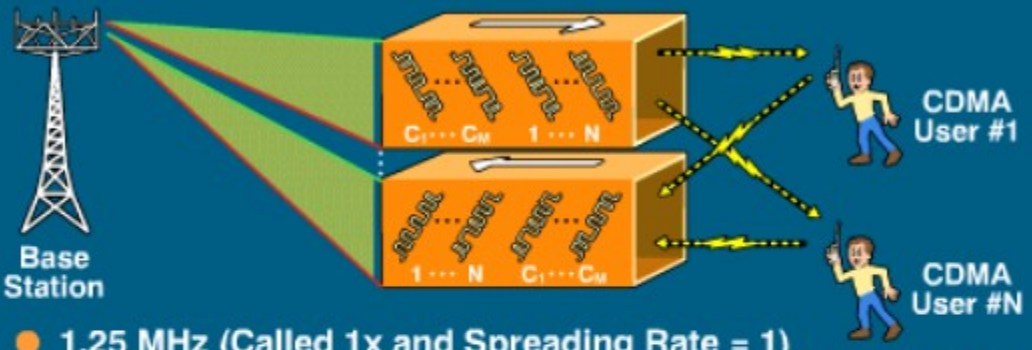
CDMA2000
Forward Channels

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

BANDWIDTH OPTIONS FOR CDMA2000
MULTIPLES OF 1.25 MHz (x2*)



- 1.25 MHz (Called 1x and Spreading Rate = 1)
  - For some 3G Services requiring bit rates only up to ~144 Kb/s
- 3.75 MHz (Called 3x and Spreading Rate = 3)
- 7.5 MHz (Called 6x and Spreading Rate = 6)**
- 11.25 MHz (Called 9x and Spreading Rate = 9)**
- 15.0 MHz (Called 12x and Spreading Rate = 12)**
- The MINIMUM bandwidths required (including guardbands of 1.25/2 MHz at each edge of the allocated spectrum) are 2.5, 5.0, 8.75, and 16.25 MHz (x2*), respectively

*For FDD (Frequency Division Duplex)
**Feasible, but not yet standardized

IS-2000 RELEASE HISTORY
MAJOR NEW CAPABILITIES

- IS-2000 Rel 0 (November, 1999)
  - Defines 1x and 3x RF carriers
    - Up to 144 Kb/s on 1x carriers
    - Up to 2 Mb/s on 3x carriers
  - Defines new SCHs* (Supplemental Channels) for higher data rate capabilities
- IS-2000 Rel A (March, 2000)
  - Defines new enhanced control channels, e.g.
    - R-EACH (Reverse- Enhanced Access Channel)
    - CCCH** (Common Control Channels)
- IS-2000 Rel B (May, 2002)
  - Mostly clarifications and corrections
  - Major new capabilities were put in Rel C (in the same timeframe)
- IS-2000 Rel C (May, 2002)
  - 1xEV-DV with data (up to 3.1 Mb/s downlink and 307.2 Kb/s uplink) and Voice
- IS-2000 Rel D (May, 2004) with Data (up to 3.1 Mb/s downlink and 1.8 Mb/s uplink) and Voice

* Very different than the SCCH (Supplemental Code Channel) which had been defined in ANSI-95-B and which achieved higher data rates by aggregating up to 8 codes for data rates up to 8 x 9.6Kb/s or 8 x 14.4 Kb/s. By contrast, the new SCH supports higher data rates still using a single Walsh code. Shorter Walsh codes are used for the higher data rates

CDMA2000 BAND CLASSES

Band Class	Frequency Band	Comments
0	800 MHz	U.S. Cellular/AMPS and in about 30 countries
1	1900 MHz	U.S. PCS
2	TACS	U.K. and in about 25 countries
3	JTACS	Japan Cellular
4	Korean PCS	Korea
5	450 MHz	Allocated in several Scandanavian and other countries
6	2 GHz	New Band (including the 2100 MHz band)
7	700 MHz	New Band
8	1800 MHz	GSM1800
9	900 MHz	GSM900
10	Secondary 800 MHz Band	U.S. SMR
11	400 MHz European PAMR	PAMR includes Police, Fire, Utilities, etc.
12	800 MHz PAMR	PAMR includes Police, Fire, Utilities, etc.

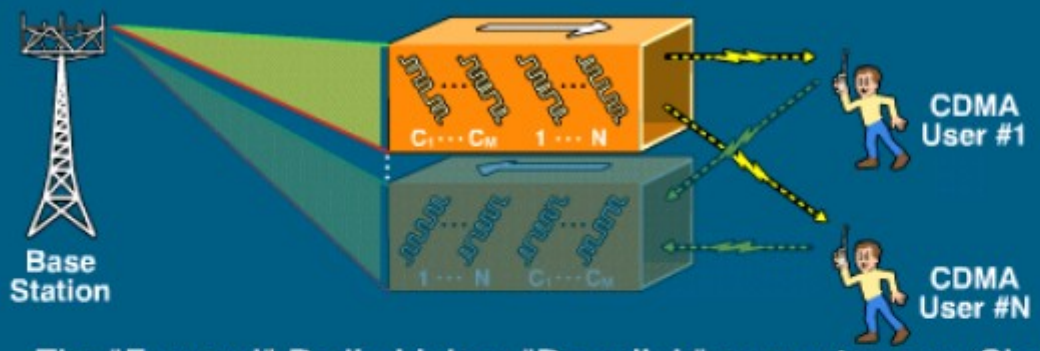
SMR = Specialized Mobile Radio (e.g., Nextel)
JTACS = Japanese TACs
TACS = Total Access Communications Systems (Cellular Band in U.K. and many other countries

Source: IS-2000.2-2

IMT-2000 STANDARDS
A.K.A. (ALSO KNOWN AS) . . .

- IMT-DS (Direct Spread)
  - a.k.a. W-CDMA FDD
- IMT-TC (Time Code)
  - a.k.a. W-CDMA TDD (with China's TD-SCDMA incorporated)
- IMT-MC (Multi-Carrier)
  - a.k.a. CDMA2000 Multi-Carrier
- IMT-SC (Single Carrier)
  - a.k.a. UWC-136 TDMA
- IMT-FT (Frequency Time)
  - a.k.a. DECT

CDMA2000 FORWARD RADIO CARRIER
MULTIPLE CHANNELS



The "Forward" Radio Link or "Downlink" supports many Channels

- Pilot Channel
- Sync Channel
- Paging Channels
- Fundamental Channels

} Similar functionality as in cdmaOne

- And...
- Supplemental Channels*

} Higher Bit Rate Channels for Data, Multimedia, etc.

*Some Common Control CHannels (CCHs) and Dedicated Control CHannels (DCCHs) have also been added

CDMA2000 DEDICATED PHYSICAL CHANNELS

Dedicated (to a single MS) Physical Channels:

- F/R-FCH (Fundamental Channel)
  - For voice and/or data and/or signaling/control up to 9.6 or 14.4 Kb/s
- F/R-DCCH (Dedicated Control Channel)
  - For signaling/control up to 9.6 or 14.4 Kb/s
- F/R-SCH* (Supplemental Channel)
  - For higher bit rate data/multimedia services up to 144 Kb/s in 3G1x

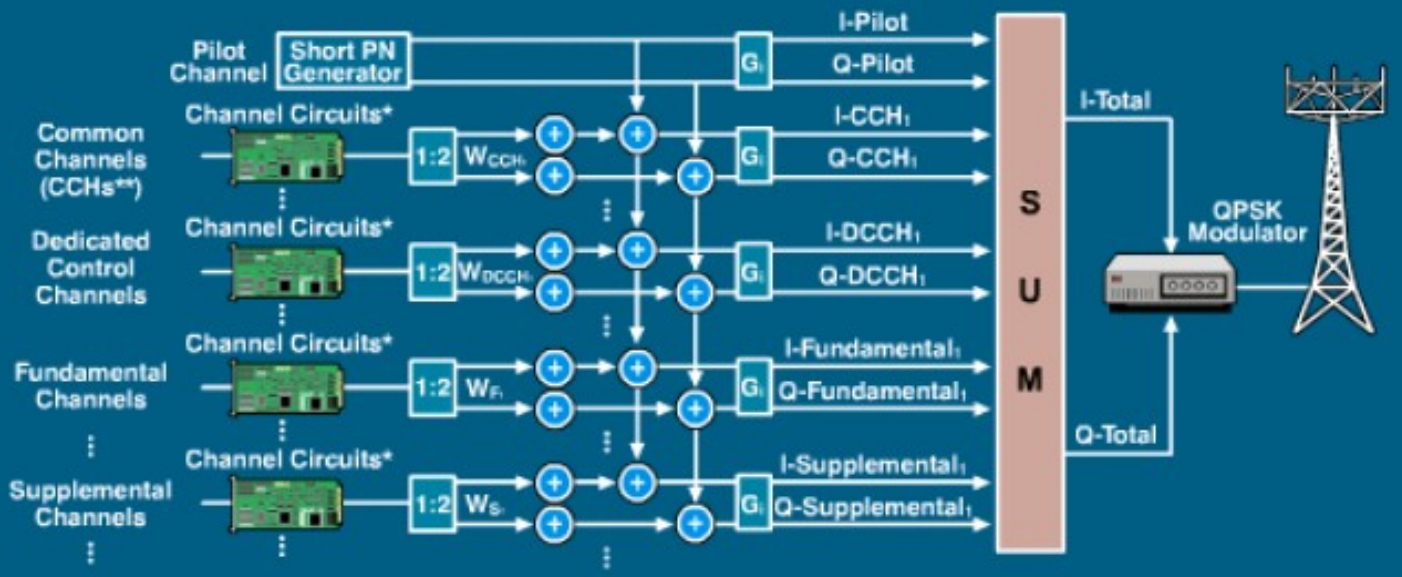
MAJOR COMMON PHYSICAL CHANNELS
CARRIED OVER* FROM cdmaOne

- F/R-PICH (Pilot Channel)
  - Forward: Aids the MS in acquiring the strongest BS
  - Forward and Reverse: Provides a phase reference for coherent demodulation
  - The Reverse Pilot Channel is new in CMDA2000
- F-SYNC (Sync Channel)
  - Aids MS initial timing synchronization and identification of the System and Network
  - Operates at 1200 b/s
- F-PCH (Paging Channel)
  - For Incoming Call/Session and System Messages, etc.
  - Operates at 9600 or 4800 b/s
- R-ACH (Access Channel)
  - Used by an idle mobile to initiate communication with the network and to respond to Paging messages
  - Operates at 4800 b/s

OTHER COMMON PHYSICAL CHANNELS
NEW IN CDMA2000

- F-CCCH and R-EACH (Forward-Common Control Channel and Reverse-Enhanced Access Channel)
  - Higher performance* common channels to enhance packet data performance
  - F-CCCH is enhanced compared to the Paging Channel (PCH)
  - R-EACH is enhanced compared to the Reverse Access Channel (RACH)
  - PCH and RACH are retained for backward compatibility
- R-CCCH (Reverse-Common Control Channel)
  - Used when the R-EACH operates in the "Reservation Access Mode", whereupon...
  - R-EACH is only used to reserve time slots on the R-CCCH, while...
  - R-CCCH carries all the data in collision-free time slots
- F/R-CCCH and R-EACH
  - May operate with 5, 10, or 20 msec control frames
  - May operate at data rates of 9.6, 19.2 or 38.4 Kb/s
  - Selectable by the MAC for each transmission

CDMA2000 BASE STATION TRANSMITTER
HIGH LEVEL ARCHITECTURE FORWARD LINK

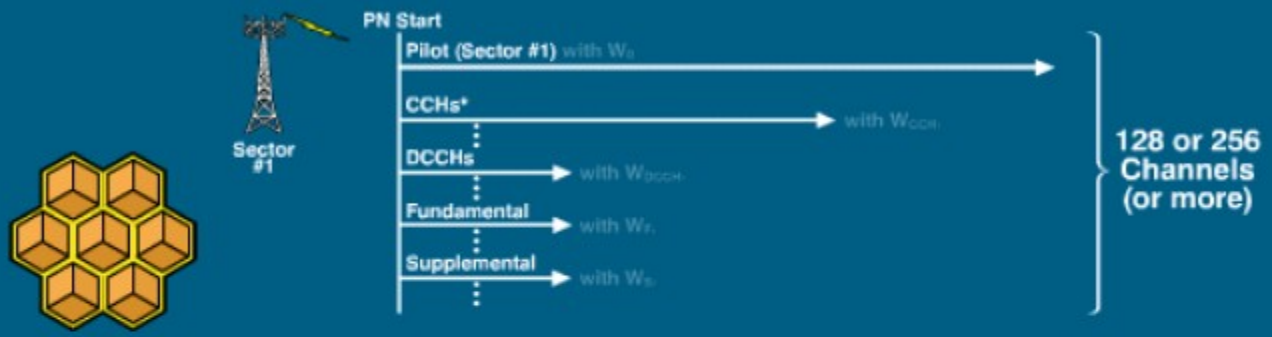


⊕ = Exclusive-OR Operation
W = Walsh Code
CCH = Common CHannel
I = In - Phase Component
PN = Pseudonoise Code Sequence
QPSK = Quadrature Phase Shift Keying
DCCH = Dedicated Control CHannel
CCCH = Common Control CHannel
Q = Quadrature (90°) Phase Component
G_i = Per Channel Individualized Gain

*Actually, a single circuit board or module can support multiple channels

**CCHs include Sync, Paging, CCCHs, etc.

UP TO 128 OR UP TO 256 WALSH CODES SUPPORT UP TO 128 OR UP TO 256 CHANNELS



- Walsh Codes create multiple "orthogonal" Channels
  - Within EACH sector... when combined with the sector's Short PN Code with its Offset
  - "Orthogonal" Channels can be separated at the receiver since:
    - Sum (Wi • Wj) = 0 unless i = j
- 3G1x 1.25 MHz RF Carriers use 128 Walsh Codes
- 3G3x 3.75 MHz RF Carriers use 256 Walsh Codes
- Wider Bandwidth RF Carriers will use more Walsh Codes to create more channels

CCH = Common CHannel
CCCH = Common Control CHannel
DCCH = Dedicated Control CHannel

*CCHs include Sync, Paging, CCCHs etc.