ITU - Telecommunication Standardization Sector Temporary Document CI-032

STUDY GROUP 15 Original: English

Chicago, 6-9 April 1998

Question: 4/15

SOURCE[1]: MATSUSHITA ELECTRIC INDUSTRIAL CO. LTD. (JAPAN)

TITLE: SPECTRUM AND ACTIVATION CONSIDERATIONS FOR G.HS

ABSTRACT

This contribution begins with a review of the upstream and downstream PSD requirements of xDSL services co-mingled with POTS or ISDN services. Implications of the xDSL PSDs on the G.hs PSD are discussed. Spectrum allocation for G.hs signals as well as modulation parameters are proposed.
(This paper will address points #1 and #3 of the G.hs Call for Papers)

1. Introduction:

G.hs will be used to initiate or activate many types of existing and future xDSL services, therefore requirements from the various xDSL services should be carefully considered in the design of G.hs. This contribution addresses two inter-related considerations: spectrum and activation methods. For G.hs, suitable bands must be selected for transmission of the negotiation and user data channels. Those bands need to be selected with consideration to the existing overall PSDs of the xDSL services and also to the activation signals of existing xDSL services.

This contribution is organized as follows: Section 2 reviews the spectra of several xDSL services. Section 3 is a discussion of the spectra and assumptions. Section 4 contains specific proposals for the G.hs spectrum.

[1] Contact: Stephen Palm
Matsushita Graphic Communication Systems
T: +81 3 5434 7090
F: +81 3 5434 7158
E: palm@itu.ch

2. Preliminary Survey of Existing Spectra and Activation

Various spectra of xDSL and existing services that might be negotiated by G.hs are shown in Table 1. These number are based on the referenced documents with example PSDs shown in Figure 1 through Figure 3.
For the purposes of this contribution (and possibly later in G.hs) we indicate the "upstream" and "downstream" directions using the nomenclature from the various xDSL services in Table 2.
Table 3 lists the initiating activating sequences.

Things to do for the Tables:

- fill-in and correct the applicable xDSL services
- fill-in the effective bandwidths (BW) in Table 1.
- provide (better) reference documents for national items

Table 1. Preliminary survey of existing spectra

Item	Modulation (Document)	Total Bandwidth		Upstream Bandwidth		Down Stream Bandwidth	
		Lower (kHz)	Upper (kHz)	Lower (kHz)	Upper (kHz)	Lower (kHz)	Upper (kHz)
P-1	G.dmt with POTS	26	1,104	26	138	26	1,104
I-1	G.dmt with ISDN-MMS-43 (G.961 Appendix I)	? 150	1,104				
I-2	G.dmt with ETR 080 Annex B (4B3T)	? 300	1,104				
I-3	G.dmt with ETR 080 Annex A (2B1Q)	? 300	1,104				
I-4	G.dmt with NA ISDN-2B1Q (G.961 Appendix II) (North America)	? 90	1,104				
I-5	G.dmt next to ISDN-TCM (G.961 Appendix III) (Japan ping pong)	? 26	1,104	??? 26	?1,104		1,104
I-6	G.dmt next? to ISDN-SU32 (G.961 Appendix IV)						
A-1	T1.413 Cat 1 w/ Analog filters				? 103	? 138	
L-1	G.lite	26	???				
L-2	DMT with only 64 tones	26	276				
L-3	DMT with only 128 tones	26	552				
H-1	G.hdsl						
H-2	G.hdsl CAP one-pair	62	390				
H-3	G.hdsl CAP two-pair	39	237				
H-4	G.hdsl 2B1Q						
H-5	HDSL2		? 375		? 245		? 375
V-1	VDSL (with European ISDN) DTS/TM-06003-1(draft) V0.0.7 (1998-2) Section 8.2 Frequency plan	300	30,000	300	30,000	300	30,000

Figure 1. Information from ETR 080, Annex A (2B1Q)

A.12.4 Power spectral density

The upper bound of the power spectral density of the transmitted signal shall be as shown in figure A.12. Measurements to verify compliance with this requirement are to use a noise power bandwidth of 1,0 kHz.

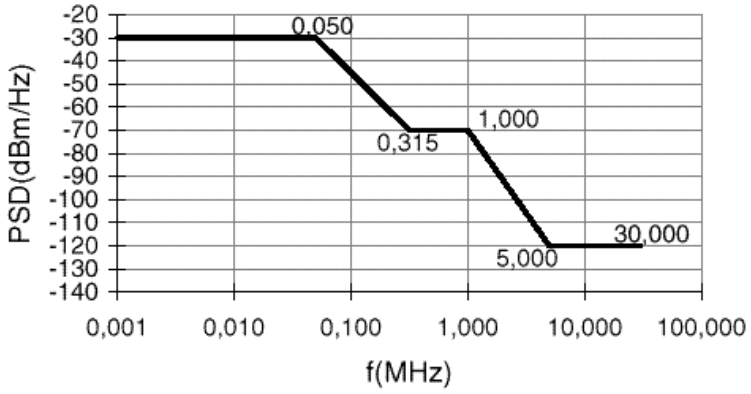


Figure A.12: Upper bound of power spectral density from NT1 and LT.

Systems deployed before January 1, 2000, do not have to meet this PSD requirement but shall meet the PSD requirements as defined in ETR 080 edition 2. It is however expected that these systems will also meet the PSD requirements of TS 080 edition 3. Some narrowband violations could occur and should be tolerated.

Figure 2. Information from ETR 080, Annex B (4B3T)

B.12.4 Power spectrum

The upper bound of the power spectral density shall be limited according to figure B.5. Measurements to verify compliance with this requirement are to use a bandwidth of 9 kHz.

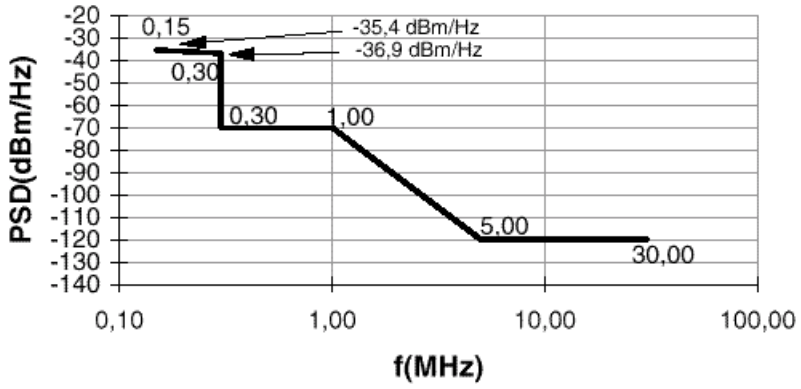


Figure B.5: Upper bound of power spectral density from NT1 and LT.

Systems deployed before January 1, 2000, do not have to meet this PSD requirement but shall meet the PSD requirements as defined in ETR 080 edition 2. It is however expected that these systems will also meet the PSD requirements of TS 080 edition 3. Some narrowband violations could occur and should be tolerated.

Figure 3. Information from ETSI DTS/TM-06003-1 (VDSL)

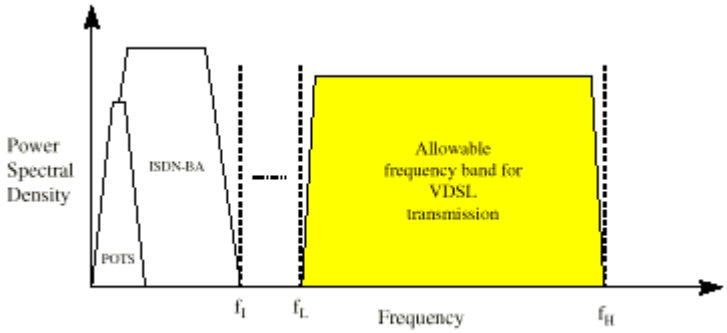


Figure 8 : Frequency plan for VDSL

Table 1 : Upper and lower frequency limits for VDSL

Class of VDSL operation	f_L lower limit (kHz)	f_H upper limit (MHz)
I (asymmetric)	300	30
II (symmetric)	300	30

Table 2. Definitions of Upstream and Downstream

Modulation (Document)	Upstream	Downstream
G.dmt	xTU-R → xTU-C	xTU-C → xTU-R
T1.413 Cat 1 w/ Analog filters	ATU-R → ATU-C	ATU-C → ATU-R
G.lite	xTU-R → xTU-C	xTU-C → xTU-R
DMT with only 64 tones	xTU-R → xTU-C	xTU-C → xTU-R
G.hdsl	NTU → LTU	LTU → NTU
HDSL2	NTU → LTU	LTU → NTU
VDSL (with European ISDN) DTS/TM-06003-1(draft) V0.0.7 (1998-2)	NT → ONU (LT)	ONU (LT) → NT-R
Notes: xTU-R, NTU, NT indicate customer side xTU-C, LTU, ONU indicate network side		

Table 3. Activation signals of existing xDSLs

Modulation (Document)	Initiator	Responder	Reference
G.dmt	None - will use G.hs		
G.lite	None - will use G.hs		
T1.413 Issue 1	R-ACT-REQ 34.5 kHz sinusoid with cadence of: 128 symbols on 64 symbol @ –2 dBm (~16ms) 64 symbol @ –22 dBm (~16ms) 896 symbols off (~221ms)		Issue#1 - 12.3.1
T1.413 Issue 2	(same as Issue 1)		Issue #2 Section 9.3.1
RADSL CAP	RTU-R transmits RSO+trailer (pseudo noise at symbol rate)		
G.hdsl (2B1Q)	LTU transmits S0	NTU transmits S0	Figure 11,Section 5.6, draft G.hdsl (TD-38)
G.hdsl (CAP - Annex B)	LTU transmits CS0 3150 symbols of pseudo noise at symbol rate	NTU transmits RS0 3150 symbols of pseudo noise at symbol rate	Section B.5.6
HDSL2	??		
VDSL DTS/TM-06003-1(draft)			Not defined yet

3. Discussion

3.1 G.hs bandwidth requirements

Given the following assumptions for G.hs :

- FSK or similar modulation (NRZI encoding to prevent long strings of 0's to cause loss of synchronization.)
- Frequency Division Multiplexing (FDM) of all channels.
- User data channels are independent of negotiation channel
- each channel having a bit rate of approximately 10k bits/sec

it would seem that G.hs would require four 10kHz bands of spectrum for the upstream and downstream negotiation and user channels.

3.2 Mutually exclusive

Assuming:

- some devices will only implement a single xDSL (so that they have filter very closely specified to the specific PSD)
- there may be requirements for G.hs to adhere to the same PSD as the xDSL
- some of the xDSLs place tighter requirements on the upstream PSD

we see that there is no band common to all of the xDSL configurations.

An extreme example is the combination of the requirements for A-1 and V-1 or I-1. A-1 requires the upstream to be below 103 kHz and V-1 requires the upstream to be above 300 kHz.

If one excludes the requirements for V-1 and I-1, the combination of the requirements for A-1 and I-4 prevent the allocation of two (negotiation and data) upstream channels. I-4 upstream must be greater than 90 kHz and A-1 upstream must be less than 103kHz.

Finally the PSDs for the European ISDN-BA (I-2, I-3) seem to indicate that frequencies above 300 kHz will be necessary.

4. Proposals for G.hs Spectrum and Activation

4.1 Definitions

4.1.1 Primary group

The primary group of frequencies occurs above 300 kHz. And below 400 kHz.

4.1.2 Secondary group

The secondary group of frequencies tries to adhere to the T1.4132 Cat 1 PSD and the North American ISDN-BA.

4.1.3 Voiceband group

The voice band group of frequencies is 0 through 4KHz

4.1.4 Pairing

The upstream and downstream channels for a given are considered as a pair. Thus, there is a negotiation channel upstream and down stream pair. Likewise, A user data channel upstream and downstream pair

4.2 Proposal Points

4.2.1 Relative Frequencies

In the initialization process, the lower frequency band of a pair will be assigned to the upstream channel and the upper frequency band of the pair will be assigned to the downstream channel.

4.2.2 Either terminal initialization

Either terminal can instigate the activation provided that it realizes if it is an customer device or network device so as to correctly assign the upstream and downstream roles

4.2.3 Initialization vis-à-vis groups

When it is within a terminal unit's capability to do so, G.hs initiates and responds to initiation using signals in the primary group of frequencies. If a terminal unit fails to receive a response in the primary group or it is not capable of communication in the primary group, the secondary group should be used. If the secondary group is also unusable, the devices may attempt communication via voice band group protocols such as V.8 or V.8bis. Voice band communication availability can be tested with spread spectrum techniques.

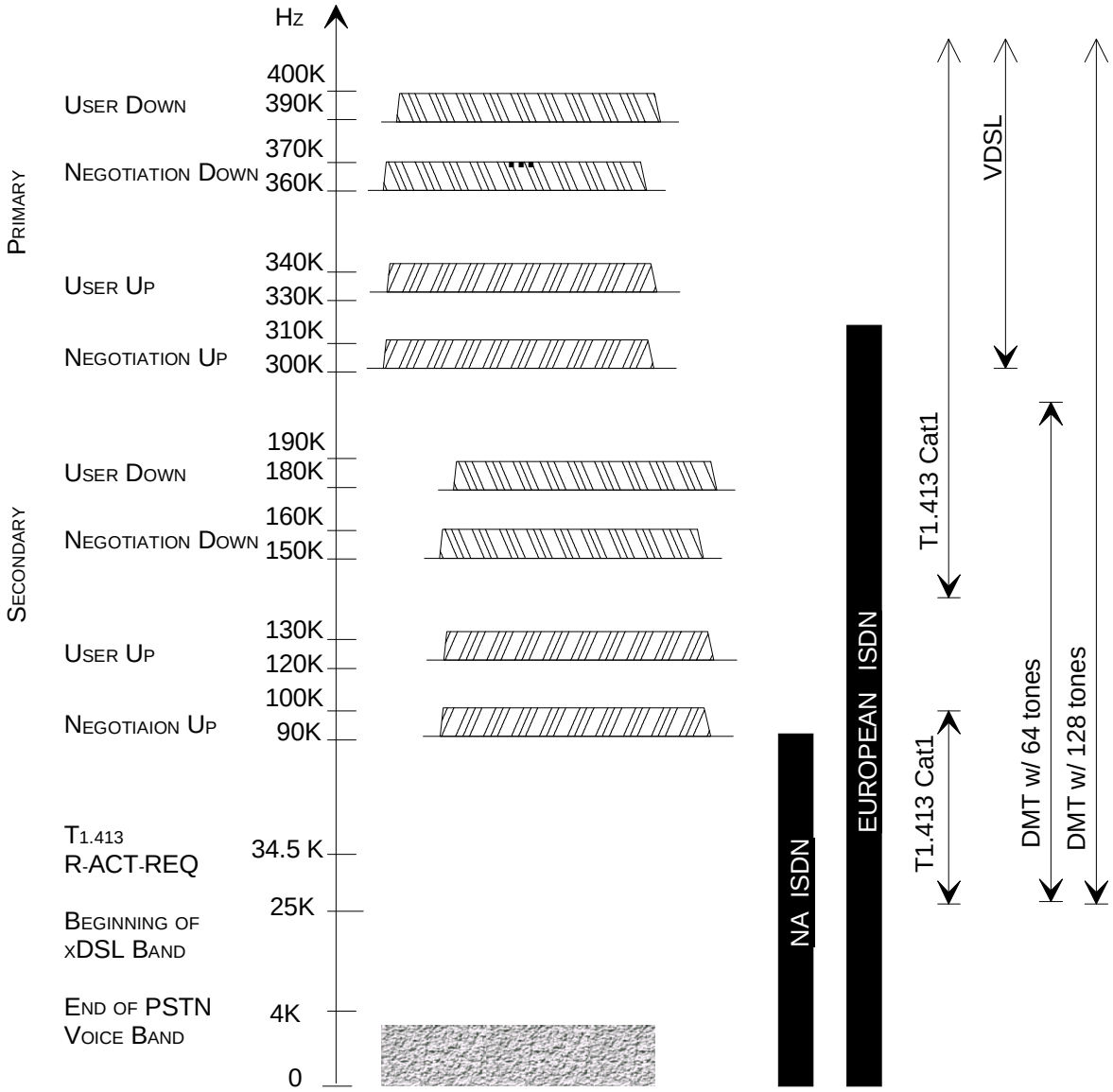
4.2.4 Group Frequency proposals

Table 4 describes two possible sets (primary group and secondary group) of the frequencies.. Note that the user and negotiation upstream frequencies have been placed adjacent to each other to facilitate easier filtering. Figure 4 summarizes the spectra information in graphical form.

Table 4. Frequency Plan

	Negotiation		User Data	
	Lower (kHz)	Upper (kHz)	Lower (kHz)	Upper (kHz)
Primary low (upstream)	300	310	330	340
Primary high (downstream)	360	370	390	400
Secondary low (upstream)	90	100	120	130
Secondary high (downstream)	150	160	180	190

Figure 4. Combined Spectra



4.2.5 Fallback Methods

Specify how to interoperate with existing xDSL specifications. (See Table 3.)

Basically start with the G.hs tones. If no response, try an existing activation signal (implementation dependent).

4.3 Proposed Algorithm

Some *very preliminary* example flow charts of portions of the above points are contained in Figure 5and Figure 6.

Figure 5. Central terminal powers on first with fallback

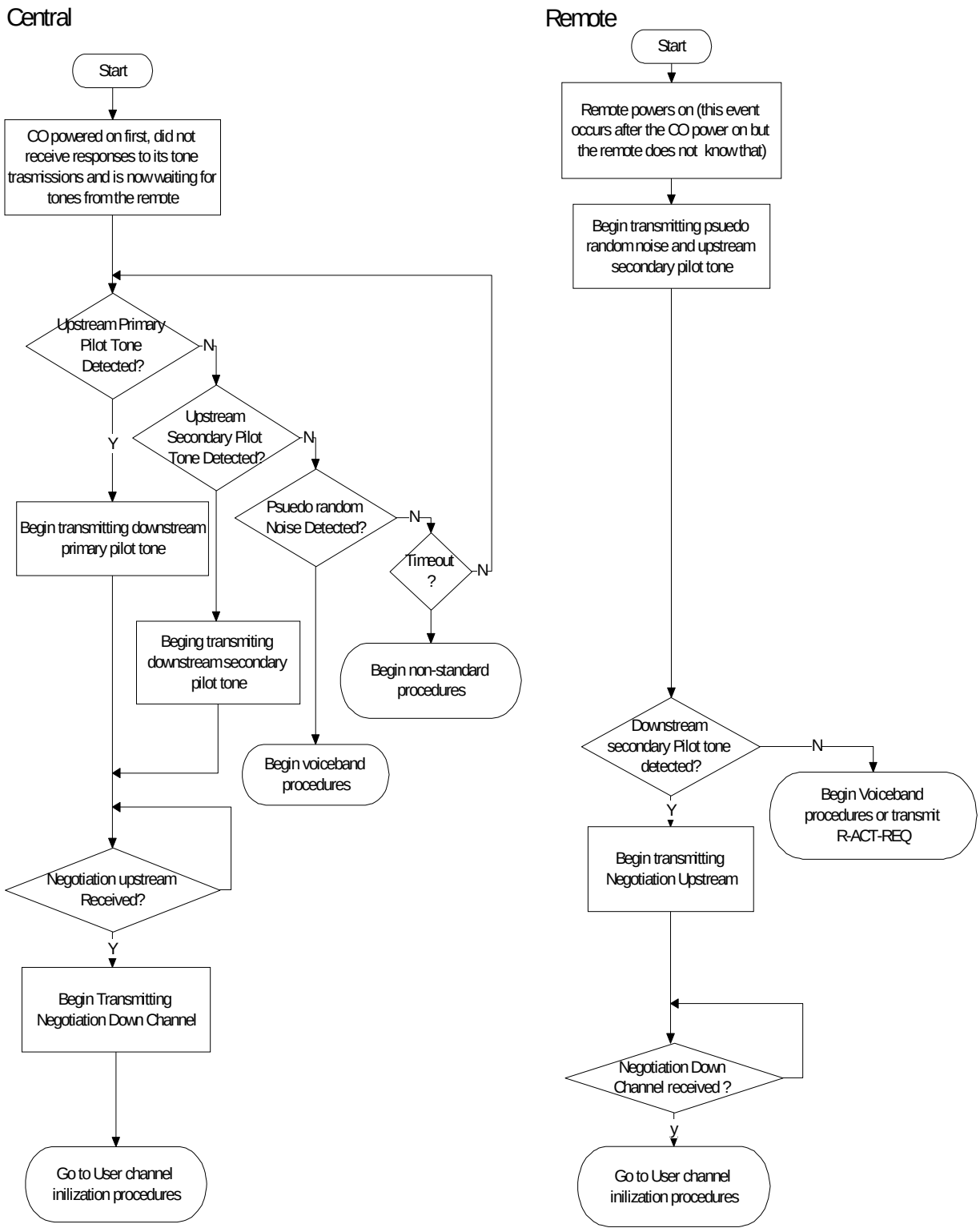
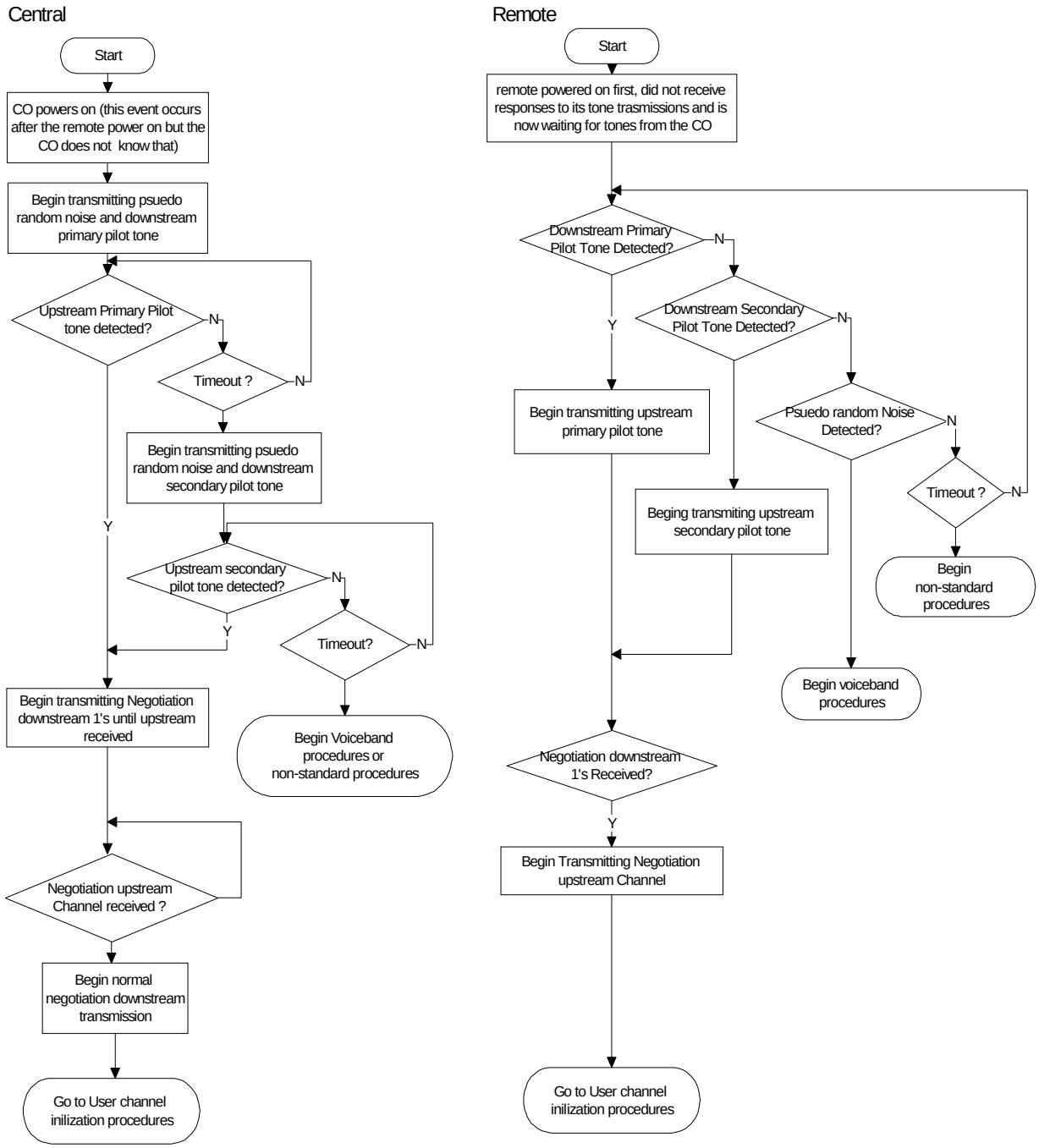


Figure 6. Remote Terminal Powers on First



5. Summary:

Use of the primary group seems to be the most universal for current and future xDSL terminals.

Use of only the primary group and not defining a secondary group will make for an easier startup mechanism.

1. Agenda Item: G.hs spectrum
2. Expectations: Come to an agreement on the G.hs spectrum/PSD open issue that would become a term of reference.