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IPCablecom 1.5 Part 11: Analog Trunking for PBX Specification

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1 INTRODUCTION

This specification defines extensions to the IP-Cablecom Network-based Call Signaling [NCS] protocol to support the following analog trunking for PBX interfaces on an embedded Voice-Over-IP client device in an IP-Cablecom environment:

- Ground-start lines
- PBX one-way and two-way DTMF trunks.

1.1 Scope

As shown in Figure 1 below, the IP-Cablecom NCS specification [NCS] already defines the Loop-Start line interface typically used for residential services today. This specification is designed for additional line/trunk interfaces to support analog trunking for PBX so that the MTA may be used to interface directly to a Legacy PBX via a Ground-Start line or other trunk interface (E&M or DID). Example PBX trunk interfaces are shown below.

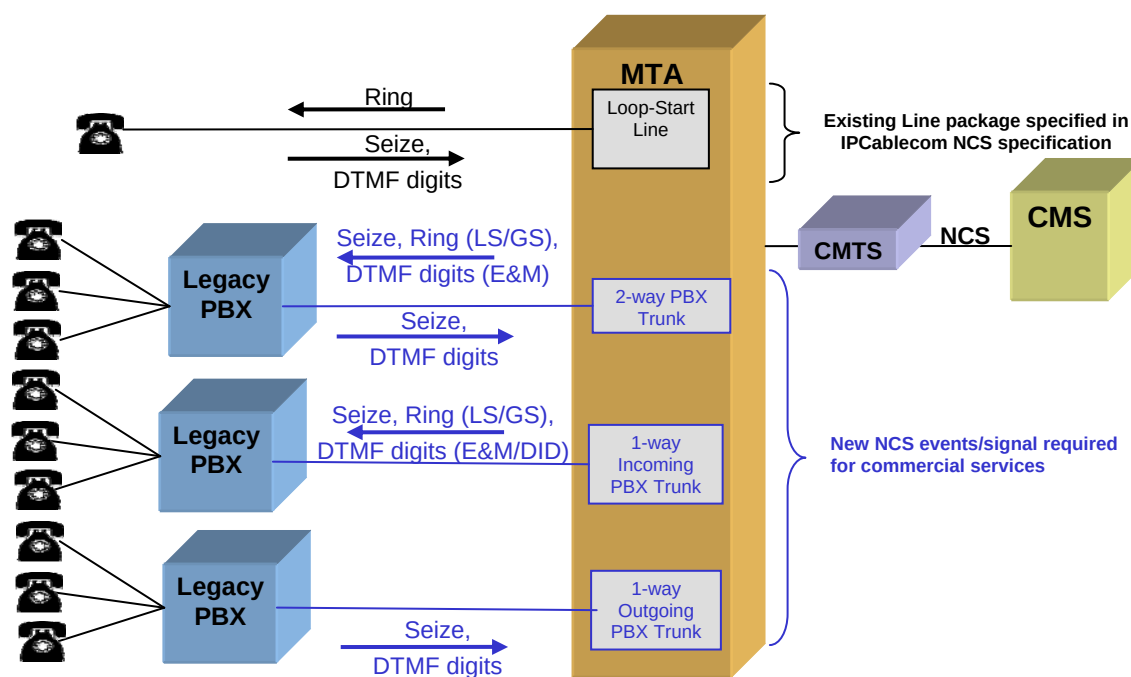


Figure 1 – Ground-Start Line & Loop Trunk Interfaces

1.2 Relation to Other IP-Cablecom Specifications

Analog Trunking for PBX is defined here as a supplement to the IP-Cablecom NCS interface. Though this specification is included as part of the IP-Cablecom 1.5 release, the features specific to IP-Cablecom 1.5 are not required to support analog trunking for PBX. The capabilities defined in this specification may be supported by components that conform to the IP-Cablecom 1.0 release. Full support for the IP-Cablecom 1.5 release is RECOMMENDED for analog trunking for PBX due to the inclusion of additional features such as [T.38] and [RFC 2833].

1.3 NCS Package Requirements

The IPCablecom analog trunking for PBX (PAT) package is defined in this specification as an extension to the NCS Line package to provide the needed functionality specific to analog trunking for PBX. Both packages are required to support analog trunking for PBX. It should be noted that the PAT package is designed in such a way as to provide a complete abstraction of the physical characteristics of an endpoint to the Call Agent. For example, the Call Agent is unaware of the physical endpoint interface (e.g., E&M or DID), start of dialing method (e.g., wink start), and out-pulse dialing type (e.g., DTMF). This abstraction exists due to time-to-market considerations. As such, the endpoint is required to alter its behavior based on these physical characteristics given a particular command from the Call Agent. In some cases this behavior breaks the general rules of NCS. The exceptions to NCS are documented in this specification and apply only to analog trunking for PBX.

1.4 Organization of document

This specification is organized as follows:

- Scope and High-Level NCS Package Requirements (Section 1.1)
- References (Section 2)
- Terms and Definitions (Section 3)
- Abbreviations and Acronyms (Section 4)
- Overview of Analog Trunking for PBX (Section 5)
- Functional Requirements of Analog Trunking for PBX (Section 6)
- Event Packages (Annex A)

1.5 Requirements

Throughout this document, the words that are used to define the significance of particular requirements are capitalized. These words are:

"MUST"	This word means that the item is an absolute requirement of this specification.
"MUST NOT"	This phrase means that the item is an absolute prohibition of this specification.
"SHOULD"	This word means that there may exist valid reasons in particular circumstances to ignore this item, but the full implications should be understood and the case carefully weighed before choosing a different course.
"SHOULD NOT"	This phrase means that there may exist valid reasons in particular circumstances when the listed behavior is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behavior described with this label.
"MAY"	This word means that this item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because it enhances the product, for example; another vendor may omit the same item.

2 REFERENCES

The following documents contain provisions which, through reference in this text, constitute provisions of this standard. At the time of publication, the editions indicated were valid. All standards are subject to revision, and parties to agreement based on this standard are encouraged to investigate the possibility of applying the most recent editions of the documents listed below.

2.1 Normative References

- [ANSI 401] ANSI T1.401-2000 Interface Between Carriers and Customer Installations – Analog Voicegrade Switched Access Lines Using Loop-Start and Ground-Start Signaling.
- [ANSI 405] ANSI T1.405-2002 Network-to-Customer Installation Interfaces - Direct Inward Dialing Analog Voicegrade Switched Access Using Loop Reverse-Battery Signaling.
- [GR 505] GR-505, Call Processing, December 1997, Telcordia.
- [GR 506] GR-506, LSSGR: Signaling for Analog Interfaces, June 1996. Telcordia.
- [NCS] SCTE 165-3 2009, IPCablecom 1.5 Part 3: Network-Based Call Signaling Protocol.
- [TIA] EIA/TIA-464-C Telecommunications - Multiline Terminal Systems Requirements for PBX Switching Equipment, June 2004.

2.2 Informative References

This specification uses the following informative references.

- [ANSI 403] ANSI T1.403-1999 Network-to-Customer Installation Interfaces – DS-1 – Electrical Interface.
- [RFC 2833] IETF RFC 2833, RTP Payload for DTMF Digits, Telephony Tones and Telephony Signals, May 2000.
- [RFC 3064] IETF RFC 3064, MGCP CAS Packages, February 2001.
- [RFC 3435] IETF RFC 3435, Media Gateway Control Protocol (MGCP) Version 1.0, January 2003.
- [SDP] IETF RFC 2327, Session Description Protocol (SDP), April 1998.
- [T.38] ITU-T Recommendation T.38, Procedures for Real-Time Group 3 Facsimile Communication over IP Networks, April 2004.
- [TR-NWT-000031] Telcordia TR-NWT-000031, Issue 4, CLASS Feature: Calling Number Delivery, December 1992.
- [TR-NWT-001188] Telcordia TR-NWT-001188, Issue 1, CLASS Feature: Calling Name Delivery, December 1991.

2.3 Reference Acquisition

- Internet Engineering Task Force (IETF), Internet: <http://www.ietf.org/>
- IHS Global, Internet: <http://global.ihs.com/>
- Telcordia Technologies Customer Service, Piscataway, New Jersey 08854-4156, USA: <http://telecom-info.telcordia.com/site-cgi/ido/index.html>
- ANSI: <http://www.ansi.org/>

3 TERMS AND DEFINITIONS

This specification uses the following terms:

Endpoint	A Terminal, Gateway or Multipoint Conference Unit (MCU).
Gateway	Devices bridging between the IP Cablecom IP Voice Communication world and the PSTN. Examples are the Media Gateway, which provides the bearer circuit interfaces to the PSTN and transcodes the media stream, and the Signaling Gateway, which sends and receives circuit switched network signaling to the edge of the IP Cablecom network.
Trunk	An analog or digital connection from a circuit switch that carries user media content and may carry voice signaling (M_F , R_2 , etc.).

4 ABBREVIATIONS AND ACRONYMS

This specification uses the following abbreviations:

CAS	Channel Associated Signaling
CMS	Call Management Server
CMTS	Cable Modem Termination System
DID	Direct Inward Dialing
DOD	Direct Outward Dialing
DTMF	Dual-tone Multi Frequency (tones)
GS	Ground-start
LS	Loop-start
MTA	Multimedia Terminal Adapter
NCS	Network-based Call Signaling
PBX	Private Branch Exchange
PAT	IPCablecom Analog Trunking (package)
RLCF	Reverse Loop Current Feed

5 OVERVIEW

This specification describes the functional requirements for an embedded client to support one-way incoming, one-way outgoing, and two-way PBX trunks. The physical interfaces used to support these trunk types are also defined.

5.1 Functional Responsibility

To maintain compliance with the IPCablecom NCS specification [NCS], the Call Agent will remain responsible for all higher order functionality whenever possible. Only when timing is critical will the endpoint be responsible for the required functionality. For example, the endpoint is expected to out-pulse a string of successive digits when requested by the Call Agent. In this case, the endpoint is responsible for the timing of the duration of each digit and the delay between them.

The endpoint is also responsible for all timing requirements related to the start method in use – wink, delay or immediate. In fact, the start method used by the interface is transparent to the Call Agent.

5.2 Physical Endpoint Interface

Various physical interfaces provided by an endpoint of an MTA are used to support the following PBX trunks:

- One-way incoming trunk – supports calls originating from the network towards the PBX via the MTA. A specific example of a one-way incoming trunk is a DID PBX trunk which **MUST** be provided using a DID PBX physical interface.
- One-way outgoing trunk – supports calls originating on the PBX towards the network via the MTA. A specific example of a one-way outgoing trunk is a DOD PBX trunk which **MAY** be provided over a number of physical interfaces.
- Two-way trunk – supports calls originating and terminating on the PBX via the MTA. A four-wire E&M physical interface is typically used to support two-way PBX trunks; however, other interfaces **MAY** also be used.

The following sections describe each physical interface that may be provided on an MTA to support one or more of the above defined PBX trunks.

5.2.1 Loop-Start Line Interface

The NCS Line package defined in the IPCablecom NCS specification [NCS] is used to support loop-start lines. Loop-start lines are typically used for residential voice services, but **MAY** be used to support analog trunking for PBX.

5.2.2 Ground-Start Line Interface

Ground-start signaling interfaces are used to provide two-way service to customer-installation switching systems, e.g., legacy PBX systems.

According to [ANSI 401] ground-start signaling for two-way dial facilities was introduced to reduce the likelihood of seizure of the line at both ends during the silent interval of the alerting signal. Ground-start signaling is typically used on one-way or two-way seizure PBX lines with Direct Outward Dialing (DOD) and attendant-handled incoming call service. Ground-start lines are also used for automatically originated data service. The two-wire ground-start line conductors transmit common-battery loop supervision, loop dial pulses or DTMF address signals, alerting signals, and voice-band signals. Ground-start lines are often used rather than loop-start lines for the following reasons:

- To avoid simultaneous seizure, i.e., glare conditions.
- To allow the application of a dc voltage between tip and ring and the closure of a path from the tip conductor to ground as a start dial signal.
- To provide a positive indication of network disconnect.

See [ANSI 401] for the network interface requirements for ground-start access lines.

5.2.3 DID PBX Trunk Interface

A one-way Direct Inward Dialing (DID) trunk interface as described in [TIA] is required to support a DID interface of a PBX. DID trunks can only make calls in the direction from the network towards the PBX.

Electrically, a DID trunk looks similar to the reverse of a 2-wire loop-start interface. The PBX provides loop current by applying -48 volt battery to the ring lead and grounding the tip lead. The MTA signals off-hook and on-hook towards the PBX by closing and opening the loop. The PBX signals answer supervision (off-hook) by reversing battery and ground on the tip and ring leads [ANSI 405]. The PBX signals call release (on-hook) by restoring battery to ring and ground to tip. Since this is a one-way trunk, there is no ringing voltage as seen on a loop-start interface.

The MTA may dial using either dial-pulse at 10 pulses per second with 300 ms between digits or DTMF at 10 tones per second. Dial-pulse may be done either by opening and closing the loop in a manner similar to loop-start dialing; or it may use battery and ground pulsing. With dial-pulse interfaces, the network typically only dials the last 2 or 3 address digits to minimize call setup delay.

The interface has three methods for start of dialing:

- Immediate start – The MTA starts dial-pulsing shortly after closing the loop indicating off-hook condition. This method cannot be used for DTMF.
- Wink start – The MTA waits for the PBX to signal that it is ready to accept digits. The signal from the PBX is a 200 ms battery reversal (off-hook).
- Delay start – The MTA waits for the PBX to signal that it is ready to accept digits. The signal from the PBX is a battery reversal of at least 100 ms (off-hook) followed by restoration of battery (on-hook) some time later.

Of the three start-of-dialing methods, wink start is most common.

5.2.4 E&M

E&M is described in Annex F of [TIA] and is typically used as a PBX tie trunk. E&M trunks may be configured to be 2-way or 1-way. Signaling may be either dial pulse or DTMF. The interface is extremely simple and only off-hook and on-hook are signaled in each direction. The PBX signals off-hook and on-hook on the M-lead (Mouth) and listens for off-hook and on-hook signals on the E-lead (Ear). The three dialing methods found in DID are also used in E&M.

The interface has three methods for start of dialing:

- Immediate start – The calling side of the interface goes off-hook. It starts dial pulsing shortly afterwards (at least 65 mSec). This method cannot be used for DTMF.
- Wink start – The calling side goes off-hook and waits for the called side to signal that it is ready to accept digits. The signal from the called side is a 200 mSec off-hook wink.