Electronic Loop Provisioning (ELP)

Enabling The Competitive, All-Service Network Of The Future

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Overview

Electronic Loop Provisioning (ELP)

Enabling The Competitive, All-Service Network Of The Future

<<< Background and Introduction >>>

<<< Network Architecture and Design >>>

<<< Investments and Costs >>>

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Background and Introduction

Background

Why The Need For ELP ?

- The local network and loop access architecture was designed with one carrier and one carrier only in mind—the Incumbent LEC

- As a result, there are inherent architectural impediments in the Incumbent LECs' local networks that effectively preclude practical and economic CLEC access to analog voice-grade loops used to provide voice services

- Unlike the ILECs, whose circuit switches are located at the same location where their end-users' loops terminate (i.e. the Local Serving Office or LSO), CLECs must create an extensive "backhaul network" to extend their end-users' loops to their circuit switches

- In order to connect their customers' loops to their switches, the ILECs merely run a jumper wire from one side of a Main Distribution Frame ("MDF") to the other in the same LSO

- In sharp contrast, CLECs face a significant "backhaul penalty" in order to connect UNE-Loops to their circuit switches

- The underlying network must change in order to accommodate practical, efficient and economical multi-carrier access to loops – ELP is one potential way

Background

The CLEC Backhaul Penalty

- In summary, the CLEC backhaul penalty includes the following costs :

  (1) Engineering, establishing and maintaining collocation, including the associated space preparation and power requirements for sustaining collocation

  (2) Installing and maintaining digitization, concentration and multiplexing equipment at collocations, as well as related monitoring/testing and power distribution equipment

  (3) Arranging for and providing transport between collocations and CLEC switch locations

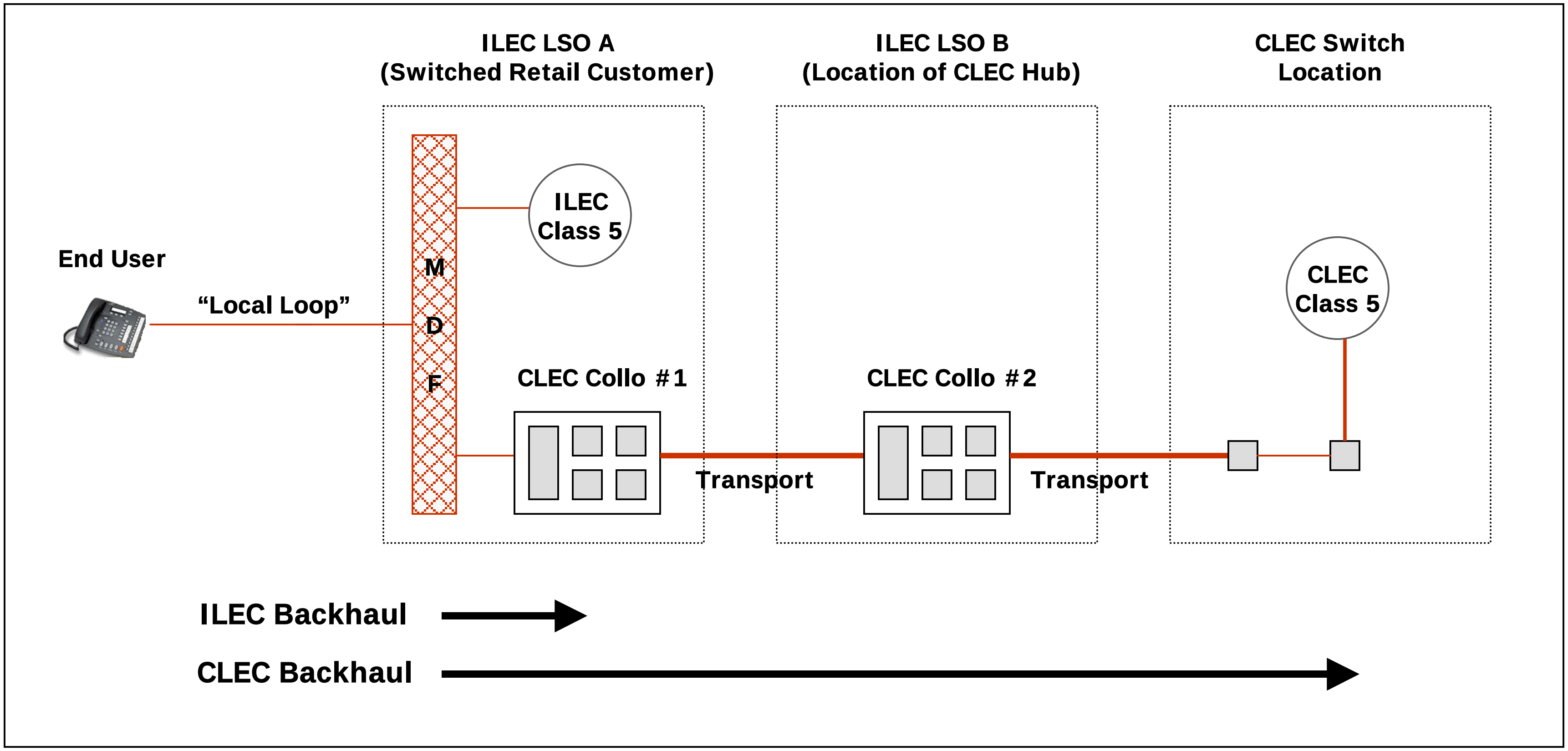
  (4) Engaging in the "coordinated hot-cut process" in order to migrate loops from the ILEC's network to the CLEC's network, which starts at the CLEC collocation

- Only after each of these requirements have been satisfied can a CLEC provision POTS service to end-users using an unbundled ILEC loop

- This "backhaul penalty" makes it practically and economically prohibitive to service analog voice grade loops using a UNE-L facilities based entry

Background

ILEC vs. CLEC Loop Access

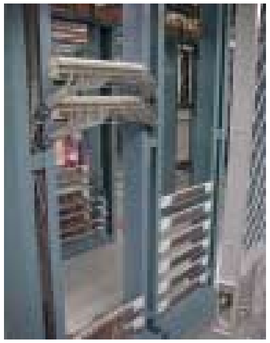


Background

Today's Collocation*
Digitization, Concentration, Multiplexing, Power and Testing Equipment

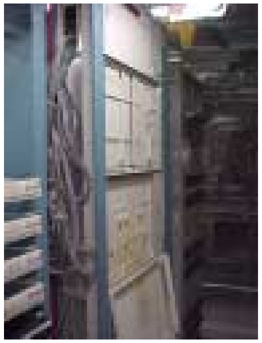
Collocation Cage
(Empty—Looking Out)

DLC



DSX-1

DSX-3



OC-X

BDFB

*NOTE : Collocation profiles may vary based on CLEC and/or particular circumstances.

Background

Today's Loop Migration via "Hot-Cuts"

Source : BellSouth

Background

ELP Is One Potential Solution

- ELP addresses the underlying network architecture issues that impede competition for the so-called “mass-market” (i.e., residential and small business locations)

- ELP is a targeted infrastructure upgrade to the incumbent LECs’ local network that introduces currently available network transmission technology into the local access network that digitizes and packetizes all end-user communications traffic, both voice and data

- Digitization and Packetization of the local access network...

  - ...eliminates the need for manual, labor-intensive “hot-cuts”
  - ...reduces the need for CLEC collocation and related equipment
  - ...improves CLEC transport economies

- ELP (or a technological equivalent that provides CLECs equivalent access to end-user loops as the ILECs) in conjunction with pro-competitive policies is required in order to make it both (a) practical, and (b) economic for CLECs to serve mass market locations using UNE-L facilities based entry

- Absent such a solution, UNE-P is the only practical and economic entry strategy to bring local competition to mass market locations

Introduction

AT&T's Proposed Solution

- AT&T's ELP proposal is <u>one way</u> in which voice digitization and packetization in the access network can be achieved

- It is premised on a "true" NGDLC access architecture that employs ATM transmission protocol

- ELP introduces three network elements into the local access network:

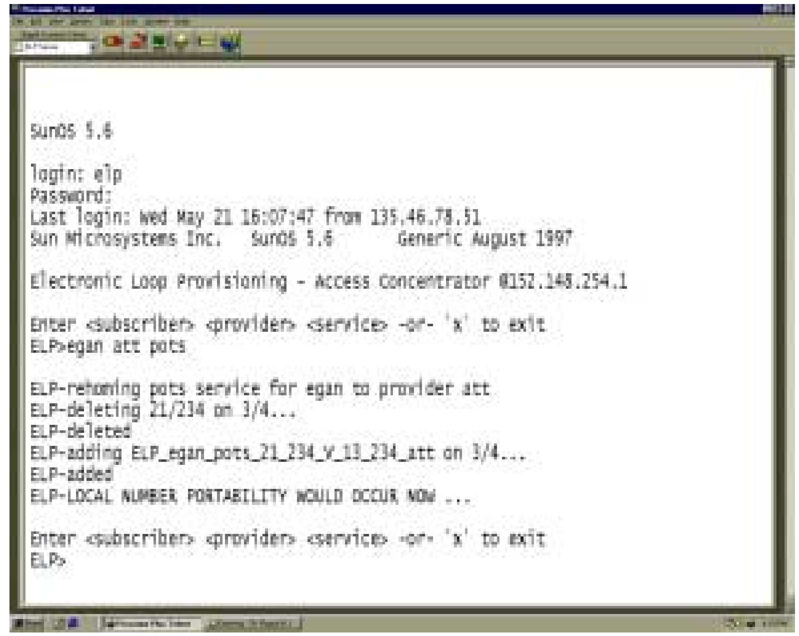
    - "true" Next Generation Digital Loop Carrier (tNGDLC) equipment
    - ATM modules
    - Voice Gateways (VGs)

- The introduction of these network elements transforms the local network into a digital, packet access network

- This fundamental change enables an open network architecture that will support nondiscriminatory multi-carrier access

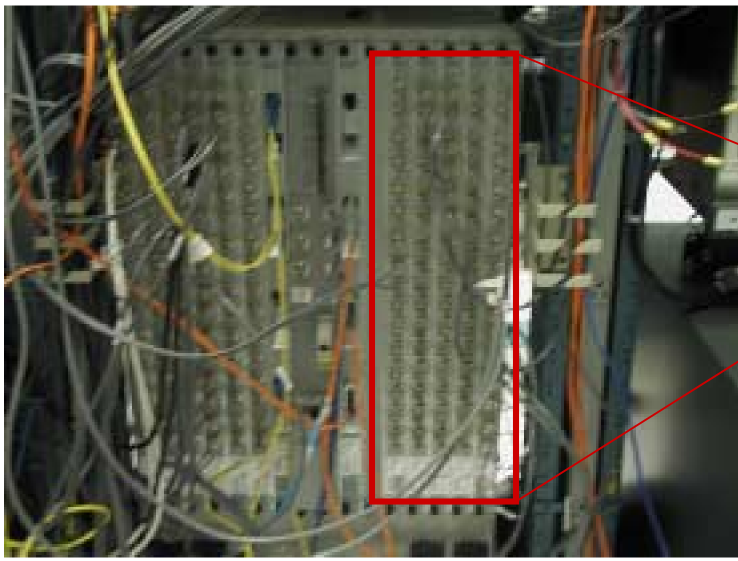
Background

Loop Migration via ELP

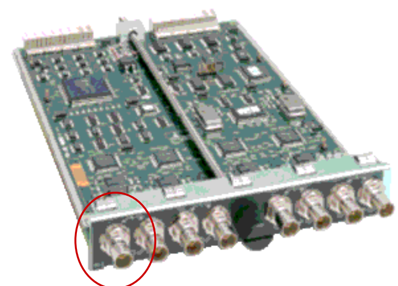


Background

Collocation Under ELP
An ATM Module Port and Associated Transport Facility*



ATM Module (Backplane View)



CLEC Collocation can equal a DS1, DS3, or OC-3 or higher port on the ATM Module w/associated transport facility

*NOTE : Collocation under ELP will vary/be dependent upon how it is architecturally implemented.

Network Architecture and Design

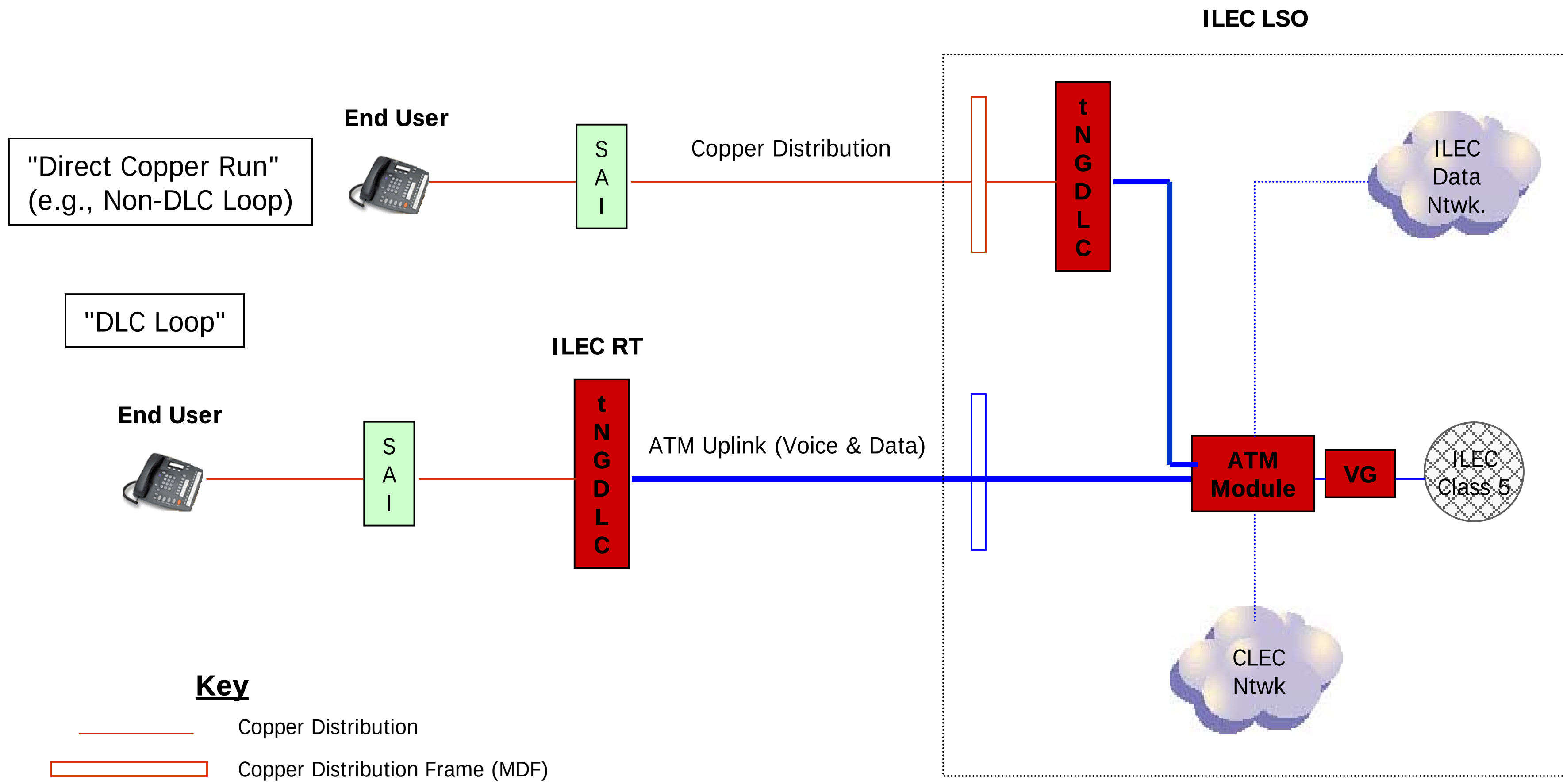
Network Architecture and Technology

Three Key Elements

- Three Prime Components in the ELP Architecture
  - "true" NGDLC (tNGDLC)
  - ATM module
  - Voice Gateway (VG)
- ***tNGDLC.*** Performs the analog-to-digital conversion, voice and data "packetization" (e.g., Voice Packet Processing or VPP), multiplexing and concentration of end-users' communications traffic
- ***ATM Module.*** Performs the multiplexing and concentration of end-users' communications traffic from sub-tending tNGDLC units in RTs or in the CO
- ***VG.*** Performs the packet-to-circuit protocol conversion between the ATM based ELP access architecture and TDM based circuit switched architecture

ELP Network Architecture Overview

Generic ELP Network Architecture



Key

Copper Distribution

Copper Distribution Frame (MDF)

Fiber Feeder

Fiber Distribution Frame (FDF)

TNGDLC "true" NGDLC with Voice Cell Processor (VCP)

VG Voice Gateway

Network Architecture and Technology

"true" NGDLC Technology

- **"True" NGDLC (tNGDLC) technology** converts current separate voice/data hardwired end-user to central office connections into software-defined connections that:
  - Convert end-user analog voice signals into packet format before they are transported to the central office
  - Combine these voice signals with data traffic (which current DSL technology already transports as packets)
  - Transport these combined voice and data packets to the central office over all-fiber facilities
- The most convenient packet-like transport format is likely to be **Asynchronous Transfer Mode (ATM)** protocol:
  - ATM is the format currently used for nearly all DSL transport
  - ATM permits quality-controlled permanent virtual circuits (PVCs) to be established and maintained for voice traffic as well

Network Architecture and Technology

Values of a Digital, Packet Access Network

- By converting data *and* voice traffic into packet format…
  - All traffic rides on a converged loop network
  - A central office-located packet module (e.g., an ATM module) serves as an efficient interface point where all service providers can access all voice and data PVCs ("loops") subtending this switch
    - An end-user's voice traffic may be unbundled separately from that end-user's data traffic
    - Both ILECs and CLECs obtain identical access to these loops (although CLECs still face some asymmetric but reduced backhaul costs and issues)
  - Because the "loop" and "network" ports on this packet module are software-controlled:
    - Loops can be assigned to different carriers instantaneously
    - New services can be provisioned by all carriers equally
    - Functionality analogous to 1980s FGD "equal access" with its automated PIC process for selecting long distance carriers is established for local loops and carriers

Network Architecture and Technology

Preservation of Legacy Investments

- All other portions of current loop infrastructure may remain unchanged by ELP
  - CPE used for voice services remains unchanged – as does CPE currently used for advanced services such as DSL or derived voice lines, etc.
  - Copper distribution facilities remain unchanged (unless they need to be shortened and/or repaired or conditioned to improve service)
  - Fiber feeder facilities remain unchanged (copper facilities upgraded to fiber, as necessary)
- Substantial portions of current ILEC NGDLC investment (and investment in legacy DLC systems) may be reusable
  - Sites, cabinets, power systems
  - Channel banks, common cards and channel cards (depending on vendor of legacy equipment)
  - ATM Modules (e.g., OCDs under Pronto, PARTS, etc.)

Investments and Costs

ELP Forward-Looking Investment Cost

Three Key Elements

- **Baseline forward-looking network costed using UNE SynMod**
  - No change to SynMod NID or loop distribution investments because are based on <18 kft. of clean copper
  - DLC investments adjusted to current GR-303 prices
  - Feeder remains copper/fiber – no concentration and no daisy-chaining
  - CO remains Class 5 circuit switch
  - SONET ring / TDM interoffice transport
  - SS7 signaling

- **Forward-looking basic ELP costed using UNE SynMod *(assuming DSL capability, but no actual DSL provisioning)***
  - No change to NID or loop distribution investments
  - Add tNGDLC investments on previous copper lines
  - Substitute tNGDLC investments on previous fiber/DLC lines
  - All feeders costed as fiber – no daisy-chaining
  - Add ATM module and voice gateway at each CO
  - CO remains Class 5 circuit switch
  - SONET ring / TDM interoffice transport
  - SS7 signaling

Network Architecture and Technology

Results

- Incremental forward-looking investment cost for basic ELP over current forward-looking baseline
  - ~ $113/line
  - Cost to upgrade all RBOC lines: ~$17.4 B
  - This cost will vary based on extent of ELP upgrade (e.g., just switched lines or switched plus special lines), carrier universe (e.g., just RBOCs or all nonrural) and expected ADSL "take" rate
- Further investments necessary to actually provision DSL
  - Substitution of a combo voice/DSL channel card for a voice-only channel card
  - Modest increases in ATM capacity
  - Cost of interoffice data network to serve ISPs
  - Extra investment cost over basic ELP: ~ $150/line
  - Cost to provision DSL on 40% of all RBOC lines: ~$9.2 B

ELP Short Run Incremental Cost

"Upgrades" By Loop Technology

Loop Technology	Additional Equipment
Fiber-fed IDLC/NGDLC	Voice Packet Processor (VPP) ATM module and VG
Fiber-fed UDLC	tNGDLC w/ VPP ATM module and VG
Copper-fed legacy DLC or all copper >18 kft.	tNGDLC w/ VPP Fiber feeder ATM module and VG
All copper <18 kft.	tNGDLC w/ VPP Fiber feeder (if needed) ATM module and VG

- The cost of these short run incremental investments to current embedded networks will depend on these networks' existing penetrations of fiber and modern DLC. It will likely exceed full forward-looking incremental investment cost by 25 to 50%.

Investments and Costs In Perspective

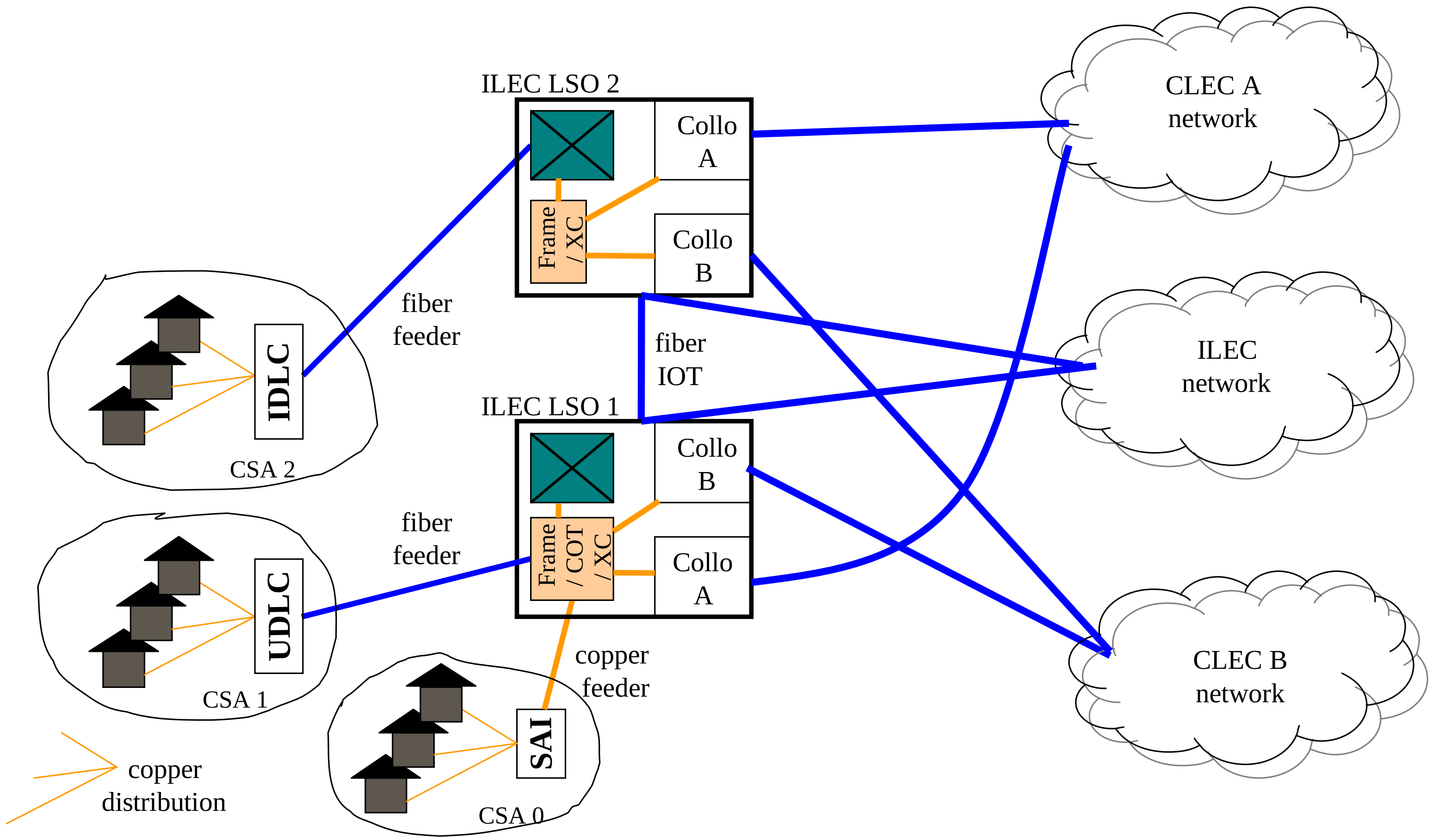
ELP Investment Must Be Viewed in The Context of Its Benefits

- ✓ End-Users
- ✓ Competition
- ✓ CLECs & ILECs
- ✓ Broadband & Advanced Services
- ✓ Local Network Infrastructure
- ✓ Telecommunications Industry / Market
- ✓ U.S. Economy

Attachments

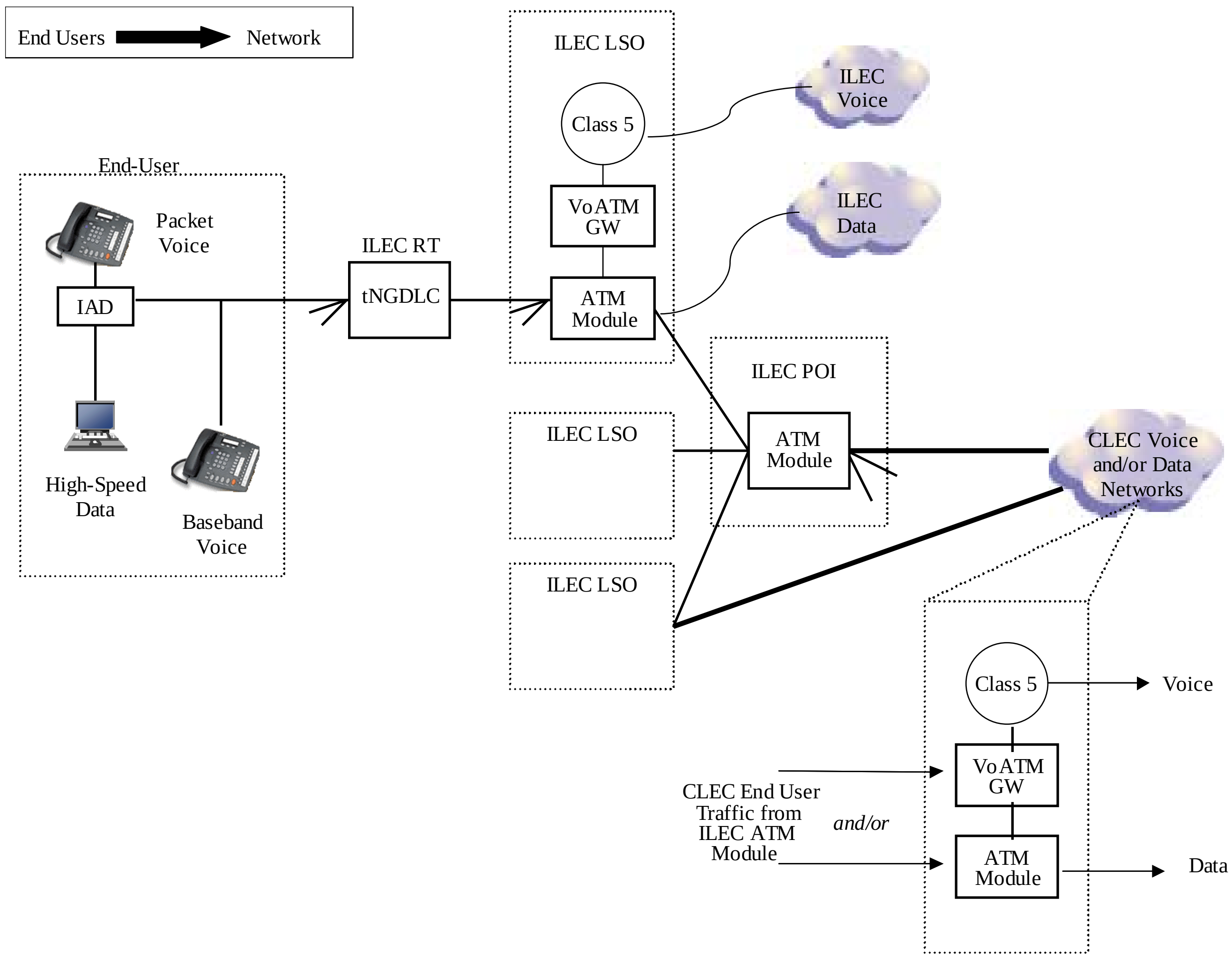
Legacy ILEC Network Topologies

Carrier Serving Architecture



ELP Network Architecture

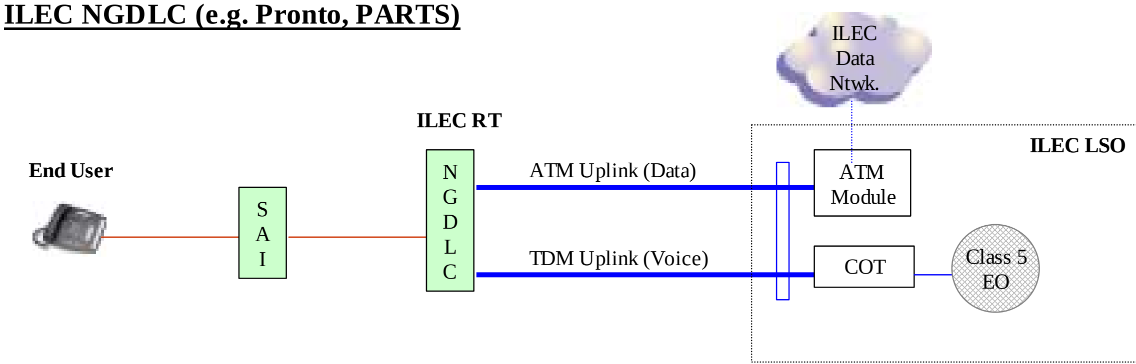
Base ELP Design



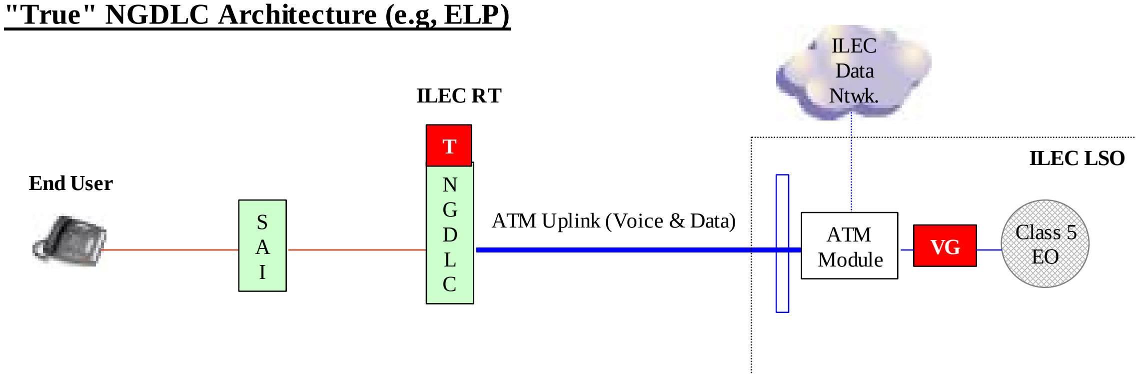
ILEC NGDLC vs. "true" NGDLC

Key Functional Differences

ILEC NGDLC (e.g. Pronto, PARTS)



"True" NGDLC Architecture (e.g, ELP)



Key

	Copper Distriction
	Fiber Feeder
	Fiber Distribution Frame (FDF)
TNGDLC	NGDLC with Voice Packet Processor (VPP)
VG	Voice Gateway