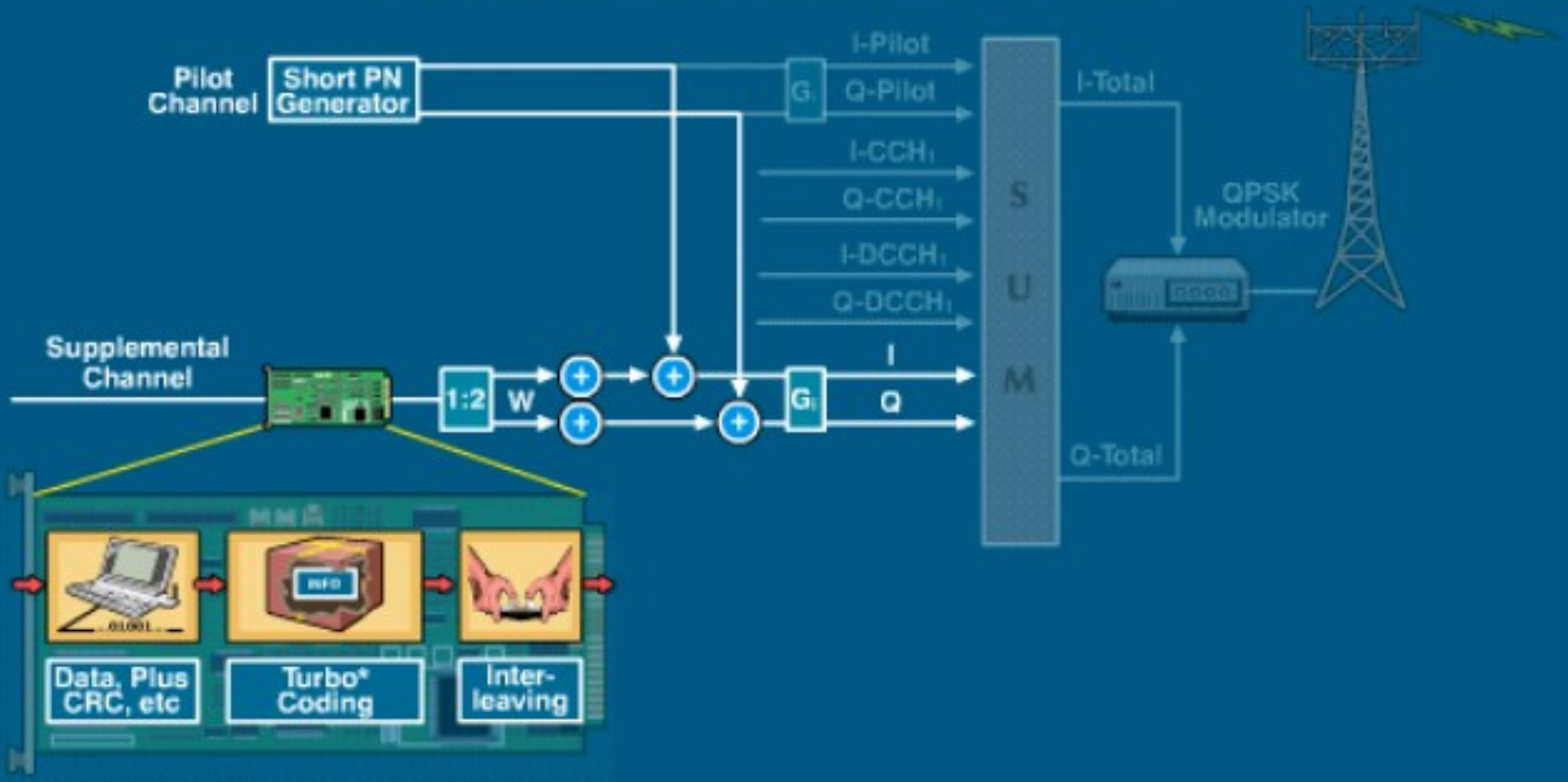
CDMA2000 Configuration / Data Rate Options

CDMA2000 RADIO TECHNOLOGY
UNIT LESSONS

- CDMA2000 Forward Radio Carrier (Downlink)
  - Pilot, Sync, Paging, and Fundamental Channels
  - Supplemental Channels
    - Packet Mode Operation
    - Configuration and Data Rate Options
  - Multi-Carrier Operation
- CDMA2000 Reverse Radio Carrier (Uplink)
- CDMA2000 Evolution to 1xEV-DO and 1xEV-DV

SUPPLEMENTAL CHANNEL



⊕ = Exclusive-OR Operation
W = Walsh Code
CCH = Common CHannel
I = In - Phase Component
PN = Pseudonoise Code Sequence

QPSK = Quadrature Phase Shift Keying
DCCH = Dedicated Control CHannel
Q = Quadrature (90°) Phase Component
G_i = Per Channel Individualized Gain

*or Convolutional Coding

MANY DATA RATE OPTIONS

Different user data rates may be supported by:

- Varying the number of chips/bit
  - Using different length "Spreading Codes"**
  - Fewer chips/bit allows more user bits/sec* per channel
    - But fewer simultaneous channels...
    - Since the channel is less tolerant of interference...
    - Due to less Processing Gain
- Varying the amount of redundancy in the Convolutional or Turbo Coding
  - Less redundancy allows more user bits/sec* per channel
    - But fewer simultaneous channels...
    - Since the channel is less tolerant of errors

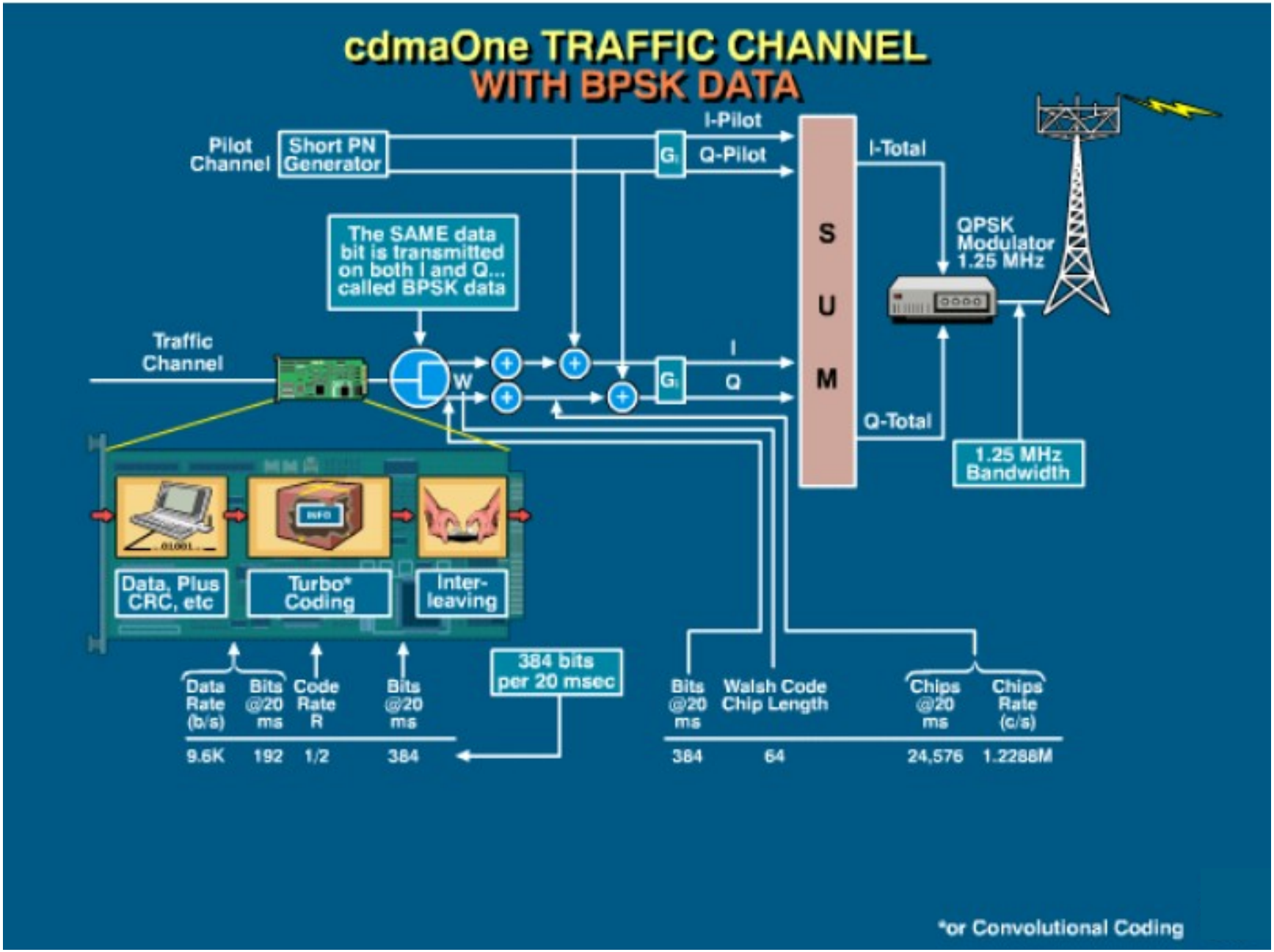
* For a given channel bandwidth
** Called Walsh Codes in CDMA2000 and Orthogonal Variable Spreading Factor (OVSF) Codes in UMTS

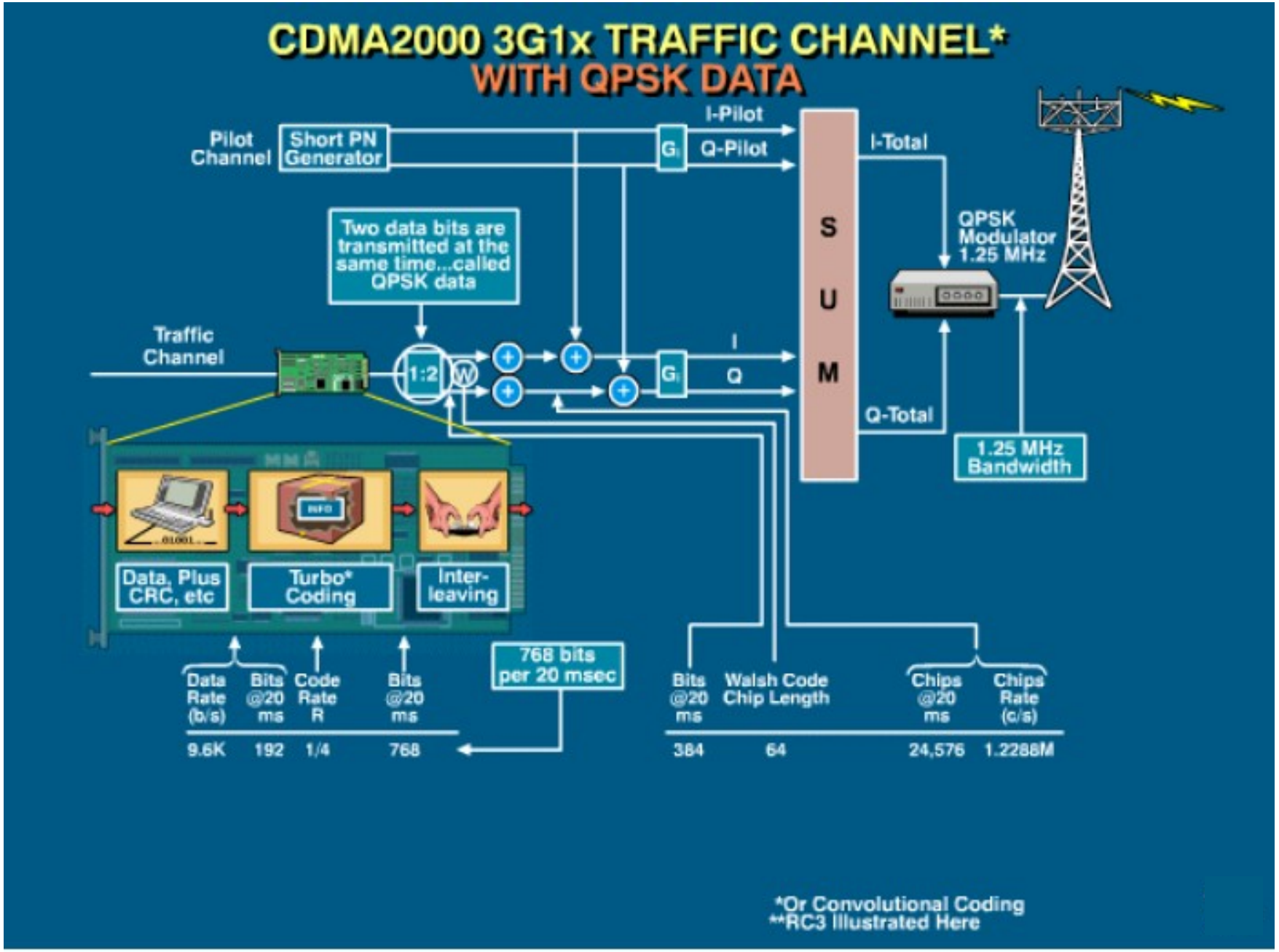
RADIO CONFIGURATIONS
CDMA2000 FORWARD TRAFFIC CHANNELS[1]

Radio Configuration	Spreading Rate	Data Rates Up To	FEC Rate	Data
1	1	9.6 Kb/s	1/2	BPSK[3]
2	1	14.4 Kb/s	1/2	BPSK[3]
3[2]	1	153.6 Kb/s	1/4	QPSK
4	1	307.2 Kb/s	1/2	QPSK
5	1	230.4 Kb/s	1/4	QPSK
6	3	307.2 Kb/s	1/6	QPSK
7	3	614.4 Kb/s	1/3	QPSK
8	3	460.8 Kb/s	1/4[4]	QPSK
9	3	1.0368 Kb/s	1/2[4]	QPSK

Note:
1. Covers Fundamental Channels for data up to 14.4 Kb/s and Supplemental Channels for higher data rates
2. This is the dominant configuration for Supplemental Channels in initial deployments
3. For backward compatibility with cdmaOne
4. For 20 msec frames; Rate 1/3 is used for 5 msec frames

Source: IS-2000.2


cdmaOne TRAFFIC CHANNEL
WITH BPSK DATA
Pilot Channel
Short PN Generator
I-Pilot
Q-Pilot
I-Total
Q-Total
S
U
M
QPSK Modulator 1.25 MHz
1.25 MHz Bandwidth
The SAME data bit is transmitted on both I and Q... called BPSK data
Traffic Channel
W
I
Q
Data, Plus CRC, etc
Turbo* Coding
Inter-leaving
384 bits per 20 msec
Data Rate (b/s)
Bits @20 ms
Code Rate R
Bits @20 ms
9.6K
192
1/2
384
Bits @20 ms
Walsh Code Chip Length
Chips @20 ms
Chips Rate (c/s)
384
64
24,576
1.2288M
*or Convolutional Coding

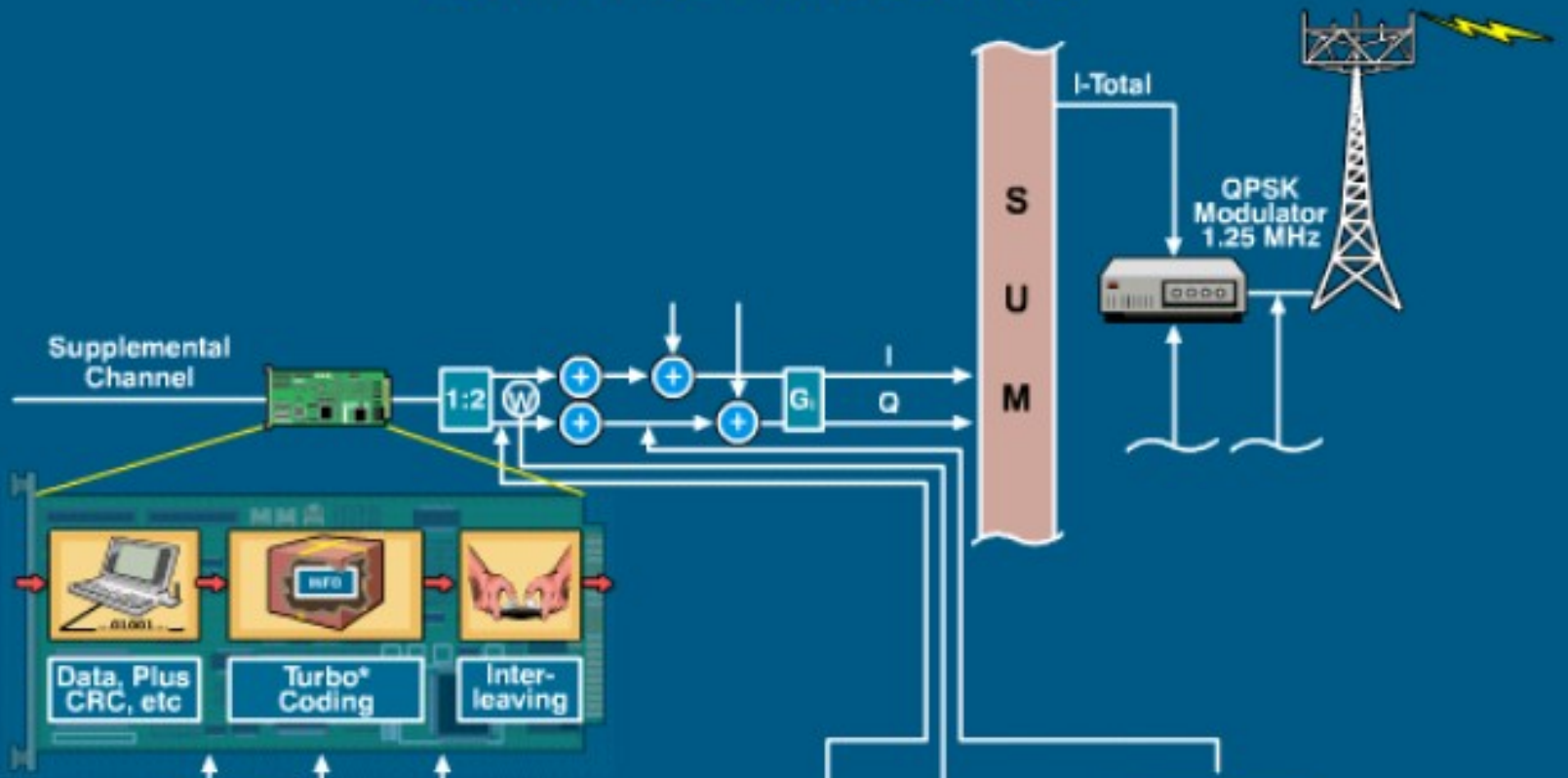

CDMA2000 3G1x TRAFFIC CHANNEL*
WITH QPSK DATA
Pilot Channel
Short PN Generator
I-Pilot
Q-Pilot
I-Total
Q-Total
S U M
QPSK Modulator 1.25 MHz
1.25 MHz Bandwidth
Two data bits are transmitted at the same time...called QPSK data
Traffic Channel
1:2
W
I
Q
Data, Plus CRC, etc
Turbo* Coding
Inter-leaving
768 bits per 20 msec
Data Rate (b/s)
Bits @20 ms
Code Rate R
Bits @20 ms
9.6K
192
1/4
768
Bits @20 ms
Walsh Code Chip Length
Chips @20 ms
Chips Rate (c/s)
384
64
24,576
1.2288M
*Or Convolutional Coding
**RC3 Illustrated Here

MORE POWERFUL FEC INCREASES CAPACITY

- More powerful FEC used in 3G contributes to increased capacity compared to 2G CDMA
  - e.g., Rate 1/4 instead of Rate 1/2 on the forward link for CDMA2000 RC 3
  - Allows the base station to transmit at reduced power levels per-channel
    - More errors will occur, but compensated for by more powerful FEC
  - Allows the base station to transmit to more mobiles concurrently before reaching its Power Amplifier limit
- Contributes to the ~2x capacity increase on the forward link compared to 2G CDMA
  - The other slightly more important factor is the implementation of fast forward power control in 3G
- Similar benefits accrue on the reverse link due to more powerful FEC in 3G
- Turbo codes provide an extra capacity boost for data (as contrasted with voice) channels
  - Turbo codes work best with longer interleaving intervals, e.g., 40 or 80 msec instead of 20 msec (used for voice*)

* Where extra delay impacts voice quality

MORE SUPPLEMENTAL DATA RATES FOR 3G1x RC 3
STARTING WITH 9.6 Kb/s



Data Rate (b/s)	Bits @20 ms	Code Rate R	Bits @20 ms
9.6K	192	1/4	768
19.2K	384		1536
38.4K	768		3072
76.8K	1536		6144
153.6K	3072		12228

Bits @20 ms	Walsh Code Chip Length	Chips @20 ms	Chips Rate (c/s)
384	64	24,576	1.2288M
768	32		
1536	16		
3072	8		
6144	4		

CDMA2000 3G3x SUPPLEMENTAL CHANNEL
RADIO CONFIGURATION 7 (RC 7)



Data Rate (b/s)	Bits @20 ms	Code Rate R	Bits @20 ms
9.6K	192	1/3	576
19.2K	384		1152
38.4K	768		2304
76.8K	1536		4608
153.6K	3072		9216
307.2K	6144		18432
614.4K	12288		36864

Bits @20 ms	Walsh Code Chip Length	Chips @20 ms	Chips Rate (c/s)
288	256	73,728	3.6864M
576	128		
1152	64		
2304	32		
4608	16		
9216	8		
18432	4		

*or Convolutional Coding

END OF LESSON 3