broadband forum

TECHNICAL REPORT

TR-013
Interfaces and System Configuration for ADSL Central Office

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ABSTRACT:

This project describes interfaces and system configurations for ADSL at the central office (wiring center). It covers electrical interfaces, connectorization, and wiring topologies with emphasis on POTS splitter issues, locations of equipment, and inter-equipment connections.

Where possible, technical information will be obtained by reference to existing specifications, and by liaison to technical standards groups.

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1. Introduction

1.1   Statement of Project

This project intends to define electrical interfaces, connectorization, and wiring topology for ADSL central office installations. Where possible, technical information will be obtained by reference to existing specifications and by liaison to technical standards groups. The work on this project is limited to addressing the logical interfaces necessary to support connection of the ATU-C to the outside plant (OSP) and PSTN (if used). This work is compatible with both conventional and splitterless (at the ATU-R) ADSL. Thus, the configuration at the central office is independent of the configuration at the customer premises.

1.2   List of Acronyms

AC.............................. Alternating Current
ADSL......................... Asymmetric Digital Subscriber Line
ANSI.......................... American National Standards Institute
ATM .... Asynchronous Transfer Mode
ATU-C .... Asymmetric Transmission Unit - Central (office)
ATU-R .... Asymmetric Transmission Unit - Remote
CLEC .... Competitive Local Exchange Carrier
CO.............................. Central Office
DC.............................. Direct Current
DSL............................ Digital Subscriber Line
E1.............................. European digital line rate 1 (2.048Mbps)
ETSI........................... European Telecommunications Standards Institute
HPF............................ High Pass Filter
ILEC .... Incumbent Local Exchange Carrier
ISDN.......................... Integrated Services Digital Network
ITU .... International Telecommunications Union
kHz .... kilohertz
LAN .... Local Area Network
LPF .... Low Pass Filter
Mbps......................... Megabits per second
MDF .... Main Distribution Frame
NID .... Network Interface Device
NT1 .... Network Termination 1
OSP........................... Outside Plant
PC .... Personal Computer
POTS .... Plain Old Telephone Service
PSTN .... Public Switched Telephone Network
SDH .... Synchronous Digital Hierarchy
SONET .... Synchronous Optical Network
STM.......................... Synchronous Transfer Mode
T1.............................. Transmission line rate 1 (1.544Mbps)
T1.413....................... ANSI document "Interface between Networks and Customer Installation - Asymmetric Digital Subscriber Line (ADSL) Metallic Interface", most recent edition
T1E1.4 .... Sub-Working group .4 of ANSI Committee T1E1 (Interfaces, Power and Protection for Networks)
U.S. .... United States
xDSL......................... unspecified type of Digital Subscriber Line, including (but not limited to) ADSL, HDSL, IDSL, SDSL

1.3 The Broadband Forum Reference Model

The Broadband Forum System Reference Model is described in Annex A.

1.4 Central Office Specific Reference Model

This project utilizes the Central Office specific Reference Model as shown in Figure 1. The interfaces identified in this model are logical interfaces and not necessarily physical implementations. Physical topology and implementation are covered in later sections.
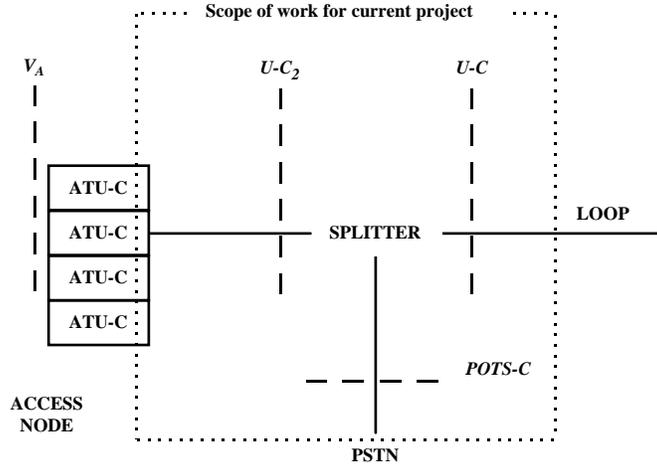
Figure 1. Central Office Specific Reference Model

ATU-C: ADSL Transmission Unit at the network end. The ATU-C may be integrated within an Access Node.

U-C: Interface between Loop and POTS Splitter on the network side. Defining both ends of the Loop interface separately arises because of the asymmetry of the signals on the line.

U-C$_2$: Interface between POTS Splitter and ATU-C. Note that at present ANSI T1.413 does not define such an interface and separating the POTS Splitter from the ATU-C presents some technical difficulties in standardizing the interface.

POTS-C: Interface between PSTN and POTS Splitter at network end.

PSTN: Public Switched Telephone Network.

V$_A$: Logical interface between ATU-C and Access Node

The central office end of a DSL link starts with the access line (twisted-pair telephone line) delineated in Figure 1 by the U-C interface. It ends with one or more ADSL transmission units delineated in Figure 1 by the U-C$_2$ interface. The telephone line may or may not be used for Plain Old Telephone Service (POTS), defined as analog POTS delivered over the metallic pair, and not derived from the ADSL signal, as well as ADSL. If it is used for POTS, then the central office installation must include a POTS Splitter that provides the POTS-C interface as well as the U-C$_2$ interface. The ATU-C terminates the access line and provides digital signals at the V$_A$ interface.

The U-C, POTS-C and U-C$_2$ logical interfaces will be specified in this document.

1.5   Relevant Work in Other Standards Groups or Forums

1.5.1 T1E1.4

ANSI committee T1E1.4 has approved text (T1E1.4 / 98-007R5) for an Issue 2 version of T1.413-1995. This text has been submitted for editing and future publication. The Issue 2 version of T1.413 includes detailed splitter performance information, but does not address central office wiring.

1.5.2 ITU SG15

ITU SG15 is progressing work on a number of draft recommendations on ADSL. These documents (G.992.2 [formerly G.lite], G.992.1 [formerly G.dmt], etc.) include detailed splitter performance information, but do not address central office wiring.

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2. Target Applications and System Implications

2.1 Applications

The primary applications supported by ADSL will be POTS and data communications and video on demand. These applications require the transport of packet data, ATM data or bit synchronous data.

In some cases, POTS may not be used, in which case the POTS splitter and POTS-C interface may not be needed.

2.2 System Implications

Serving these applications involves routing a subscriber's POTS service through a central office modem to combine it with the ADSL signals. The different configurations shown in this document have distinct cabling, cross-connect, and hardware configurations. Local practices will determine which configuration best meets the needs of the service provider.

3.   ATU-C / Splitter Installation

3.1   General Considerations

In the telephone company central office the access line is terminated on the protected side of the MDF, commonly referred to as the vertical side. The telephone equipment connections are presented on terminal blocks mounted on the distribution side of the MDF, commonly referred to as the horizontal side. For normal POTS service, a cross-connection is made between a protector block and a line terminal block in order to establish the connection between the PSTN and the access line.
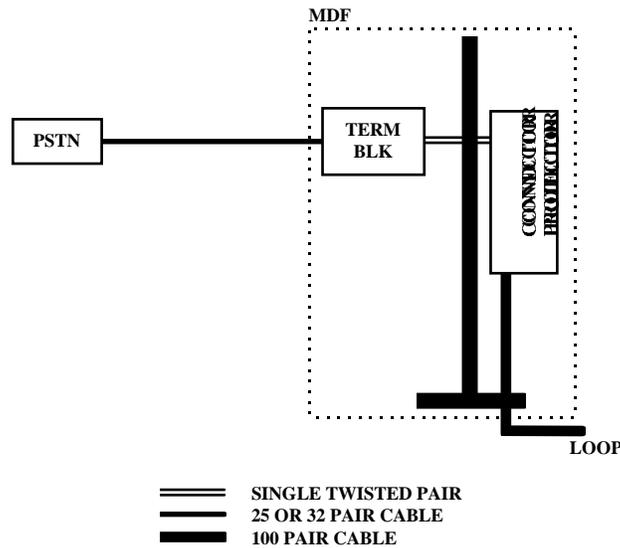
Figure 2. Baseline POTS MDF Configuration

When ADSL and POTS services are combined on the same access line, the POTS signal must be separated from the ADSL signal before the cross-connection to the line terminal block is made. The location of the POTS Splitter can have a significant impact on the number of MDF terminal blocks and the quantity of cable that must be used to facilitate the necessary connections. Moreover, the POTS Splitter circuit design depends on whether the only requirement is to remove the ADSL signal from the POTS signal before the POTS signal is delivered to the PSTN switch, or whether the POTS signal must also be removed from the ADSL signal before it is delivered to the ATU-C. In the first case, a low pass filter may be the only requirement. In the second case, both low pass and high pass filters may be required.

3.2   POTS Splitter

3.2.1 Splitter Definition

The POTS Splitter, for the purposes of this project, is considered to be the device that splits the POTS signals from the ADSL signals thus preventing the ADSL signals from reaching the telephone equipment. It may also prevent the POTS signals from reaching the ATU-C. The POTS Splitter may be active or passive, comprise the low pass filter (LPF) section only, or comprise the LPF section and the high pass filter (HPF) section. The LPF section

contains circuitry that passes POTS frequencies (approximately 0 to 4 kHz[1]) to and from the telephone equipment and blocks the ADSL signal. The POTS Splitter (LPF only variation) may allow for the complete spectrum, including the ADSL signals (above approximately 20 kHz) to pass to the ATU-C.

In the case that an HPF section is needed to prevent low frequency, high level POTS signals from entering the ATU-C front end components, the circuitry may be included in, and be considered part of, the ATU-C. HPF circuitry may be included as part of POTS Splitter (along with the LPF) when it is necessary to provide access to the ADSL signals while preventing access to the POTS signals. This may occur when ADSL signal access must be given to an alternate service provider by an incumbent service provider.

The ATU-C manufacturer should not assume that the HPF has been implemented external to its equipment. Even when the HPF is included as part of the POTS Splitter, the possibility of noise ingress may require another HPF at the ATU-C, if the ATU-C and the POTS Splitter are not located near one another. It is recommended that all manufacturers of ATU-C equipment plan on explicitly implementing the appropriate HPF.

See Annex B for additional details.

3.2.2 POTS Splitter Characteristics

POTS Splitter electrical, environmental and physical characteristics will not be specified in this text. Instead the POTS Splitter is used as an existing system component and is shown along with the other system components such as ATU-C and wiring to comprise the configurations detailed in sections to follow.

The current ANSI standard, T1.413-1995, and the pending Issue 2 version of this standard (T1E1.4 / 98-007R5) specify the loop conditions under which the splitter and ADSL must be able to operate without causing significant degradation to the POTS signal. These characteristics will be incorporated in this document by reference. Work by other groups (such as ETSI, ITU, UAWG, etc.) applicable to POTS Splitters will be addressed when available.

3.3   ATU-C / Splitter Configurations

Various central office POTS Splitter configurations are discussed in the following sections.

- POTS Splitter Located with ATU-C
- POTS Splitter Located near ATU-C
- POTS Splitter Located on MDF
- POTS Splitter Located near MDF
- ATU-C Remote
- POTS Splitter Located near PSTN Switch
- Integrated POTS and ADSL Line Card

A brief introduction for each configuration is presented along with a figure depicting both logical and physical attributes (topology & implementation).

This is followed by a list of advantages and disadvantages for each configuration. These advantages and disadvantages can be utilized in order to choose the configuration that best suits the needs of any particular deployment.

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[1] Out of band signaling tones may need to be passed in some applications (to be defined outside the scope of this document).

A suggested list of criteria is provided below. When used in conjunction with specific priorities or importance values (as determined by the provider) these criteria would allow a selection of the best configuration to be made for any particular ADSL system deployment.

Criteria:
    Installation complexity
    Central office layout
    MDF capacity
    MDF maintenance complexity
    Separate service provision requirements (Ownership and/or regulatory requirements that may be country specific)
    Failure effects of Splitter, ATU-C
    Testing and Maintenance -- Splitter, ATU-C
    Type of Splitter -- Active or Passive

3.3.1 POTS Splitter Located with ATU-C

Figure 3 shows a configuration with the POTS Splitter combined with the ATU-C, e.g., on the same circuit card. In this configuration, the ATU-C and POTS Splitter are located a significant distance from the MDF. The location could be in a separate room from the MDF, on a separate floor in the same building or in a separate building.
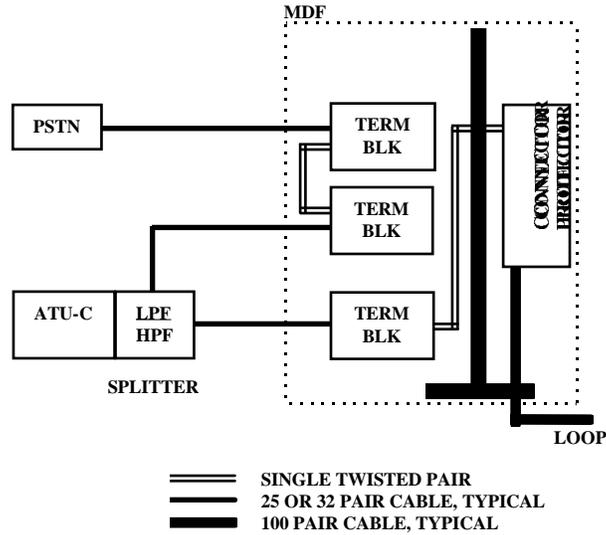
Figure 3. POTS Splitter Located with ATU-C

Advantages:
- Low susceptibility to high frequency interference between POTS Splitter and ATU-C.
- Power for active POTS Splitter readily available.

Disadvantages:
- Removal of the ATU-C circuit for servicing could interrupt POTS.
- The POTS signal must be returned to the MDF from the ATU-C shelf using a second cable.
- Separate access to the ADSL signal, without access to the POTS signal, is not available at the MDF.
- If customer moves, jumper must be returned to PSTN line terminal block to maintain soft dial tone to recover use of ATU-C.
- May limit equipment rack density, especially if POTS is not provided.

3.3.2 POTS Splitter Located near ATU-C

Figure 4 shows a configuration with the POTS Splitter close to the ATU-C, e.g., in a shelf on the same equipment rack. In this configuration, the ATU-C and POTS Splitter are located a significant distance from the MDF. The location could be in a separate room from the MDF, on a separate floor in the same building or in a separate building.
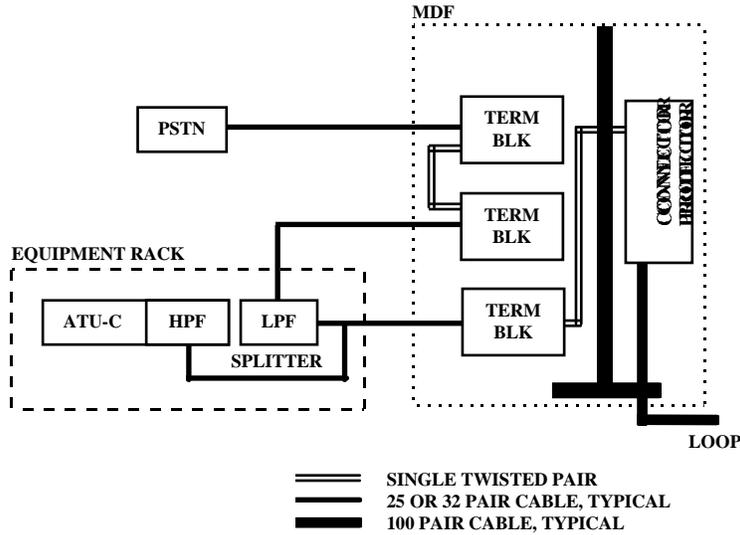
Figure 4. POTS Splitter Located near ATU-C

Advantages:
- Power for active POTS Splitter readily available.
- Removal of the ATU-C card does not affect POTS service.
- Low susceptibility to high frequency interference between POTS Splitter and ATU-C.
- POTS Splitter is optional if data-only service is provided.

Disadvantages:
- The POTS signal must be returned to the MDF from the POTS Splitter using a second cable.
- Separate access to the ADSL signal, without access to the POTS signal, is not available at the MDF.
- If customer moves, jumper must be returned to PSTN line terminal block to maintain soft dial tone to recover use of ATU-C.

3.3.3 POTS Splitter Located on MDF

Figure 5 shows a configuration with the POTS Splitter separate from the ATU-C. The POTS Splitter is contained in a housing mounted on the MDF (horizontal or vertical side). The housing also provides the POTS Splitter connections to the Loop, ATU-C and PSTN. The ATU-C and the PSTN switch are located a significant distance from the MDF.
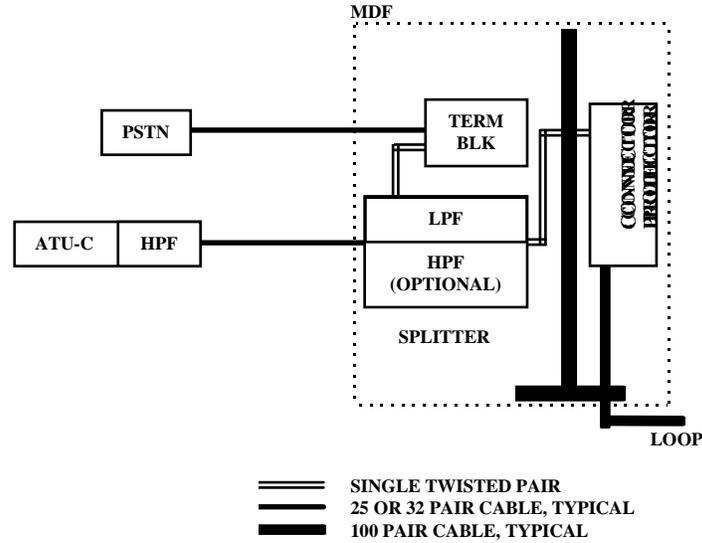
Figure 5. POTS Splitter Located on MDF (Horizontal Side Shown)

Advantages:
- Removal of the ATU-C card does not affect POTS service.
- One cable connection is required between the ATU-C and the MDF.
- Incorporation of an optional high pass filter provides separate access to the ADSL signal at the MDF without access to the POTS signal.
- Provides ability to maximize ATU-C equipment rack density.
- POTS Splitter is optional if data-only service is provided.

Disadvantages:
- MDF conditions may constrain the number and size of POTS Splitters.

3.3.4 POTS Splitter Located Near MDF

Figure 6 shows a configuration with the POTS Splitter separate from the ATU-C. The POTS Splitter mounts in an equipment rack near the MDF while the ATU-C and the PSTN switch are located a significant distance from the MDF. The POTS Splitter connections to the Loop, ATU-C and PSTN are centralized at a single terminal block via connectorized cables.
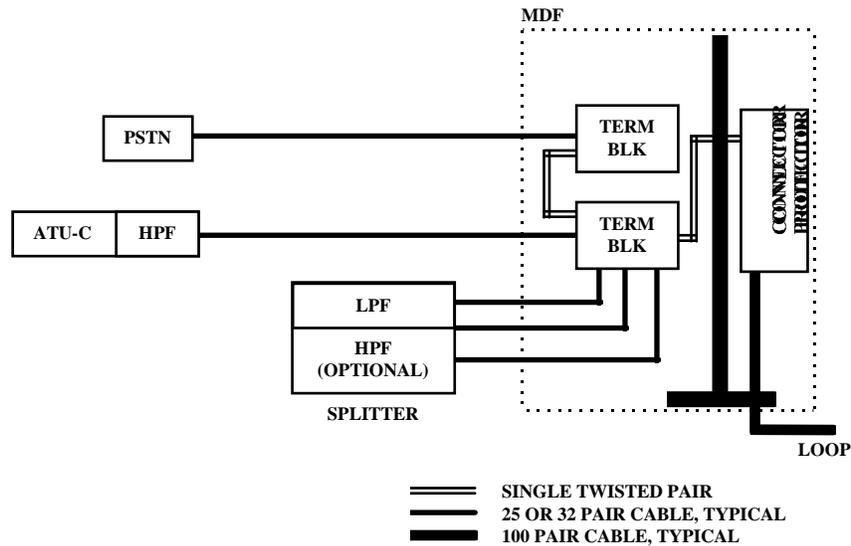
Figure 6. POTS Splitter Located Near MDF

Advantages:
- Removal of the ATU-C card does not affect POTS service.
- High density, e.g., 32 circuit, terminal blocks may be used to provide POTS Splitter connections.
- One long cable is required between the ATU-C and the MDF.
- Incorporation of an optional high pass filter provides separate access to the ADSL signal at the MDF without access to the POTS signal.
- Provides ability to maximize ATU-C equipment rack density.
- POTS Splitter is optional if data-only service is provided.

Disadvantages:
- A separate equipment rack is required to house the POTS Splitters.
- Two or three cables are required to connect the POTS Splitters to the MDF terminal block.

3.3.5 ATU-C Remote

In Figure 7 the ATU-C is located outside the CO in a nearby building. This requires passing the ADSL signal from the ATU-C building to the vertical side of the MDF for lightning protection, and then to the POTS Splitter. This requires additional MDF wiring and additional protection compared to locating the ATU-C in the CO. Furthermore, the cable between the ATU-C and the MDF, and the associated connector protector must be dedicated to ADSL signals only.   Refer to Sections 3.3.3 and 3.3.4 for discussions of POTS Splitter configurations on or near the MDF that are compatible with the remote ATU-C.

This is an instance of "reverse ADSL". As such, a separate cable, or special engineering, is strongly recommended for the facilities used between the central office and the separate building.
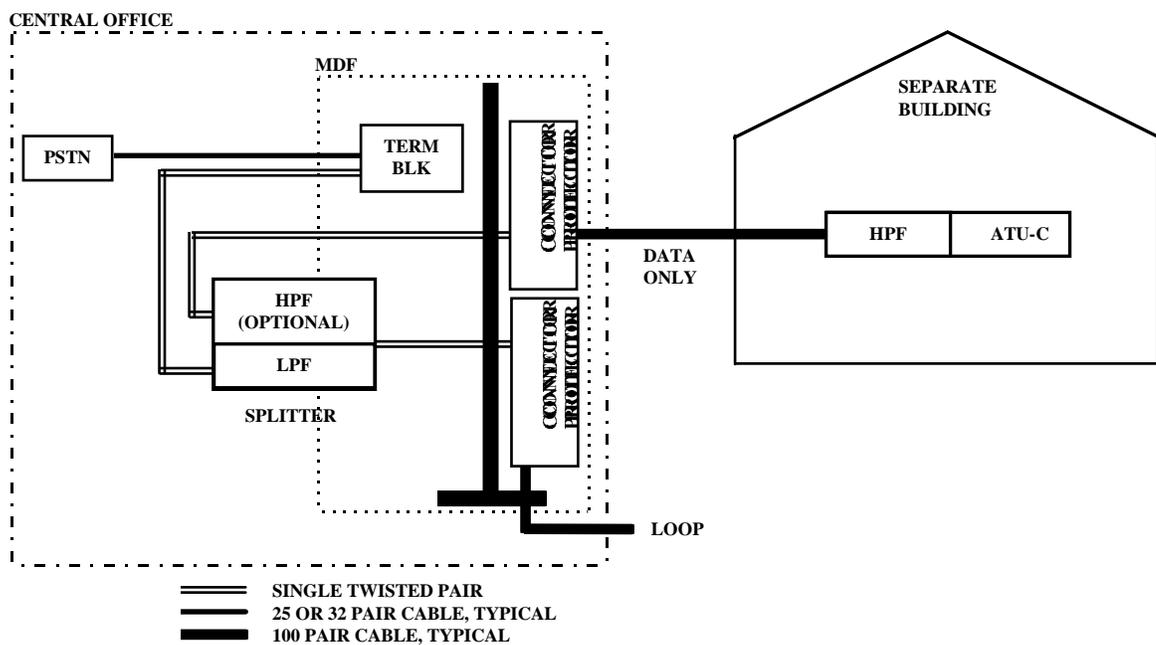
Figure 7. ATU-C Remote

Advantages:
- Removal of the ATU-C card does not affect POTS service.
- One long cable is required between the ATU-C and the MDF.
- Incorporation of optional high pass filter provides separate access to the ADSL signal on the MDF without access to the POTS signal.
- Provides ability to maximize ATU-C equipment rack density.
- POTS Splitter is optional if data-only service is provided.

Disadvantages:
- Effective ADSL reach is reduced by the cable between the CO and the separate building and additional series protection elements, if used.
- Requires additional MDF wiring and additional protection.
- A separate cable, or special engineering, is strongly recommended for the facilities used between the central office and the separate building.

3.3.6 POTS Splitter Located Near PSTN Switch

Figure 8 shows a configuration with the POTS Splitter located near the PSTN switch in a location separate from the MDF. This configuration may involve the ATU-C and the POTS Splitter located in the same equipment rack. This configuration requires a dedicated POTS line for each ATU-C.
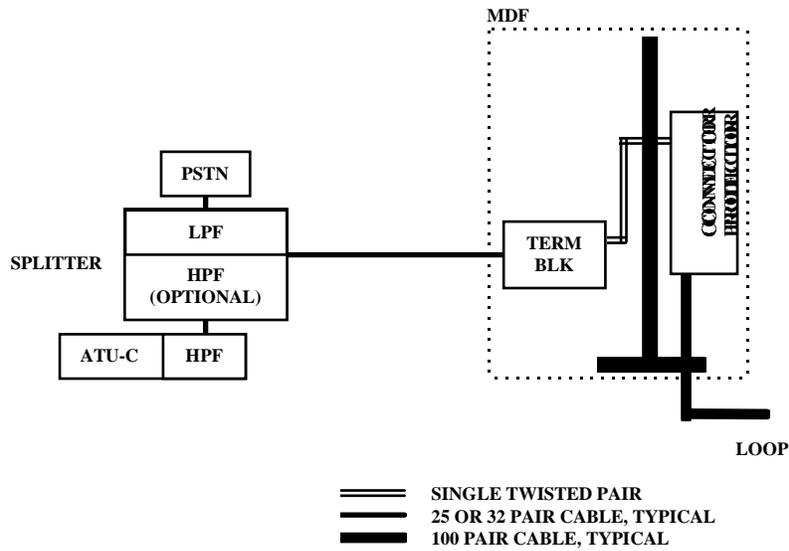
Figure 8. POTS Splitter Located Near PSTN Switch

Advantages:
- No additional connections required for ADSL service on MDF.
- Low susceptibility to high frequency interference between POTS Splitter and ATU-C.

Disadvantages:
- Separate access to the ADSL signal without access to the POTS signal is not available at the MDF. Two additional cables between the ATU-C shelf and the MDF and an additional terminal block would be required to accomplish this.
- ADSL is dedicated and MDF jumper must be moved if subscriber does not want ADSL service.

3.3.7 Integrated POTS and ADSL Line Card

Figure 9 shows a configuration with the POTS Splitter, ATU-C and PSTN circuits integrated on the same line card.
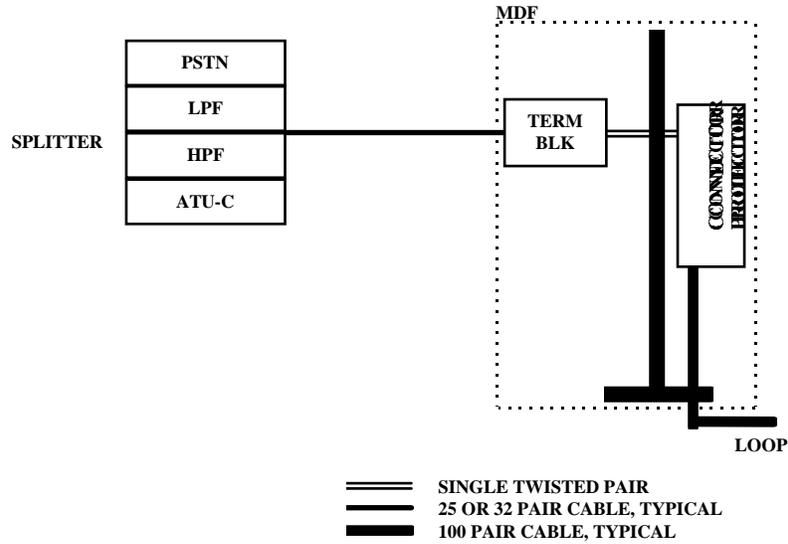
Figure 9. Integrated POTS and ADSL Line Card

Advantages:
- No additional connections required for ADSL service on MDF.
- Minimal number of physical wire connections improves reliability.
- POTS and wideband test access can be easily provided.
- POTS Splitter design can be coordinated with optimized POTS signaling.
- Soft dial tone is always available.
- Power for active POTS Splitter is readily available.
- Provides ability to offer integrated POTS and ADSL OAM&P.
- Reduces installation time.

Disadvantages:
- Both POTS and ADSL services must be provided by the same service provider.
- Removal of the ATU-C circuit for servicing will interrupt POTS service.
- Higher complexity for data-only service.

3.4   ATU-C/Splitter Configuration Complexity Comparison

This section provides an alternate method of comparing the complexity of the various CO wiring configurations shown in sections 3.3.1 through 3.3.7 (inclusive) relative to the POTS-only reference configuration shown in section 3.1.

The term "cables" refers to fixed CO wiring installed to connect ADSL equipment to the MDF. It is not dependent on customer moves, adds, or changes.

The term "cross-connections" refers to jumper wires installed on the MDF to connect specific subscribers to specific equipment. Customer moves, adds, or changes would normally result in changes to the cross-connections, not the office cabling.

Section	3.3.1	3.3.2	3.3.3	3.3.4	3.3.6	3.3.7
Cables	+2	+3	+1	+3 / +4*	+2	+0
Cross-Connections	+1	+1	+1	+1	+0	+0
Total MDF Connections	+4	+4	+3	+5 / +6*	+0	+0
Total CO Connections	+6	+3	+4	+8 / +10*	+4	+0

* - First figure reflects when HPF is co-located with ATU-C.
      Second figure reflects when HPF is co-located with LPF.

Table 1. Comparison to Baseline POTS MDF Configuration

4.   INTERFACE WIRING CONSIDERATIONS

4.1   Wiring Considerations

Experience suggests that the quality of standard central office wiring is sufficient for ADSL installations. Disruptive cross-coupling between ADSL signals and POTS signals on the MDF has not been observed. As such, standard non-shielded multi-pair cables may be used to connect ADSL equipment to terminal blocks on the MDF. Additionally, standard twisted pair frame jumper wire may be used for connections between terminal blocks.

It is also unnecessary to segregate ADSL wiring on the MDF. Standard wire termination techniques are also suitable for ADSL installations.

Annex A   The Broadband Forum System Reference Model

Figure 10. (below) presents The Broadband Forum System Reference Model for ADSL network systems.
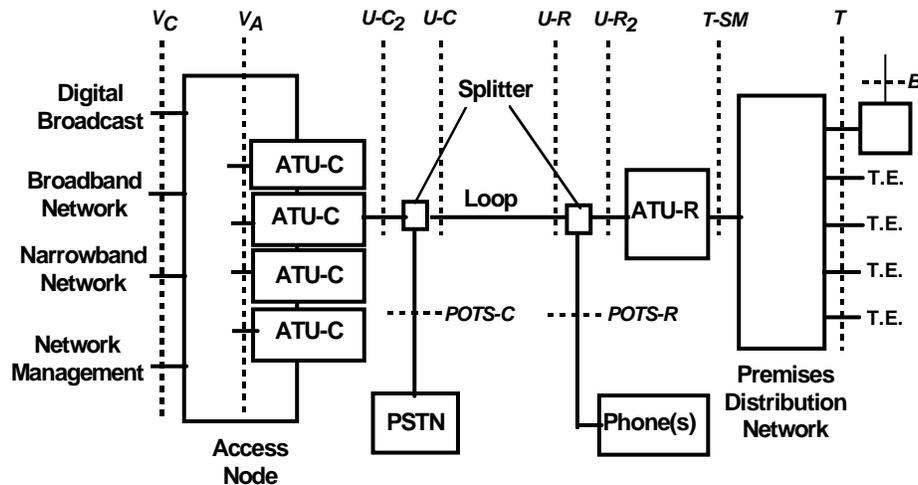
Figure 10. The Broadband Forum System Reference Model

ATU-C: ADSL Transmission Unit at the Central Office end. The ATU-C may be integrated within an Access Node.

ATU-R: ADSL transmission Unit at the customer premises end.

Access Node: Concentration point for Broadband and Narrowband data. The Access Node may be located at a Central Office or a remote site. Also, a remote Access Node may subtend from a central access node.

B: Auxiliary data input (such as a satellite feed) to Service Module (such as a Set Top Box).

Broadcast: Broadband data input in simplex mode (typically broadcast video).

Broadband Network: Switching system for data rates above 1.5/2.0 Mbps.

Loop: Twisted-pair copper telephone line.

Narrowband Network: Switching system for data rates at or below 1.5/2.0 Mbps.

POTS: Plain Old Telephone Service.

POTS-C: Interface between PSTN and POTS splitter at network end.

POTS-R: Interface between phones and POTS splitter at premises end.

Premises Distribution Network: System for connecting ATU-R to Service Modules. May be point-point or multi-point; may be passive wiring or an active network. Multi-point may be a bus or star.

PSTN: Public Switched Telephone Network.

Service Module (SM): Performs terminal adaptation functions. Examples are set top boxes, PC interfaces, or LAN router.

Splitter: Filters that separate high frequency (ADSL) and low frequency (POTS) signals at CO end and premises end. The splitter may be integrated into the ATU, physically separated from the ATU, or divided between high pass and low pass, with the low pass function physically separated from the ATU. The provision of POTS splitters and POTS-related functions is optional.

T-SM: Interface between ATU-R and Premises Distribution Network. May be same as T when network is point-point passive wiring. An ATU-R may have more than one type of T-SM interface implemented (e.g., a T1/E1 connection and an Ethernet connection).

T: Interface between Premises Distribution Network and Service Modules. May be same as T-SM when network is point-point passive wiring. Note that T interface may disappear at the physical level when ATU-R is integrated within a Service Module.

U-C: Interface between Loop and ATU-C (analog). Defining both ends of the Loop interface separately arises because of the asymmetry of the signals on the line.

U-C$_2$: Interface between POTS splitter and ATU-C. Note that at present ANSI T1.413 does not define such an interface and separating the POTS splitter from the ATU-C presents some technical difficulties in standardizing this interface.

U-R: Interface between Loop and ATU-R (analog).

**U-R$_2$:** Interface between POTS splitter and ATU-R. Note that at present ANSI T1.413 does not define such an interface and separating the POTS splitter from the ATU-R presents some technical difficulties in standardizing the interface.

V$_A$: Logical interface between ATU-C and Access Node. As this interface will often be within circuits on a common board, The Broadband Forum does not consider physical V$_A$ interfaces. The V interface may contain STM, ATM, or both transfer modes. In the primitive case of point-point connection between a switch port and an ATU-C (that is, a case without concentration or multiplexing), then the V$_A$ and V$_C$ interfaces become identical (alternatively, the V$_A$ interface disappears).

V$_C$: Interface between Access Node and network. May have multiple physical connections (as shown) although may also carry all signals across a single physical connection. A digital carrier facility (e.g., a SONET or SDH extension) may be interposed at the V$_C$ interface when the access node and ATU-Cs are located at a remote site. Interface to the PSTN may be a universal tip-ring interface or a multiplexed telephony interface such as specified in Bellcore TR-TSY-000008 or GR-303-CORE. The broadband segment of the V$_C$ interface may be STM switching, ATM switching, or private line type connections.

Annex B   The POTS splitter

B.1 Definition

Define the POTS splitter as a three port device with ports for POTS, xDSL and the outside plant LINE.
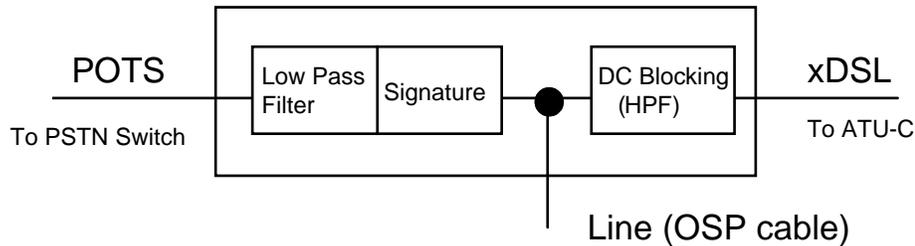
Figure 11. Idealized Central Office Pots Splitter
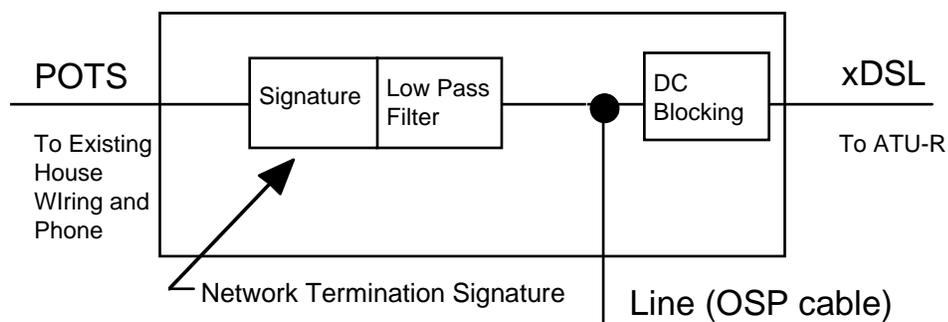
Figure 12. Idealized Remote POTS Splitter

B.2 Low Pass Filter on POTS port

At the service provider end of the circuit the CO POTS splitter contains a low pass filter that separates the high frequencies from the POTS signal before the POTS signal is presented to the normal MDF (Main Distribution Frame) environment. It is not desirable to have the high and low frequencies running in parallel in the jumper trays on the MDF. The low pass filter allows only the low frequencies to exit the POTS splitter and therefore to run in the jumper tray with the other normal low frequency signals. High frequencies can be routed immediately out of the MDF and into their own environment. The high frequencies are never presented to the switch line card.

At the Remote end of the circuit the low pass filter on the POTS port keeps high frequency signals from exiting the splitter and traveling on the existing house wiring. The wiring is usually of unknown condition and would represent a bridge tap to the xDSL circuit at a critical location near the end of the circuit. The high frequency signals are not presented to the POTS phones. The bandwidth of the low pass filter is of significant concern. Spectral compatibility with other services on the same pair is necessary. In the U.S. frequencies from 0-8 kHz are in use and in Europe there are tones at 12 kHz and at 16 kHz for signaling. The low pass filter needs to take these signals into consideration.

B.3 Security High Pass Filter on xDSL port

Another (desired) characteristic of the CO POTS splitter is the high pass filter on the xDSL port. This filter will allow only the higher frequencies to pass to the xDSL port and on to the ATU-C. This is desirable for several reasons.

B.3.1 Security/Privacy

Of primary importance are the security and privacy of the voice band signals on the POTS circuit. These signals are the responsibility of the vendor providing the POTS service and that vendor must maintain and have ultimate control over the circuit for security, maintenance and testing reasons. Signals that are bridge tapped out of control of the vendor are subject to fraud. In addition, circuit conditions beyond the control of the service provider (i.e., shorts or grounds or crosses) could affect the POTS signal and the POTS provider would not have access to repair the circuit.

B.3.2 DC Blocking

The minimum requirement is that the xDSL port must be DC blocked to avoid shorts or grounds from affecting the POTS circuit. Emergency services such as 911 in the U.S. are delivered over the POTS circuit and all care must be taken to avoid accidental disruption of the 911 capability.

B.4 Testability

Of prime importance is the ability to continue to test POTS circuits with the full capability present today. Many millions of dollars have been invested in POTS testing capability and adding the ADSL service should not be allowed to degrade the POTS test capabilities.

Field and laboratory tests have shown that the POTS splitters in use today in the U.S. are not "transparent" or testing neutral. Inaccuracies are introduced in length, fault detection and in detection of normal line conditions such as network or premises termination (i.e., ringer or half-ringer) detection.

Several methods are available for testing transparency. One way is for the test system to account for each different splitter made and subtract the complex impedance or "signature" of the splitter from the raw results to obtain a true reading of the line condition. Another way is to define a "standard" signature that all test systems would recognize and have the splitter manufacturers design to this standard signature. Close cooperation of the test system vendors and the ADSL vendors is required. Another way would be for the POTS splitter to have such a "slight" signature that it did not interfere with the current test systems. Another approach could be the switching in and out of the splitter during testing to avoid the interference (i.e., active splitters).

The most basic requirement is, however, to not degrade POTS testing.

B.5 Maintenance Signature on the POTS Port

A defined signature could be placed between Tip and Ring on the POTS port. It could be an AC or DC signature that could be uniquely recognized in the maintenance mode (that is intrusive testing from the POTS port). This signature is intended to be recognized only in the maintenance mode and should not interfere with normal operations of the POTS circuit. At the Remote end another unique signature is located in the Remote POTS splitter at the NID (Network Interface Device). Both signatures are recognizable by suitable test equipment at the service provider end. This could be a loop test system such as Lucent's MLT (TM), Teradyne's 4TEL (TM) or a similar product. These test systems would have to be modified to test, detect and recognize these signatures. This is a similar procedure used to detect the signature for an ISDN NT1 device in the ISDN networks worldwide.

B.6 Maintenance Signature in Remote

B.6.1 Half Ringer

It has been standard practice in many areas of the United States to install, at the Network Interface Device (NID), a network termination device that is called a half ringer. It is an example of an AC type termination device since it is detected using AC techniques.

A normal POTS mechanical ringer, in a residential telephone, is made up of an inductor and a capacitor in series that is bridged between Tip and Ring of the line in the phone. The 'half' ringer is just the capacitor part of the ringer. The half ringer is actually a capacitor in series with a zener diode and a resistor that resembles one half of a 'normal' mechanical ringer. This, in the U.S., is a 0.47 micro Farad capacitor without the addition of the inductor part of the circuit, hence the name 'half' ringer.
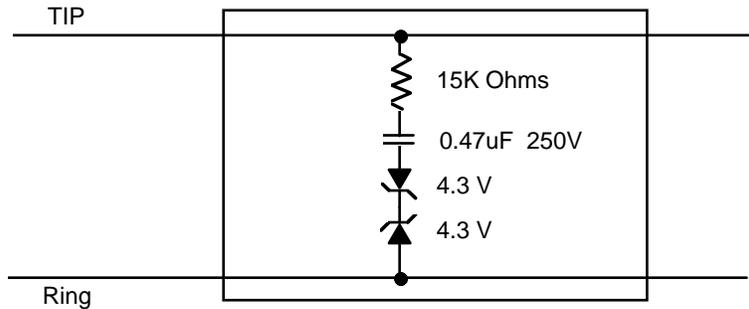
Figure 13 Typical "Half-Ringer" used in U.S. in the NID

B.6.2 Maintenance Signature in Remote POTS splitter

Borrowing the idea of a unique signature, we can employ a unique signature for the POTS splitter on the Remote end of the circuit. The signature should be distinctive from the other known or expected signatures in the network and also unique from common expected faults such as shorts or grounds. It should be easily identifiable by the service provider test systems and inexpensive to include in the designs of the splitters. The electronic components should be small so as not to take up too much space on a circuit board. The signature is subject to all of the other design considerations of components at this place in the network.