30 miles in total length and connect 10 to 20 buildings to the LSO transport node. As with the Customer Lateral, the Building Ring is assumed to be an underground fiber placed within one of the four highest density zones of the HAI model. Accordingly, the same unit cost per foot and per strand is employed as was used for determining the investment cost of the lateral. The cost modeling assumes 2 strands per building. Accordingly, the gross investment in the Building Ring is about $6.7 million.[7] Because this facility is shared among 20 buildings, the assigned investment cost per building is $334,952 of gross investment. Note that the maximum number of buildings typically placed on a ring was employed. As a result, this generates the lowest likely gross investment attribution.

A consistent approach was used to develop the monthly cost for the Building Ring component as was employed for the Customer Lateral. The only exception is that the life for the Building Ring was assumed to be that of underground fiber, *i.e.*, about 26 years, rather than the 6-year life for the lateral. While the life of an individual lateral may be relatively short, the assumption here is that as individual buildings drop off the ring (due to lack of demand) others are added to replace them, resulting in a stable number of on-net buildings. The monthly investment recovery cost is $5,533 and the associated monthly maintenance and tax-related costs are $170 and $285, respectively. The total Building Ring assigned cost is, therefore, $5,988 per month per building.

LSO Ring Transport:

The last component of physical connectivity associated with the CLEC loop is the LSO Ring transport. This is the same connectivity that would be employed by any other service configuration or loop connecting to the CLEC network through the node. As such, the cost previously developed for the Transport *ex parte* is employed here. Because the costs are basically fixed at the node, the issue is simply one of determining the total DS3 volume presented to the node and then determining the number of DS3s that an individual building contributes. For the purposes of this analysis, the fixed costs of the node are assumed to be the same as that developed in the Transport *ex parte* or $32,557 per month. Furthermore, in order to present the most conservative evaluation of the cost of a CLEC loop, the analysis assumes that the facility is used to 90% of capacity, or $740 per DS3 per month.

Customer Location Costs:

The customer location costs are primarily equipment and space related. The equipment costs are related to those elements shown at the customer location in Figure 2: the DSX-1, the Optical Mux and the Fiber Distribution Panel (FDP). The FDP investment is the

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[7] The calculation is as follows: 30 miles * 5280 ft/mi*($40..99/ft + 20 buildings*(2 strands/building)*($0.033/strand-foot).

same as that used in the Transport *ex parte*, *i.e.*, $1000 per panel and 2 connections per multiplexer at $60 per connection ($1120 per connected panel). The Optical Mux cost is that for an OC-3 and is found in the HAI inputs (p. 96). The common cost is $20,000 plus $500 per 7 DS1s, up to a maximum of 84 DS1s. No cost was available in HAI for the DSX-1; however, costs were available on the ADC website for such equipment (www.adc.com). Specifically, a DSX-1 shelf with a capacity of 84 DS1s is priced at $2,085 (see item: Di M2GU1). Most customer building connections are at the OC-3 level. Accordingly, the investment at a customer premise is $23,205 plus $500/7 DS1s. This converts to a monthly cost of $407 plus $9 for every 7 DS1s active.[8] Thus, the total monthly investment cost for equipment at a customer location is in the range of $416 to $513 if from 1 to 84 DS1 (84 DS1s equal 3 fully utilized DS3s) are active. This investment cost results in a maintenance cost of $40 to $49 and taxes of $23 to $28 per month.

The final cost that must be considered is that for space rental. For the purposes of this analysis, space rental at each building adds about $678 per month.[9] Because no site preparation costs are explicitly included, there is no associated gross investment and, accordingly, no maintenance assumed. Taxes, however, account for $34/month.

The customer location costs are summarized below:

Item	Investment Cost	Maintenance	Other	Taxes	Total
Equipment	$416 to $513	$40 to $49	$0	$23 to $28	$479 to $590
Space	$0	$0	$678	$34	$712
Total at Premise	$416 to $513	$40 to $49	$678	$57 to $62	$1,191 to $1,302

Node Costs:

As shown in Figure 2, the equipment at the node necessary to interface with the LSO Ring transport included a FDP, an OC-3 multiplexer, a DSX-3 cross-connection device and a DCS. The FDP and OC-3 have the same cost, maintenance and tax implications as for the customer premises. The cost of the DCS is found in HAI 5.2 inputs (p. 99) and reflects a gross investment of $30,000 per DS3. HAI inputs do not explicitly list a DSX-3 cost. The same ADC website referenced for the DSX-1 also contains a cost for a DSX-3 (see DSX-4B-24-7A), which is $8,463 and can accommodate 24 DS3s. Because this function is shared at the node, rather than incurring the full cost of a shelf, the study

[8] The equipment lives, gross salvage and maintenance factors are those used for circuit equipment as described in the Transport *ex parte*, *i.e.*, 10.24 years, -1.69% and 2%, respectively.

[9] AT&T's internal records relating to common space rentals indicate a national average monthly cost of $678.30.

assumes that sharing occurs and that the cost will be incurred on a DS3 basis (or $353 per DS3 port). Based on Figure 2, 5 ports are required per DS3 at the node. Accordingly, the gross investment formula for the node is $21,120+$500 per 7 DS1s+ $30,863 per 84 DS3s.[10] Thus, the node costs are largely a function of the number of DS3s delivered from the building. The table below summarizes the node related costs for various demand levels at the building:

Building Volume (DS1s)	investment cost	maintenance	taxes	total
0-7	$922	$87	$50	$1059
8-14	$931	$88	$51	$1070
15-21	$940	$89	$51	$1080
22-28	$949	$90	$52	$1091
29-35	$1516	$144	$83	$1743
36-42	$1525	$145	$83	$1753
43-49	$1534	$145	$84	$1763
50-56	$1543	$146	$84	$1773
57-63	$2110	$200	$115	$2425
64-70	$2119	$201	$116	$2436
71-77	$2128	$202	$116	$2446
78-84	$2137	$203	$117	$2457

[10] The investment cost equation, based on the same life and salvage assumptions applied to the customer node equipment is $355+$558/DS3+$9/7 active DS1. The fixed cost is slightly different compared to the customer premises, because rather than one FDP there are two and the cost of those two are shared among 20 buildings.

With all the components of the cost now established, it is possible to develop the total cost of connecting a building that provides varying levels of demand:

	Monthly Costs By Source						
DS1s active	cust location eqpt	lateral	bldg ring	node eqpt	LSO Backhaul	total	avg cost/DS1
1	$ 1,191	$ 370	$ 5,988	$ 1,059	$ 740	$ 9,348	$ 9,348
7	$ 1,191	$ 370	$ 5,988	$ 1,059	$ 740	$ 9,348	$ 1,335
14	$ 1,201	$ 370	$ 5,988	$ 1,070	$ 740	$ 9,369	$ 669
21	$ 1,211	$ 370	$ 5,988	$ 1,080	$ 740	$ 9,389	$ 447
28	$ 1,221	$ 370	$ 5,988	$ 1,091	$ 740	$ 9,410	$ 336
35	$ 1,231	$ 370	$ 5,988	$ 1,743	$ 1,480	$ 10,812	$ 309
42	$ 1,241	$ 370	$ 5,988	$ 1,753	$ 1,480	$ 10,832	$ 258
49	$ 1,251	$ 370	$ 5,988	$ 1,763	$ 1,480	$ 10,852	$ 221
56	$ 1,261	$ 370	$ 5,988	$ 1,773	$ 1,480	$ 10,872	$ 194
63	$ 1,271	$ 370	$ 5,988	$ 2,425	$ 2,220	$ 12,274	$ 195
70	$ 1,281	$ 370	$ 5,988	$ 2,436	$ 2,220	$ 12,295	$ 176
77	$ 1,291	$ 370	$ 5,988	$ 2,446	$ 2,220	$ 12,315	$ 160
84	$ 1,301	$ 370	$ 5,988	$ 2,457	$ 2,220	$ 12,336	$ 147

Having the total cost and unit cost for a constructed loop now permits an evaluation of when it is reasonable to substitute a build for an alternative facility. Because AT&T has generally been unable to obtain high capacity UNEs, particularly UNE DS1 loops multiplexed onto UNE DS3 facilities, the only possible comparison is to ILEC special access.

Special Access Alternative:

Other than access to a UNE loop, the alternative to constructing loops is a special access configuration from the customer premises to the CLEC network. Given the volumes, the configuration would most likely be a combination of DS1 channel terminations, DS3:1 multiplexing and DS3 interoffice transport. The approximate cost of such a configuration, under a long term pricing arrangement, is approximately the following:

DS1 Channel Term (with NRC amortized): $113 to $127 per DS1/month
DS3 fixed with mux (NRC amortized): $850 to $1,018 per DS3/month
DS3 interoffice mileage: $53 to $73 per mile per DS3/month

The figure represents the approximate rate, averaged across RBOC territories, for a three-year term agreement, and the lower figure represents the average rate for a 5-year term agreement. This is, therefore, a highly conservative estimate of the ability of a CLEC to self-deploy a loop because special access rates are well-above the RBOCs' economic

costs. As AT&T has explained, a CLEC needs to achieve costs comparable to the RBOC's economic costs in order to deploy economically its own facilities.

These unit costs can be used to develop the average (per DS1) cost of a special access configuration. The only additional information required is the inter office mileage. For the analysis, the same mileage was used as is employed for the transport *ex parte* (8.94 miles). The following table compares the average cost per DS1 under an overbuild assumption (build) compared to the average cost of obtaining the equivalent capacity as a DS1 Channel Termination + DS3 interoffice transport using access obtained under a 5-year term agreement (SA-5) or a 3-year term agreement (SA-3). The table shows that the average cost of the self-provided loops are not less than special access pricing until a third DS3 is activated (each DS3 represents 28 DS1s). At 63 active DS1 loops, the build has a superior cost structure compared to the 3-years special access average unit cost ($195/DS1 compared to $206/DS1). Similarly, compared to the 5-year special access average unit cost, it is not until the 77th DS1 is activated that the build unit cost are an improvement over the special access rate ($160/DS1 compared to $165/DS1). All this leads to the conclusion that a CLEC requires at least 3 DS3s of customer demand at a building before a facility build can generally be proven in as financially prudent.

DS1s	build	SA-5	SA-3
7	$ 1,335	$ 302	$ 365
14	$ 669	$ 208	$ 246
21	$ 447	$ 176	$ 206
28	$ 336	$ 160	$ 187
35	$ 309	$ 189	$ 222
42	$ 258	$ 176	$ 206
49	$ 221	$ 167	$ 195
56	$ 194	$ 160	$ 187
63	$ 195	$ 176	$ 206
70	$ 176	$ 170	$ 198
77	$ 160	$ 165	$ 192
84	$ 147	$ 160	$ 187