If it is necessary to change parameters *during* the session, the transmitter may initiate a DIS/DCS renegotiation. For example, the transmitter may elect to renegotiate a lower speed if the receiver complains about page quality. Similarly, the ability to intermix pages of different resolutions or sizes requires renegotiation for each page.

With both fax machines now synchronized on the parameters for the session to follow, the transmitter sends a 1.5-second burst of zeros using the carrier specified in DCS. The official name of this signal is TCF, or "Training Check." For purposes of this book, we sometimes refer to it with the odd-looking term *G3training*. To understand why this term is necessary, refer to the box entitled "Attention Readers of the CCITT T.30 Documents" earlier in this chapter.

Using an unspecified algorithm, the receiver evaluates the G3training and sends a packet to accept or reject it. To accept the G3training, the receiver sends CFR (Confirmation to Receive), and both fax devices jump immediately to Phase C for page transfer. To reject the G3training, the receiver sends FTT (Failure to Train), in which case both fax devices reenter the DCS/TCF procedure. In most cases, FTT is a sign that the quality of phone line will not support the chosen speed, so the transmitter may elect to change the speed-selecting bits in the DCS. The DCS/TCF loop continues until the receiver sends CFR; if the receiver rejects G3training at the lowest supported speed, the transmitter has no recourse but to hang up.

Phase C: Data ("Message") Transmission

Phase C is governed by Recommendation T.4 (covered in detail elsewhere in this chapter), but is summarized here. Once the receiver accepts G3training, both devices are ready to transfer page data at the rate given in DCS. Immediately thereafter, the transmitter turns on its page carrier and begins to modulate it with page data. When all the data has been sent, the transmitter sends an in-band end-of-data sequence (Return to Control, RTC). It then turns off its high-speed carrier and proceeds to Phase D, the post-page phase.

The receiver accepts the page data and passes it along for decompression. When the receiver detects the end-of-data marker[11] it jumps to Phase D, the post-page phase.

Phase D: Post-Page Procedures

Immediately after shutting down its page-carrier, the transmitter sends one of three HLDC packets stating its intentions:

1. **EOP** (End of Procedure): no more pages follow.
2. **MPS** (Multi-Page Signal): another page with the same metrics follow.
3. **EOM** (End of Message): another page with different metrics follows (or that it intends to poll).

[11]Some devices don't look for RTC, but simply wait for the transmitter to turn off its carrier.

Now the transmitter waits for the receiver either to accept or reject the page just sent in Phase C.

Immediately after entering Phase D, the receiver receives one of the post-page HLDC packets listed above. Before acknowledging the transmitter's stated intentions, however, the receiver must first pass judgment on the quality of the page just received. It evaluates the page and replies with one of three evaluations:

1. **MCF** (Message confirmation): the page quality was acceptable—proceed.
2. **RTP** (Retrain Positive): the page quality was barely acceptable—another G3training is necessary.
3. **RTN** (Retrain Negative): the page quality was not acceptable—another G3training *and* retransmission are necessary.

If the receiver replies MCF, the flow chart proceeds according to the transmitter's stated intentions. If the receiver replies RTP or RTN, (that is, the page quality was not OK), a number of options are possible: resend G3training, return to Phase B for DCS and G3 training, or simply hang up. The possibilities are explained later in the flow chart narratives.

Phase E: Call Release

Call release is the process of disengaging from the line. If the session is at a rational place in the flow chart, it performs an *orderly* release: a DCN (Disconnect) packet is sent, followed by hanging up. If the session is in an irrational place in the flow chart—receiving an illegal response to a packet, for example—the transmitter *bails out* by simply hanging up the line.

Narratives of Sample Sessions

Mortals can learn only so much from an abstract discussion of T.30. The best learning tool is to walk through sample sessions step-by-step noting the events that take place at both fax devices. Each of the following narratives traces through a single kind of T.30 session—single-page, multi-page, and so forth—explaining what things are and why they happen. The sequential numbers in the "Step" column on the left are merely for reference; the other columns present the receiver and transmitter actions in parallel, and their numbers refer to the numbers in the flow chart in Figure 11.4 and 11.5.

Narrative: A Single Page

Table 11.2 is a narrative of the simplest session: faxing a single page with no complications. Because many subsequent narratives begin and end as this one does, it contains considerable detail.

Table 11.2. Flow-chart narrative of a single page.

STEP	*Transmit Flow Chart References*	*Receive Flow Chart References*
1	1. Call establishment (Phase A) takes place (refer to "Phase A: Call Establishment," above for details) and control passes to point T, the beginning of the negotiation and identification phase (Phase B).	1. Call establishment (Phase A) takes place (refer to "Phase A: Call Establishment," above for details) and control passes to point R, the beginning of the negotiation and identification phase (Phase B).
2	2. Originator listens for an HDLC packet. If none is received in about 40 seconds, it hangs up. In this example a packet is received.	2-3. Answerer alternately sends DIS (capabilities) packet and waits for an HDLC packet in reply. If no reply is received in about 40 seconds, it hangs up.
3	3. Originator first checks whether the packet is DIS or DTC. DIS is the "expected" capabilities bitmap packet from the answerer; DTC is a packet requesting a polling operation. In either case, optional phone number, security codes, and non-standard facilities packets might also be received. In this example, DIS is received and the originator sets its X bit to 1, designating it as the transmitter.	
4	4. Transmitter evaluates the bits in the remote's DIS and learns that its receiver is Group 3-compatible and that its poll-request bit is clear.	
5	5. In this example, the transmitter has a document to send. (Refer to the narrative "Single Page with Polling" below for a scenario where the originator doesn't have a document to send.)	

STEP	*Transmit Flow Chart References*	*Receive Flow Chart References*
6	6. Transmitter now examines the rest of the remote's capabilities, compares them to its own, and derives a group of parameters that provides the best performance.	
7	7. Transmitter now sends the DCS packet so that the receiver knows the parameters under which the session will be conducted.	6. At 3 an HDLC packet is received After checking it for polling request at 4 and 5, the receiver identifies it it as DCS containing page and session parameters. The answerer sets its X bit to 0, designating it as the receiver.
8	8. Immediately after DCS, the transmitter sends TCF—a burst of zero bits 1.5 seconds in length at the speed given in bits 11-14 of DCS.	7. Immediately after receiving DCS, the receiver receives TCF at the speed given in bits 11-14 of DCS.
9	10. Transmitter awaits an HDLC packet announcing the receiver's evaluation of TCF.	8-9. Receiver evaluates TCF according to unspecified criteria. In this example, TCF is acceptable and CFR (Confirmation to Receive) is sent.
10	12. CFR (Confirmation to Receive) is received, indicating that the receiver, based upon unspecified criteria, evaluated TCF and found the phone line to be suitable.	11-12-13-14. Receiver enters a loop with a 6-second time-out, alternately looking for an HDLC packet or high-speed page carrier.
11	13. The transmitter then turns on page carrier and transmits the page data.	14-15. Receiver detects high-speed page carrier at 14 and commences to receive page data at 15.
12	14. When the page data ends, the transmitter switches to low-speed modulation and immediately sends a post-page HDLC packet declaring its plans to send another next page. In this example there are no more pages, so it answers 'Yes' to the "All Done?" decision.	11-12-13-14. When receiver hears data and page carrier end, it enters a loop with a 6-second time-out, alternately looking for an HDLC packet or high-speed page carrier.

continues

Table 11.2. continued

STEP	*Transmit Flow Chart References*	*Receive Flow Chart References*
13	15. Transmitter sends EOP (End of Procedure) to inform the receiver that there are no more pages to come, effectively declaring an end to the current session.	11. Receiver detects an HDLC packet and evaluation of the packet number passes through 4, 5, 6, 16, and finally to 17 where it is recognized as EOP.
14	16. Transmitter awaits an HDLC packet announcing the receiver's acceptance of the page just sent.	19-20-21. Receiver evaluates the page, finds it acceptable. Retraining is deemed unnecessary at 20, and at 21 MCF (Message Confirmation) is sent.
15	17. MCF (Message Confirmation) is received, indicating that the receiver found the page acceptable.	11-12-13-14. Receiver enters a loop with a 6-second time-out, alternately looking for an HDLC packet or high-speed page carrier.
16	21. The session terminates with the transmission of DCN (Disconnect), and the phone line is hung up.	11. Receiver detects an HDLC packet and evaluation of the packet number passes through 4, 5, 6, 16, 17, and 18. The packet is unrecognized at 17, and the line is hung up at 24.

Narrative: Multiple Pages with Same Metrics

Table 11.3 is a narrative of sending several pages with identical metrics.

Table 11.3. Flow chart narrative of multiple pages with the same metrics.

STEP	*Transmit Flow Chart References*	*Receive Flow Chart References*
1-11	These steps are identical to the "Single Page Narrative" in Table 11.2.	
12	14. When the page data ends, and the transmitter switches to low-speed modulation and immediately sends a post-page HDLC packet declaring its plans for the next page. In this example there is a next page, so it answers 'No' to the "All Done?" decision.	11-12-13-14. When receiver hears data and page carrier end, it enters a loop with a 6-second time-out, alternately looking for an HDLC packet or high-speed page carrier.

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