# GL Insight™ Modem Analysis Training

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# Introduction to Modem Communication Phrases

| | |
|---|---|
| Phase 1 | Network Interaction |
| Phase 2 | Probing /Ranging |
| Phase 3 | Equalizer and Echo canceller training |
| Phase 4` | Final training |

# Phase 1 – Network Interaction (as per V.8)

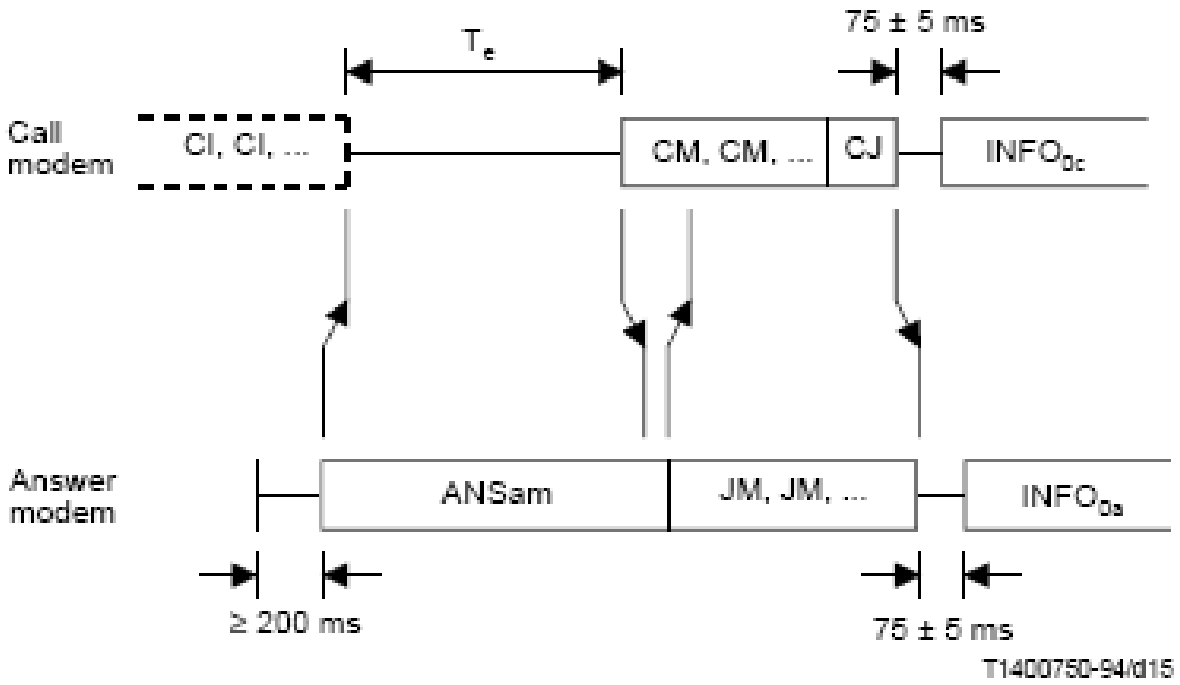
I.After transmitting no signal for 1s, the DCE shall initiate transmission of CNG, or continue transmission of no signal.

2. The DCE shall then seek to detect ANS, ANSam, or a sigA that is characteristic of an acceptable mode of modulation.

3. After detection of ANS or ANSam, the call signal shall be stopped. However, the call DCE may choose to ensure that CI has been transmitted for a minimum of 3 full sequences.

4.If ANSam (rather than ANS) is detected, the DCE shall transmit no signal for a period Te prior to transmitting signal CM. The silent period Te begins after the termination of the call signal or, in the absence of a call signal, after the detection of ANSam.

The minimum value for Te shall be 0.5 s. However, if it is desired to allow for network echo canceller disabling in the manner defined in ITU-T V.25, Te shall be set to a value ≥1s.

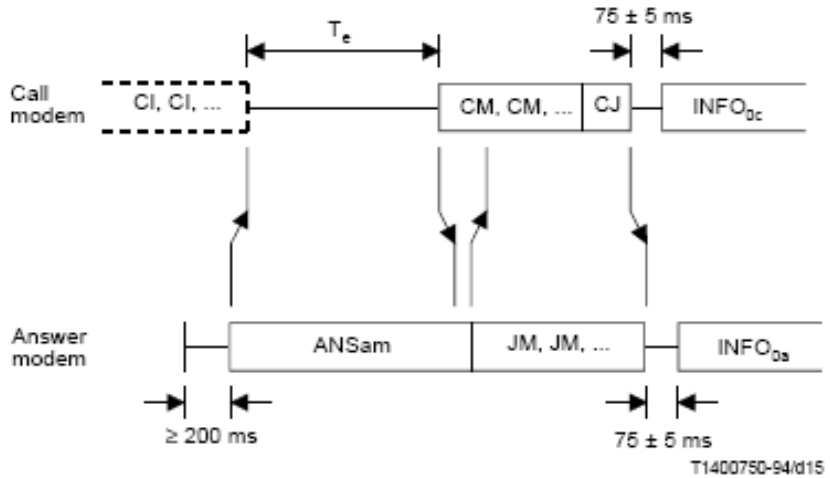


# Phase 1 – Network Interaction (as per V.8)

5.For a period of at least 0.2 s after connection to line, the answer DCE shall transmit no signal.

6.If a minimum of 2 identical CM sequences are received and the modulation mode bits indicate V.34 operation,
the modem shall send JM and condition its receiver to detect CJ.

7.After receiving all 3 octets of CJ, the modem shall transmit silence for 75 ± 5 ms and proceed with Phase 2 of start-up.




**Call menu signal (CM)**: A signal transmitted from the call DCE primarily to indicate modulation modes available in the call DCE. CM consists of a repetitive sequence of bits at 300 bit/s, modulating V.21 (L), the low-band channel defined in ITU-T V.21. Signal CM initiates the process of modulation-mode selection. A CM sequence starts with 10 ONEs followed by 10 synchronization bits

**CM terminator (CJ)**: A signal, which acknowledges the detection of a JM signal and indicates the end of CM signal. CJ consists of three consecutive octets of all ZEROs with start and stop bits, modulating V.21 ( at 300 bit/s.

**Joint menu signal (JM):** A signal transmitted from the answer DCE primarily to indicate modulation mod available
jointly in the call and answer DCEs. JM consists of a repetitive sequence of bits at 300 bit/s, modulating V.21 (H), the high-
band channel defined in ITU-T V.21.
A signal JM is transmitted from an answer DCE only in response to a detected CM signal. JM shall be transmitted after a
minimum of two identical CM sequences has been received.

# Phase 2 – Probing/Ranging

1.During the 75 ± 5 ms silent period ending Phase 1, the call modem shall condition its receiver to receive

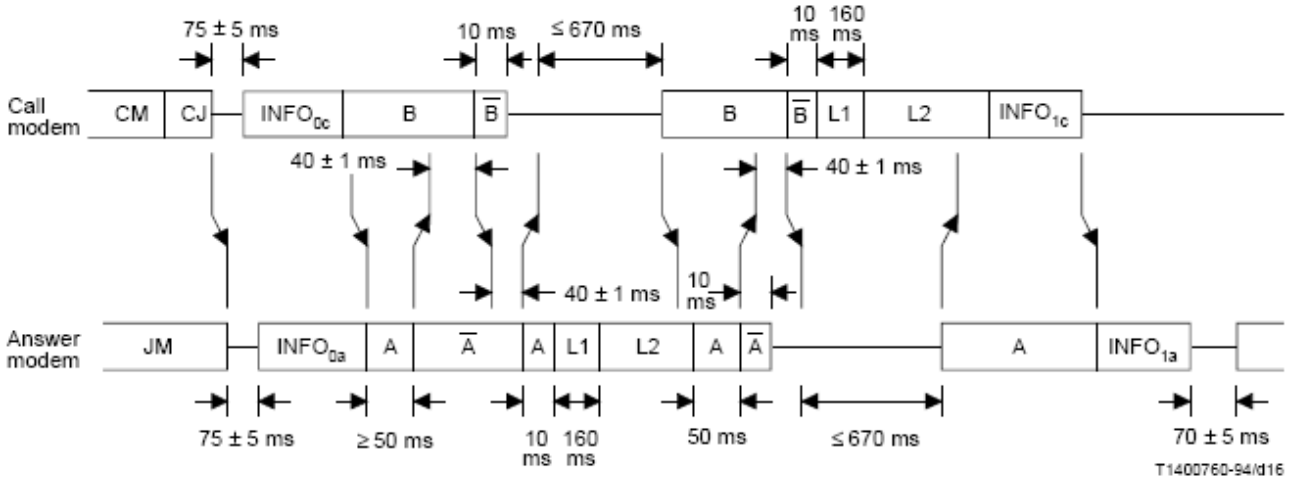
INFO0a and detect Tone A.

2.After the 75 ± 5 ms silent period, the call modem shall send INFO0c with bit 28 set to 0, followed by Tone B

3.After receiving INFO0a, the call modem shall condition its receiver to detect Tone A, receive INFO0a and detect the subsequent Tone A phase reversal

4.After detecting the Tone A phase reversal, the call modem shall transmit a Tone B phase reversal.

5.Tone B shall be transmitted for another 10 ms after the phase reversal. The modem shall then transmit silence and condition its receiver to detect a second Tone A phase reversal.



# Phase 2 – Probing/Ranging

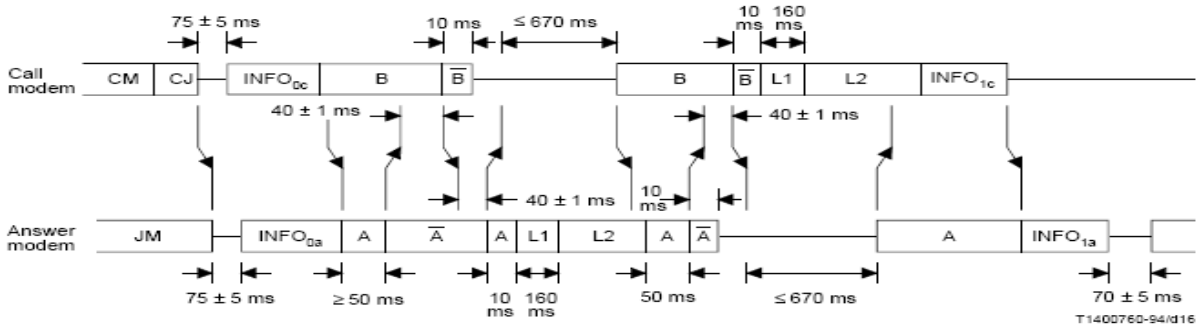
After detecting the second Tone A phase reversal, the call modem can calculate the round-trip delay

7.The round-trip delay estimate, RTDEc, is the time interval between the appearance of the Tone B phase reversal at the modem line terminals and receiving the second Tone A phase reversal at the line terminals minus 40 ms.

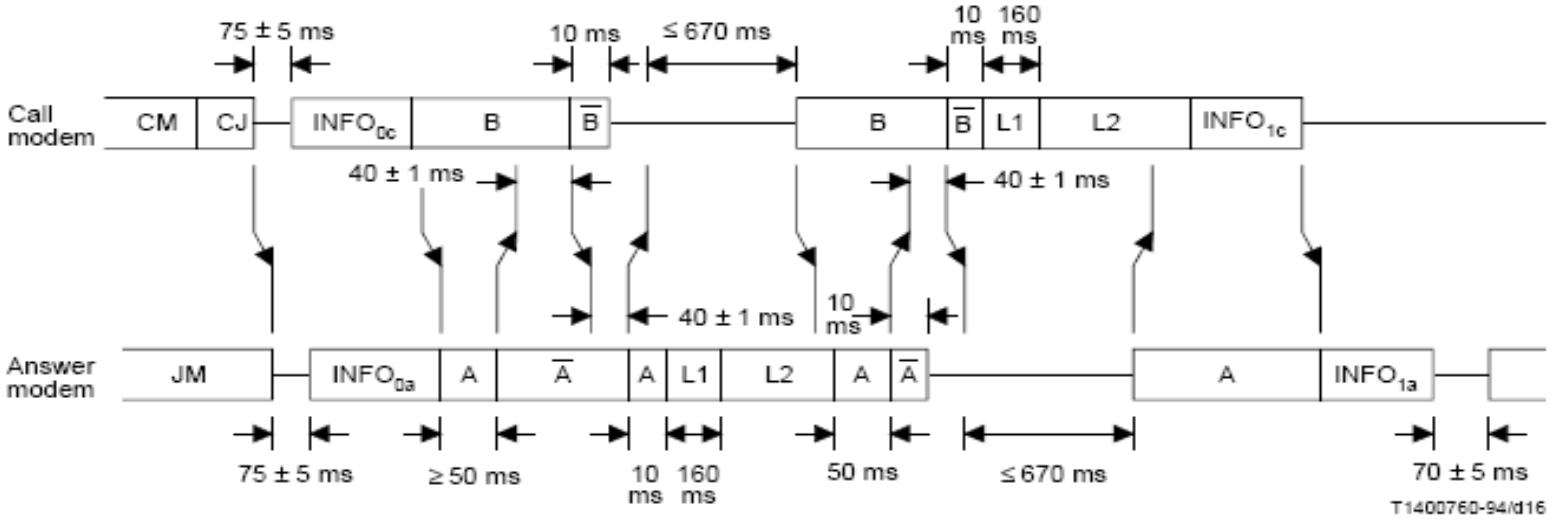
8.The modem shall then condition its receiver to receive the probing signals L1 and L2.

9.The call modem shall then transmit Tone B and condition its receiver to detect Tone A and the subsequent Tone A phase reversal.

<u>Two-line probing signals, **L1 and L2**,</u> are used to analyze channel characteristics. L1 is a periodic signal with a repetition rate of 150 ± 0.01% Hz which consists of a set of tones (cosines) spaced 150 Hz apart at frequencies from 150 Hz to 3750 Hz. L1 is transmitted for 160 ms (24 repetitions) at 6 dB above the nominal power level. L2 is the same as L1 but is transmitted for no longer than 550 ms plus a round trip delay at the nominal power level.



# Phase 2 – Probing/Ranging




10.After detecting Tone A and the subsequent Tone A phase reversal, the call modem shall transmit a Tone B phase reversal.

11.The modem shall then transmit signal L1 followed by signal L2 and condition its receiver to detect Tone A.

12.After the call modem detects Tone A and has received the local echo of L2 for a period not to

exceed 550 ms plus a round trip delay, the modem shall send INFO1c

13. After sending INFO1c, the call modem shall transmit silence and condition its receiver to receive INFO1a.After receiving INFO1a, the modem shall proceed to Phase 3 of the start-up procedure

**INFO sequences** are used to exchange modem capabilities, results of line probing, and data mode modulation parameters. Two sets of INFO sequences are used: (INFO0a, INFO0c) and (INFO1a, INFO1c), where "a" identifies INFO sequences sent by the answer modem, and "c" identifies INFO sequences sent by the call modem.

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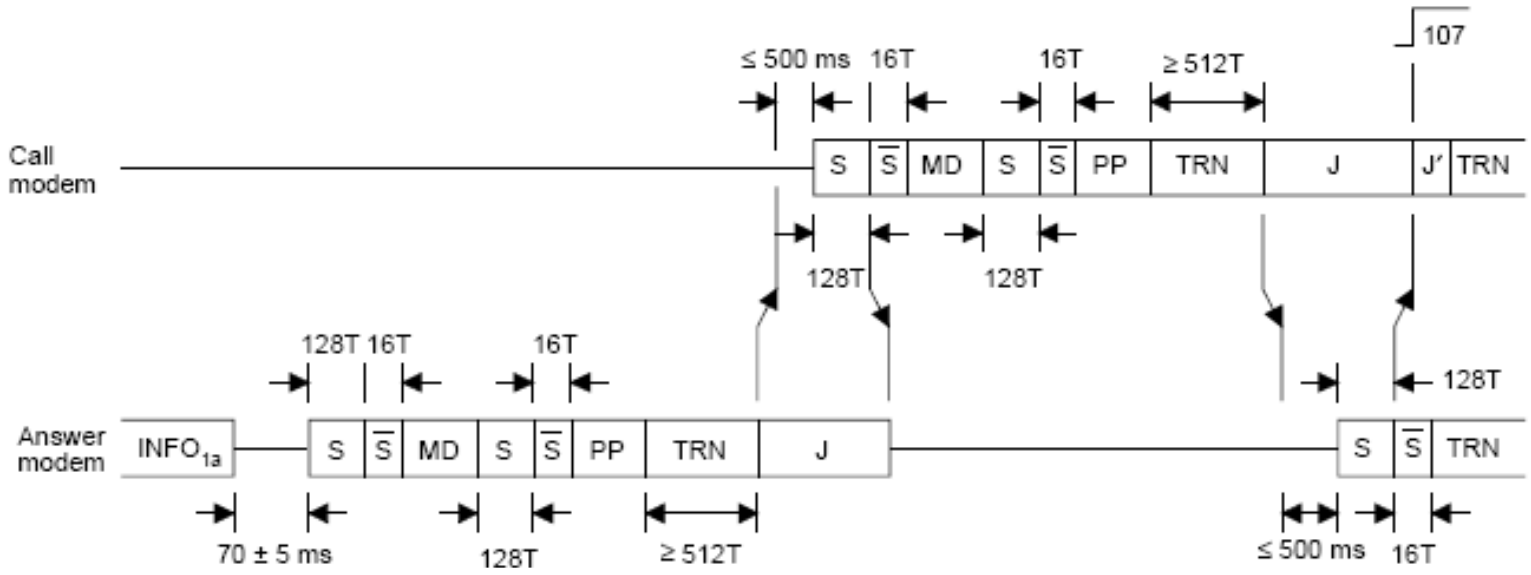
# Phase 3 – Equalizer and echo canceller training




1.The call modem shall be initially silent and condition its receiver to detect S and the subsequent S .

2.After detecting signal S and the S-to-S transition, the modem shall condition its receiver to begin training ts equalizer using signal PP. After receiving signal PP, the modem may further refine its equalizer using the first 512T of signal TRN.

3.After receiving the first 512T of signal TRN, the modem shall condition its receiver to receive sequence J.After receiving J, the call modem may wait for up to 500 ms and then shall transmit signal S for 128T and signal Sfor 16T.

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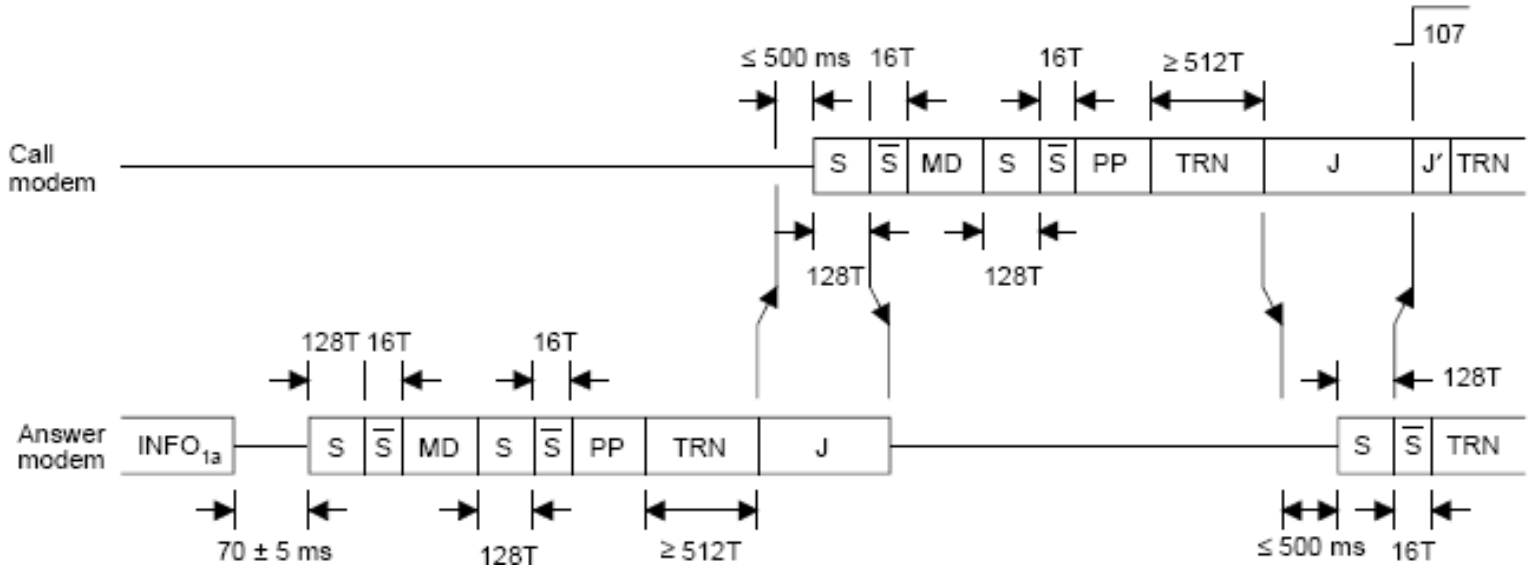
# Phase 3 – Equalizer and echo canceller training




4. If the duration of the call modem's MD signal, as indicated in the previous INFO1c, is zero, the call modem shall then transmit signal PP.

5. After transmitting signal PP, the modem shall transmit signal TRN. Signal TRN consists of four constellation points and shall be transmitted for at least 512T. The total time from the beginning of transmission of signal MD to the end of signal TRN shall not exceed two round trip delays plus 2000 ms.

6. After transmitting signal TRN, the modem shall send sequence J and condition its receiver to detect signal S. After detecting signal S, the modem shall proceed to Phase 4 of the start-up.

MD is an optional Manufacturer-Defined signal used by a transmitting modem to train its echo canceller if this cannot be accommodated by the TRN signal in Phase 3.

Signal PP consists of six periods of a 48-symbol sequence and is used by the remote modem for training its equalizer.

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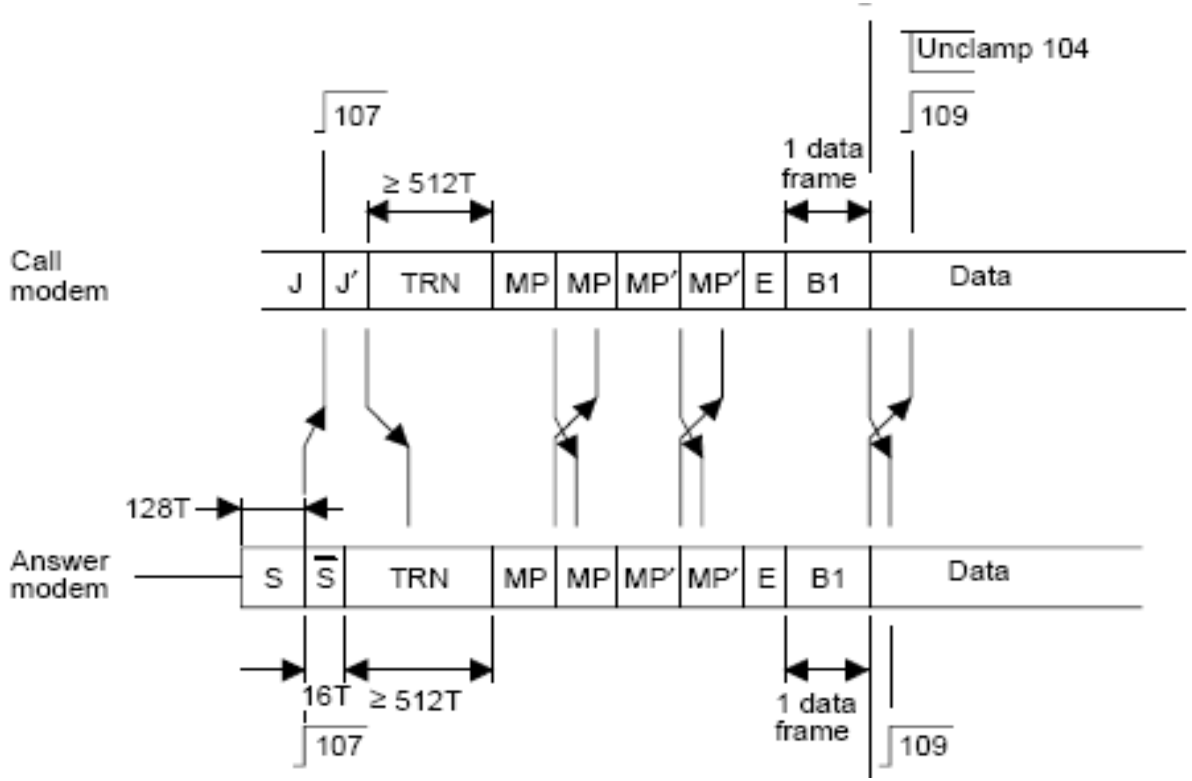
# Phase 4 – Final Training

1. Final training of the modem in duplex mode and exchange of final data mode modulation parameters are performed in Phase 4 of the start-up procedure
2. After detecting S followed by S , the call modem shall stop sending J sequences, condition its receiver to detect signal TRN, turn on Circuit 107, transmit one J¢ sequence, and then transmit signal TRN.
3. After transmitting signal TRN for a minimum of 512T, the modem shall condition its receiver to receive sequence MP and may continue sending TRN for up to 2000 ms. After training adequately, the call modem shall then cease transmitting TRN and send sequence MP. After receiving the answer modem's MP sequence, the call modem shall complete sending the current MP sequence and then send MP¢ sequences (MP sequences with the acknowledge bit set).

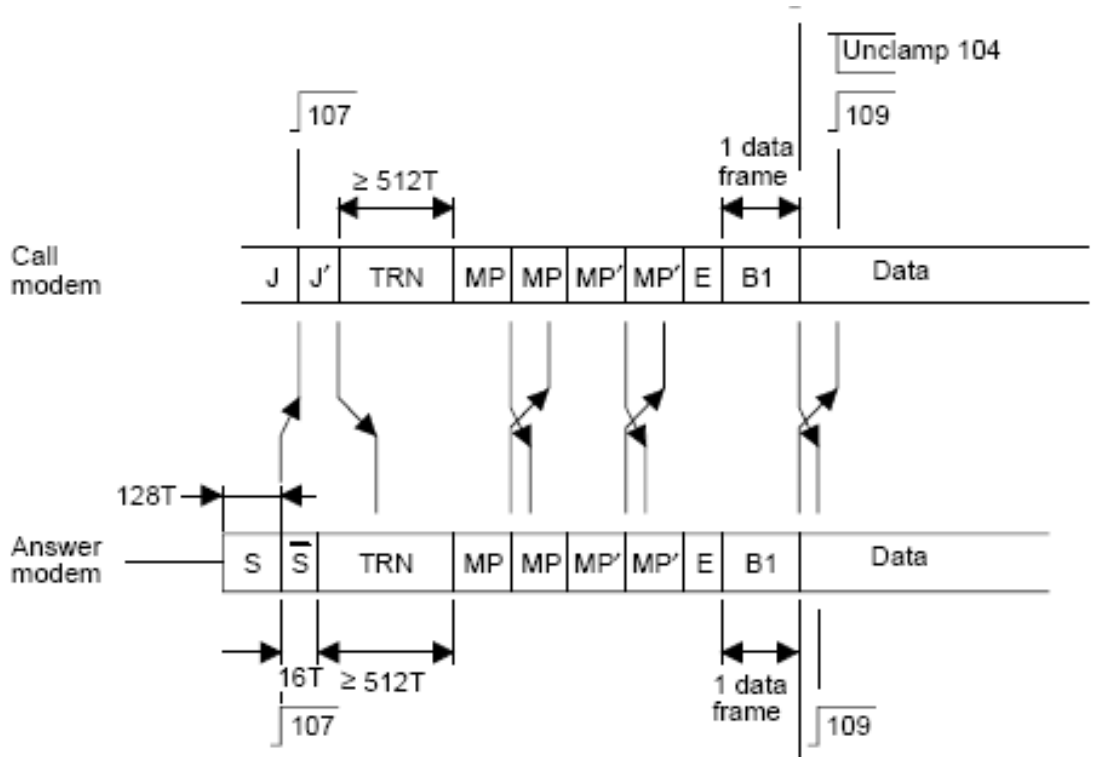


# Phase 4 – Final Training

4.The call modem shall continue sending MP¢ sequences until it receives MP¢ or E from the answer modem. The modem shall then complete the current MP¢ sequence and then send a single 20-bit E sequence.

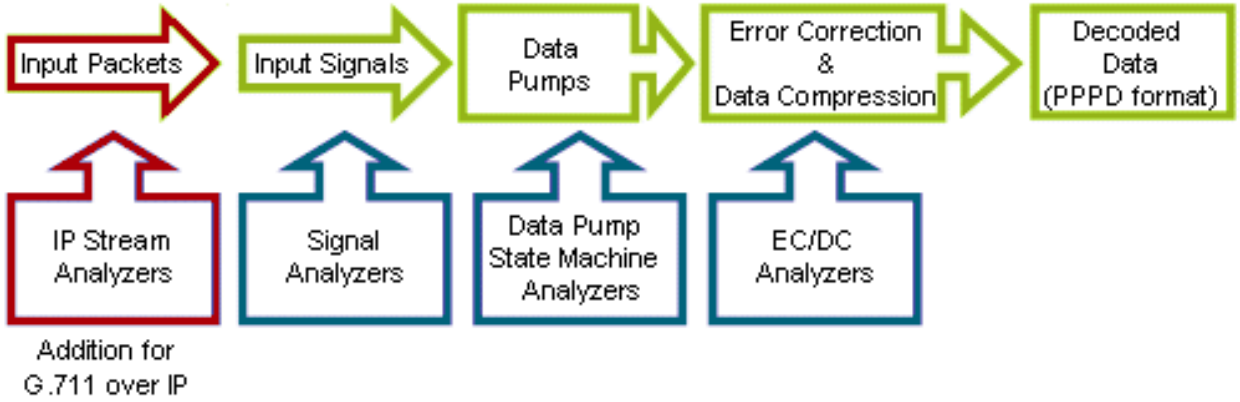
5.After sending an E sequence, the call modem shall send B1 at the negotiated data signaling rate using the data mode modulation parameters, enable Circuit 106 to respond to the condition of Circuit 105, start a new super frame and begin data transmission using the modulation procedures

Modulation Parameter (**MP**) sequences are exchanged between modems during start-up and rate renegotiation and contain modulation parameters to be used for data mode transmission.



# GL Insight™ Modem Decoding-and-Analysis Information

1. Signal Analyzers
   - Discriminator information
   - Improper Automode signal flow detector
   - Improper V.8 signal flow detector
   - Unstable Signal level detector
   - Signal overflow detector
2. Data Pump State Machine Analyzers
   - Modem phase changes, retrains, rate renegotiations, data rates, symbol rates
   - Internal phase states such as S detections and all the phase 2 sub-states
   - Structure's interchange (MP, CP, Info) and complete connection parameters
   - Data-pump improper flow detector such as inconsistency of the signal with the standard
   - PDSNR (post detection signal quality monitoring) improper quality drop detector
   - Improper phase reversal detector
3. Error Correction Data Compression Analyzers
   - Error-correction and data compression setup information including XID info
   - Error-correction frame statistics
   - Data compression negotiation
   - Error-Correction improper flow detector



# GL Insight Decoded Files

| | |
|---|---|
| **V34_33600energy_ans_lo.pcm**<br>**V34_33600energy_org_lo.pcm** | It is Answer modem detected signal power<br>Shows the level of the signal level dBm of the answer side and origin of the connection. The energy files are in dBm(/100) units. Value of -1900 represent -19dBm.The energy files are generated only on V.34 and V.90 connections (lower data pump like v.32 and v.22 are not generating these files). |
| **V34_33600pdsnr_ans_lo.pcm**<br>**V34_33600pdsnr_org_lo.pcm** | Post Detection Signal to Noise Ratio) files should be opened as 8000samples/sec, mono, 16 bit linear. Lo is low resolution (133.3 measurements per second) and Shows the value in dB (/100) of the Signal-to-Noise ratio of the answer side training data signal respectively |
| **V34_33600raw_out_bits1.pcm**<br>**V34_33600raw_out_bits2.pcm** | This file contains the bits extracted by the data pump before the ECDC layer. It means for example that in start stop connection – the start and stop bits will be found in this file |
| **V34_33600output_chars.bin** | This file contains the bits extracted after the ECDC layer in both directions in a PPPD format. |
| **V34_33600symbols1.pcm**<br>**V34_33600symbols2.pcm** | The symbols received by the originate modem and shows the four-point TRN sequence (Phase 3), and the full constellation in the data stage (Phase 4).<br>demodulated symbols in the 2-dimensional symbol space, received by the Originate modem |

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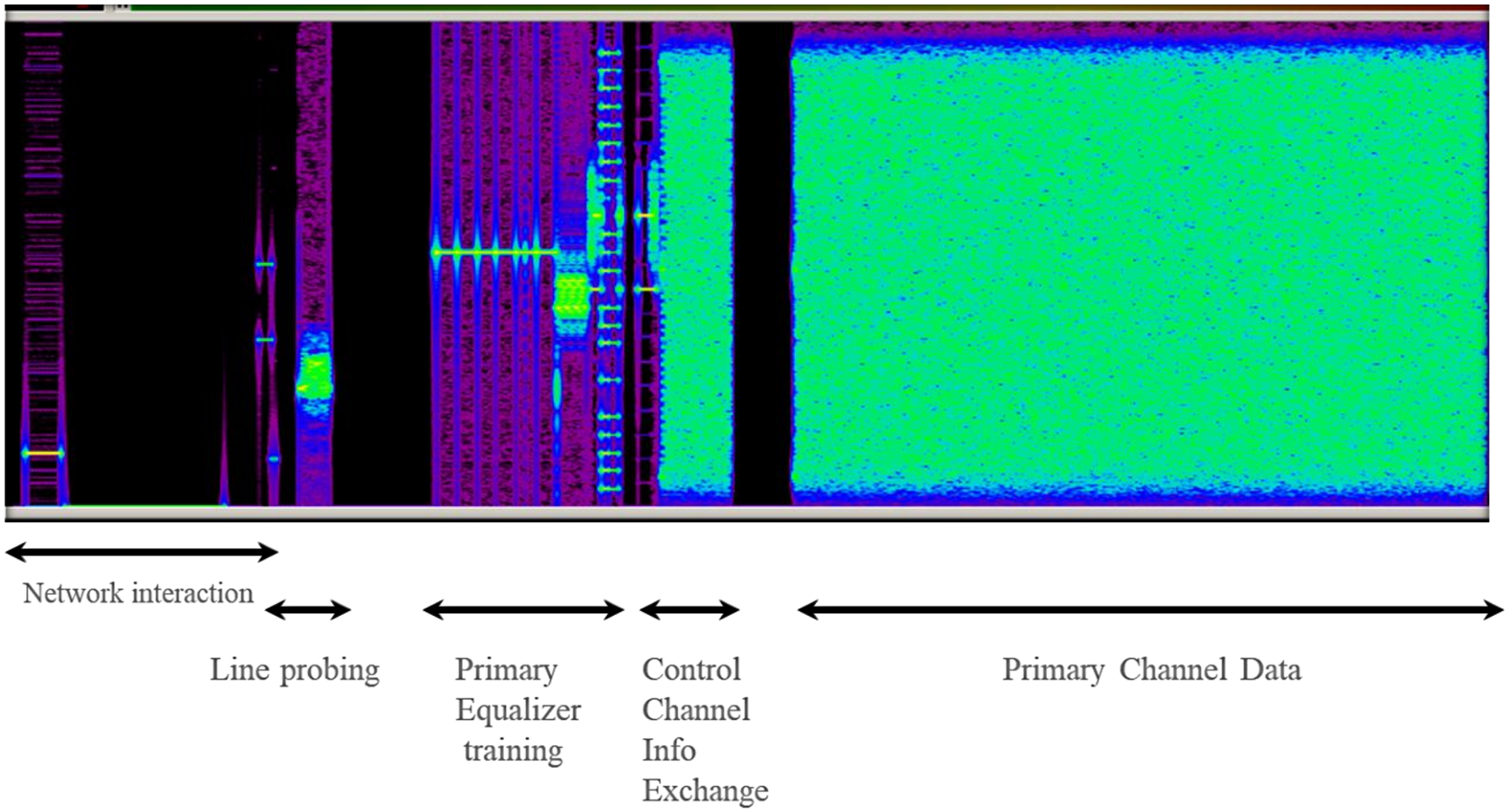
# Spectrogram view of ECM_v17_14400_ans.pcm

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# Thank you