ITU - Telecommunication Standardization Sector Temporary Document **NG-103**

STUDY GROUP 15

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Question(s): 4/15

SOURCE[1]: Matsushita

TITLE: G.gen: Power Back Off (PBO) measurement for G.shdsl and G.vdsl

ABSTRACT

This contribution was motivated by NG-062 which proposes to use G.hs to negotiate and indicate parameters for Power Back Off (PBO) measurements. While NG-062 proposes some potentially useful signals and timing for the actual power measurement signals, the suggested method of using G.hs messages seemed to be inappropriate. Specifically, the contents of the CLR and CL messages has previously been used to *indicate/express* the capabilities of the transmitting modem whereas NG-062 suggests that CLR/CL octets (also?) be used to *request* behavior from the opposite HSTU-X. Since changing the functionality of messages is likely to lead to new message types and amending G.hs, this contribution proposes several different methods of using unmodified G.hs messages. Some previous proposals for performing PBO measurements using new G.hs messages and transactions was presented in D.565.

1. Introduction

In the interest of expediency, we may assume that the Q4/15 committee may just want to add codepoints to G.hs in order to facilitate Power Back Off (PBO) measurements. Codepoints can easily be added without the tedious decision process, while adding messages and transaction to G.hs may require more time to complete. This contribution present proposals for PBO measurements using the existing messages and transactions in G.hs. In these proposals, the PBO measurement signals are viewed as a mode (or modulation) that the HSTU-X negotiate and select. After the PBO measurement signals have been sent, G.hs restarts to negotiate and select the appropriate xDSL modulation. Although others have suggested related approaches, the current proposals would require modification to the definitions of the messages and transactions.

This contribution presents several proposals of increasing complexity. First a very simple session using standard parameters and only a few message exchanges is proposed. If the xTU-x are going to require more sophisticated control of the character and timing of the signals, complexity increases as additional message exchanges are necessary.

Finally if we assume that we want to initially send low power signals, the PBO session algorithms must gracefully deal with lack of signal reception and have a method to indicate when it receiving sufficiently high enough power signals.

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This contribution address the following agreed and open issues:

G.shdsl (BM-015R1)

Agreed	4.11	G.shdsl shall provide for automatic transmitted power cutback in both upstream and downstream directions.
Agreed	7.2	a preactivation communication channel shall be established.
	(4.11.1)	Should a power control procedure based on a power control digital link be used in G.shdsl? (This issue is covered by Item 7.2.)

G.vdsl (BM-021R3)

Agreed	8.2,	Upstream power control procedure shall be applied to G.vdsl.
Agreed	8.5	A power control procedure with a message link may be very useful to reach a proper Power Back Off (PBO) implemetation (e.g. Politeness, off hook cutback)
Open	8.1	What Power Management and Power Cutback methods should be specified?
Open	8.3	Should Power Back Off (PBO) be used for downstream?
Open	8.6	Should the power back-off (PBO) in the upstream of G.vdsl be performed with a method that uses target bit rates as parameters ?

G.lite.bis (BM-018R2

Agreed	13.2	A power control procedure with a message link may be very useful to reach a proper power back off implementation (e.g., politeness and fast retrain cutbacks).

The agreements clearly indicate that automated power control procedure is needed for G.shdsl, G.vdsl, and G.lite.bis. Several goals are suggested:

- A method that starts with **small** signals that still allows loss and power measurements
- A method that is common among the various xDSL
- A method that allows independent upstream and downstream measurement to independently control upstream and downstream power.
- A method that provides direct feedback of the power control information using protocol-level bits.
- A method that allows programmable (e.g. frequency content, power level, duration) wide band probe signals suitable for each DSL (including any specific variations needed due to variation in deployment scenarios).
- A method that allows DSLs that include repeaters to be addressed, for example, through simple protocol extensions to address each segment.
- A method that allows upstream or downstream power control that can be enabled and disabled easily.

There are several ways of defining procedures that accomplish those goals. Four basic ideas using G.hs "As Is" are presented:

2. Power Back Off Measurement Procedures

In the recently approved G.hs, the only message that can send a request with parameters is the MS message. Although messages such as MR, REQ-MR, REQ-MR, and REQ-CLR are "requesting" action by the opposite HSTU-X, those messages do not contain parameter octets. Similarly, while a CLR message is requesting the HSTU-C to send a CL, the parameters in the CLR message describe the HSTU-R and there is no means to ACK/NAK "requests" that might attempted to be made in the octets. Only CLR protocol errors can be NAK'd, not the contents of the octets. That leaves only MS messages to make parameter and mode requests.

Power Back Off measurements methods with fixed power level signals and stepped power level signals are described. Additionally two types of G.hs negotiation are described.

2.1 Fixed power level measurements

2.1.1 Standard Parameters

This simple means of operation assumes that a standard set of parameters for both upstream and downstream measurement signal characteristics is being requested. While the HSTU-X sending the MS could send explicit parameters about the signal it wants to receive, the other side would not have that opportunity. Thus one item of a prefabricated set for both sides is proposed by the HSTU-X sending the MS and the other side merely ACKs or NAKs it.

A HSTU-x would set a SPar(2) bit under each of the xDSL modulations knowing that the PMMS of the particular xDSL will return control to G.hs after the transmission of the PMM signals. After the opposite side ACKs, the G.hs session would terminate as per §11.3 and then the PMM signals would be sent. First the xTU-R would send signals and then the xTU-C would send signals. The characteristics and timing of the signals must be predetermined.

After each side has performed their measurements and analysis, the must inform the opposite side on their specific value request of the PBO. Again this is a request with parameters so it would require each side to send an MS in the current G.hs or for one (or both) of the PBO requests to be made after a single MS message.

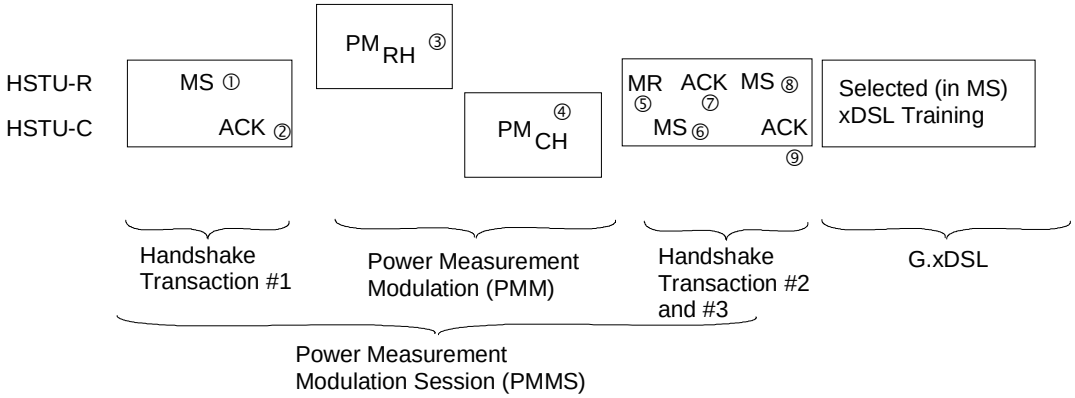


Table 1. PMMS - standard measurements

Transmit Unit	Message / Signal Name	#	Description
HSTU-R	MS	1	The message: • is a request for the HSTU-C and HSTU-R to send the power measurement modulation session (PMMS) signals (PM_{CH} and PM_{RH}) • includes the category choice which represents the parameters of the desired signal (PM_{CH} and PM_{RH}) to be transmitted.
HSTU-C	ACK	2	The message Acknowledges selection of PMMS
HSTU-R	PM_{RH}	3	This signal allows the HSTU-C to measure the line conditions and power loss
HSTU-C	PM_{CH}	4	This signal allows the HSTU-R to measure the line conditions and power loss
HSTU-R	MR	5	a request the HSTU-C to send an MS.
HSTU-C	MS	6	conveys the upstream PBO request
HSTU-R	ACK	7	The message Acknowledges the upstream PBO request value
HSTU-C	MS	8	The message: is a request for a specific xDSL modulation mode. contains a parameter request a certain amount of PBO in the downstream direction
HSTU-C	ACK	9	The message Acknowledges selection of the xDSL using the specified downstream PBO
-	Training	-	Training begins

The contents of the MS messages are using G.shdsl as an example, but it can be used for any of the xDSL.. The octet coding of the MS messages is shown in Table 2 through Table 7. The procedure with example contents is shown in Table 8.

Table 2. Standard information field - SPar(1) coding

SPar(1)s	8	7	6	5	4	3	2	1
G.992.1 - Annex A	x	x	x	x	x	x	x	1
G.992.1 - Annex B	x	x	x	x	x	x	1	x
G.992.1 - Annex C	x	x	x	x	x	1	x	x
G.992.2 - Annex A/B	x	x	x	x	1	x	x	x
G.992.2 - Annex C	x	x	x	1	x	x	x	x
G.SHDSL	x	x	1	x	x	x	x	x
Reserved	x	1	x	x	x	x	x	x
No parameters in this octet	x	0	0	0	0	0	0	0

Table 3. G.SHDSL SPar(2) coding

G.SHDSL NPar(2)s	8	7	6	5	4	3	2	1
G.SHDSL PMMS initiate (measure using set #)	x	x	x	x	x	x	x	1
G.SHDSL Upstream PBO	x	x	x	x	x	x	1	x
G.SHDSL Downstream PBO	x	x	x	x	x	1	x	x
G.SHDSL Initiate training	x	x	x	x	1	x	x	x
Reserved	x	x	x	1	x	x	x	x
Reserved	x	x	1	x	x	x	x	x
No parameters in this octet	x	x	0	0	0	0	0	0

Table 4. G.SHDSL PMMS initiate - NPar(3) coding

G.SHDSL PMMS initiate - NPar(3)	8	7	6	5	4	3	2	1
G.SHDSL PMMS set #1 (all carriers)	x	x	x	x	x	x	x	1
G.SHDSL PMMS set #2 (all V128 carriers)	x	x	x	x	x	x	1	x
G.SHDSL PMMS set #3 (all V138 carriers)	x	x	x	x	x	1	x	x
G.SHDSL PMMS set #4 (all A4 and P4 carriers)	x	x	x	x	1	x	x	x
G.SHDSL PMMS set #5 (all P4 carriers)	x	x	x	1	x	x	x	x
Reserved	x	x	1	x	x	x	x	x
No parameters in this octet	x	x	0	0	0	0	0	0

Table 5. G.SHDSL Upstream PBO - NPar(3) coding

G.SHDSL Upstream PBO - NPar(3) coding	8	7	6	5	4	3	2	1
Upstream PBO (dB) (bits 6-1 x 1dB)	x	x	x	x	x	x	x	x
Reserved	x	x	1	1	1	1	1	1

Table 6. G.SHDSL Downstream PBO - NPar(3) coding

G.SHDSL Upstream PBO - NPar(3) coding	8	7	6	5	4	3	2	1
Downstream PBO (dB) (bits 6-1 x 1dB)	x	x	x	x	x	x	x	x
Reserved	x	x	1	1	1	1	1	1

Table 7. G.SHDSL training parameters - NPar(3) coding

G.SHDSL training parameters - NPar(3)	8	7	6	5	4	3	2	1
G.SHDSL parameter #1	x	x	x	x	x	x	x	1
G.SHDSL parameter #2	x	x	x	x	x	x	1	x
G.SHDSL parameter #3	x	x	x	x	x	1	x	x
G.SHDSL parameter #4	x	x	x	x	1	x	x	x
G.SHDSL parameter #5	x	x	x	1	x	x	x	x
Reserved	x	x	1	x	x	x	x	x
No parameters in this octet	x	x	0	0	0	0	0	0

Table 8. PMMS - fixed power measurements procedure

Transmit Unit	Name	#	Contents of octets
HSTU-R	MS	1	Table 2 x010 0000 (Select GVDSL) Table 3 xx00 0001 (start PMMS measurements) Table 4 xx00 0001 (all carriers) Table 5 N/A Table 6 N/A Table 7 N/A
HSTU-C	ACK	2	The message Acknowledges selection of PMMS
HSTU-R	PM_{RH}	3	
HSTU-C	PM_{CH}	4	
HSTU-R	MR	5	Request MS
HSTU-C	MS	6	Table 2 x010 0000 (Select GVDSL) Table 3 xx00 0010 (upstream PBO) Table 4 N/A Table 5 xx00 0110 (6 dB) Table 6 N/A Table 7 N/A
HSTU-R	ACK	7	The message Acknowledges the upstream PBO request value
HSTU-C	MS	8	Table 2 x010 0000 (Select GVDSL) Table 3 xx00 1100 (downstream PBO & initiate traing) Table 4 N/A Table 5 xx00 0110 (6 dB) (repeat) Table 6 xx00 0111 (7 dB) Table 7 xxxx xxxx
HSTU-C	ACK	9	The message Acknowledges selection of the G.SHDSL using the specified downstream PBO
-	Training	-	G.SHDSL training begins.

2.1.2 Explicit Parameters

Similar but requires another G.hs transactions. PMMS session is selected by each side in succession and all of the various explicit parameters of their desired receive set are transmitted

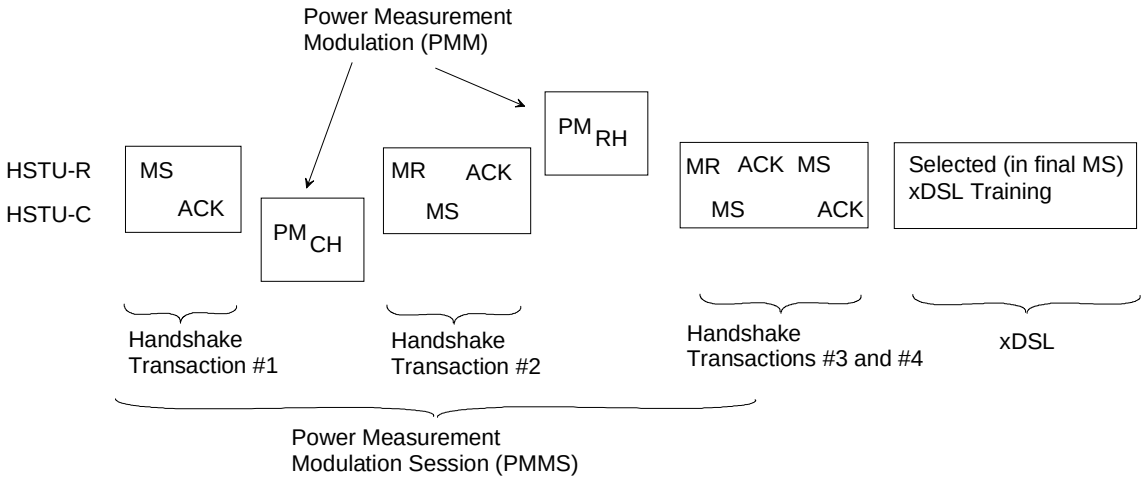


Table 9. PMMS - explicit parameters

Transmit Unit	Message / Signal Name	HS #	Description
HSTU-R	MS	1	• is a request for the HSTU-C to send the power measurement modulation session (PMMS) signals PM_{CH} • includes the explicit details on the parameters of the desired signal (PM_{CH}) to be transmitted.
HSTU-C	ACK	1	The message Acknowledges selection of PMMS
HSTU-C	PM_{CH}	-	This signal allows the HSTU-R to measure the line conditions and power loss
HSTU-R	MR	2	• the HSTU-R is done receiving PM_{CH} • is a request the HSTU-C to send an MS.
HSTU-C	MS	2	• is a request for the HSTU-R to send the power measurement modulation session (PMMS) signals PM_{RH} • includes the explicit details on the parameters of the desired signal (PM_{RH}) to be transmitted.
HSTU-R	ACK	2	The message Acknowledges selection of PMMS
HSTU-R	PM_{RH}	-	This signal allows the HSTU-C to measure the line conditions and power loss
HSTU-R	MR	3	a request the HSTU-C to send an MS.
HSTU-C	MS	3	conveys the upstream PBO request
HSTU-R	ACK	3	The message Acknowledges the upstream PBO request value
HSTU-C	MS	4	• is a request for a specific xDSL modulation mode. • contains a parameter request a certain amount of PBO in the downstream direction
HSTU-C	ACK	4	Acknowledges selection of the xDSL using the specified downstream PBO
-	Training	-	Training begins

The octet coding of the MS messages is shown in Table 2 through Table 7 and Table 10 through Table 12. The procedure with example contents is shown in Table 13. Power levels are expressed in 3 bits as shown in Table 11. The power level for each carrier is coded in Table 12

Table 10. PM_X signal duration -NPar(2) coding

PM_X signal duration -NPar(2) coding	8	7	6	5	4	3	2	1
PM_X signal duration (bits 6-1 x 20 msec)	x	x	x	x	x	x	x	x
Reserved	x	x	1	1	1	1	1	1

Table 11. Power level encoding bits

Code	Description
000	not transmitted
001	-60 dBm (per carrier)
010	-50 dBm (per carrier)
011	-40 dBm (per carrier)
100	-30 dBm (per carrier)
101	-20 dBm (per carrier)
110	-10 dBm (per carrier)
111	Nominal

Table 12. Carrier Transmit Power {NPar(2)} coding

Power			8	7	6	5	4	3	2	1
Octet #1	#009	#012	x	x	x	x	x	x	x	x
Octet #2	#014	#017	x	x	x	x	x	x	x	x
Octet #3	#025	#037	x	x	x	x	x	x	x	x
Octet #4	#040	#045	x	x	x	x	x	x	x	x
Octet #5	#053	#056	x	x	x	x	x	x	x	x
Octet #6	#064	#072	x	x	x	x	x	x	x	x
Octet #7	#088	#096	x	x	x	x	x	x	x	x
Octet #8	#115	#138	x	x	x	x	x	x	x	x
Octet #9	#165	#198	x	x	x	x	x	x	x	x
Octet #10	#238	#255	x	x	x	x	x	1	1	1

Table 13. PMMS - explicit measurements procedure

Transmit Unit	Name	#	Contents of octets
HSTU-R	MS	1	Table 2 x010 0000 (Select G.SHDSL) Table 3 xx00 0001 (start PMMS measurements with PM_{CH}) Table 10 xx00 0001 (duration) Table 12 xx00 1001 (favorite carriers) Table 5 N/A Table 6 N/A Table 7 N/A
HSTU-C	ACK	1	The message Acknowledges selection of PMMS
HSTU-C	PM_{CH}	-	This signal allows the HSTU-R to measure the line conditions and power loss
HSTU-R	MR	2	• the HSTU-R is done receiving PM_{CH} • is a request the HSTU-C to send an MS.
HSTU-C	MS	2	Table 2 x010 0000 (Select G.SHDSL) Table 3 xx00 0001 (start PMMS measurements with PM_{RH}) Table 10 xx00 0001 (duration) Table 12 xx00 1001 (favorite carriers) Table 5 N/A Table 6 N/A Table 7 N/A
HSTU-C	ACK	2	The message Acknowledges selection of PMMS
HSTU-R	PM_{RH}	-	This signal allows the HSTU-C to measure the line conditions and power loss
HSTU-R	MR	3	Request MS
HSTU-C	MS	3	Table 2 x010 0000 (Select G.SHDSL) Table 3 xx00 0010 (upstream PBO) Table 4 N/A Table 5 xx00 0110 (6 dB) Table 6 N/A Table 7 N/A
HSTU-R	ACK	3	The message Acknowledges the upstream PBO request value
HSTU-C	MS	4	Table 2 x010 0000 (Select G>SHDSL) Table 3 xx00 1100 (downstream PBO & initiate training) Table 4 N/A Table 5 xx00 0110 (6 dB) (repeat) Table 6 xx00 0111 (7 dB) Table 7 xxxx xxxx
HSTU-R	ACK	4	The message Acknowledges the downstream PBO request value
-	Training	-	G.SHDSL training begins

2.2 Stepped power level measurements

In the measurements of § 2.1, fixed power signals are sent. Since long distance or high attenuation must be allowed for, the signals can often be overly powerful for in many loops. This section described methods were the broadband measurement power is gradually increased until a sufficient measurement can be made.

2.2.1 Stepped with Standard parameters

Similar to §2.1.1 method except that the power levels are progressively stepped up. The power stepping continues until the opposite HSTU-X can receive sufficient power and then sends an “Acknowledgement”. The sequence of the transaction and signals is very similar to Table 1 but an “ACK” signal using the same carriers as the G.hs transaction is inserted between the measurement signals as shown in Table 14.

From the multiple "narrow band" singles of the G.hs modulation, reasonable estimates can be made for the initial values of the broadband PMM signal power levels.

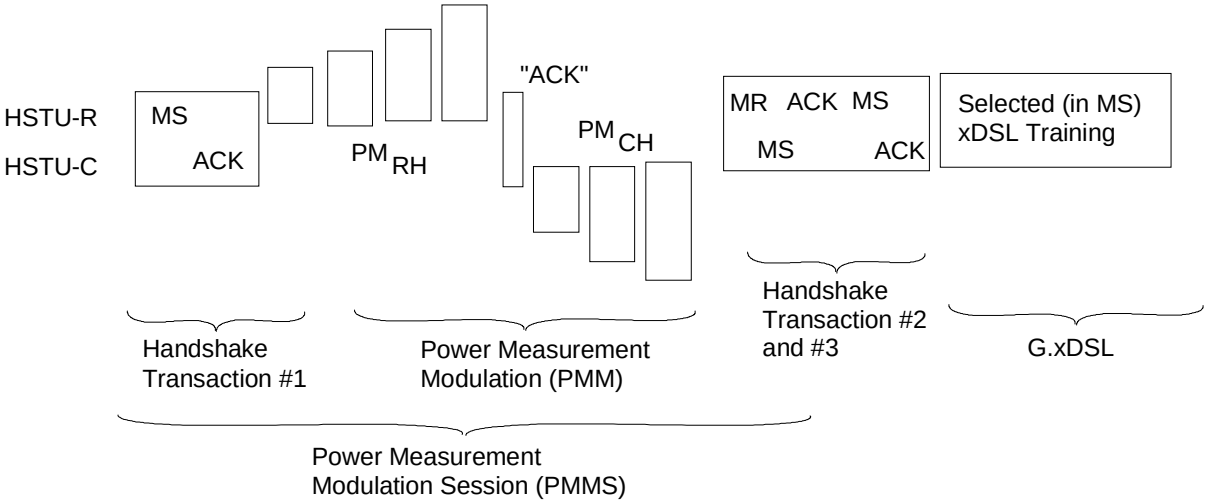
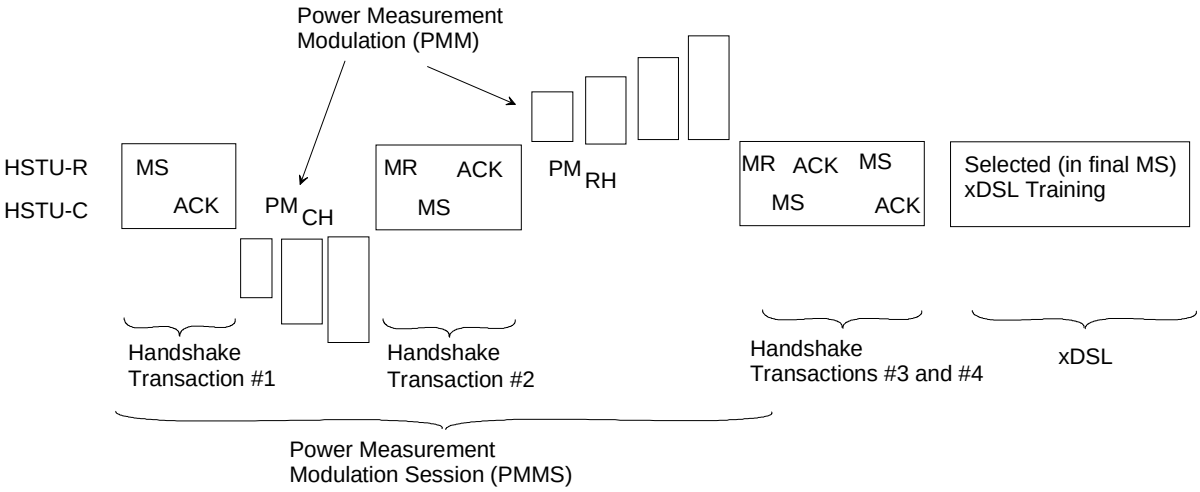


Table 14. PMMS - stepped standard measurements

Transmit Unit	Message / Signal Name	Description
HSTU-R	MS	• is a request for the HSTU-C and HSTU-R to send the power measurement modulation session (PMMS) signals (PM_{CH} and PM_{RH}) • includes the category choice which represents the parameters of the desired signal (PM_{CH} and PM_{RH}) to be transmitted.
HSTU-C	ACK	The message Acknowledges selection of PMMS
HSTU-R	PM_{RH}	This signal allows the HSTU-C to measure the line conditions and power loss
HSTU-C	ACK	Acknowledge reception of PM_{RH} and beginning of transmission of PM_{CH}
HSTU-C	PM_{CH}	This signal allows the HSTU-R to measure the line conditions and power loss
HSTU-R	MR	a request the HSTU-C to send an MS.
HSTU-C	MS	conveys the upstream PBO request
HSTU-R	ACK	The message Acknowledges the upstream PBO request value
HSTU-C	MS	• is a request for a specific xDSL modulation mode. • contains a parameter request a certain amount of PBO in the downstream direction
HSTU-C	ACK	Acknowledges selection of the xDSL using the specified downstream PBO
-	Training	Training begins

2.2.2 Stepped with Explicit parameters

Very similar to §2.1.2 but power is successively stepped up.



3. Summary

1. Agenda Area: This should be presented in the discussion on G.gen work, and applies to each of G.shdsl and G.vdsl, as well as possibly G.lite.bis and G.dmt.bis.

2. Expectations:

- Acceptance of one of the proposals or an Ad hoc group discussion on the topic.
- Open items should be added to the Call for Papers and the issue list under the agreements initial points listed in §1 above:

The detailed examples that were presented in D.565 should also be considered in the Ad Hoc discussion.