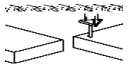
Access Channel

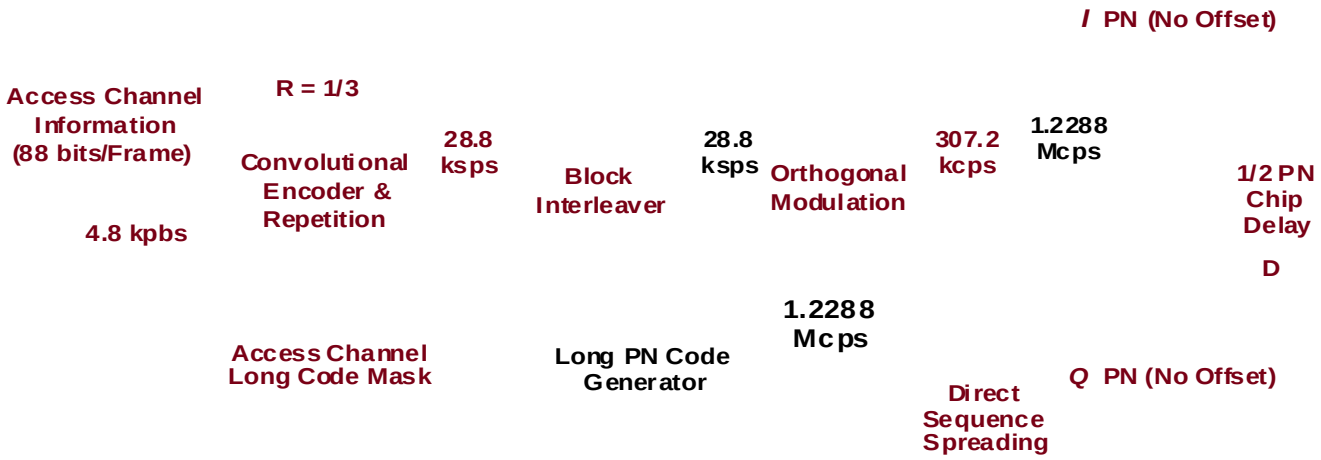


4800 bps



- Used by the mobile station to
  - Initiate communication with the base station
  - Respond to Paging Channel messages
- Has a fixed data rate of 4800 bps
- Each Access Channel is associated with only one Paging Channel
- Up to 32 access channels (0-31) are supported per Paging Channel

Access Channel Generation

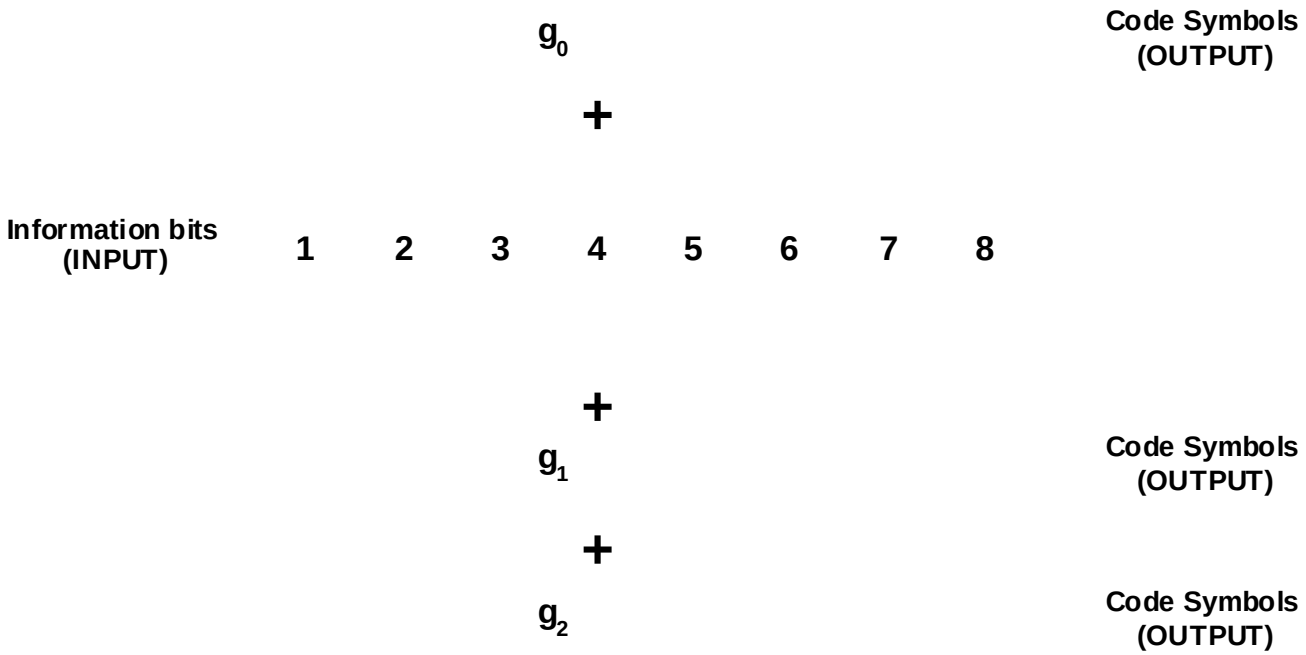


- Message attempts are randomized to reduce probability of collision
- Two message types:
  - A response message (in response to a base station message)
  - A request message (sent autonomously by the mobile station)

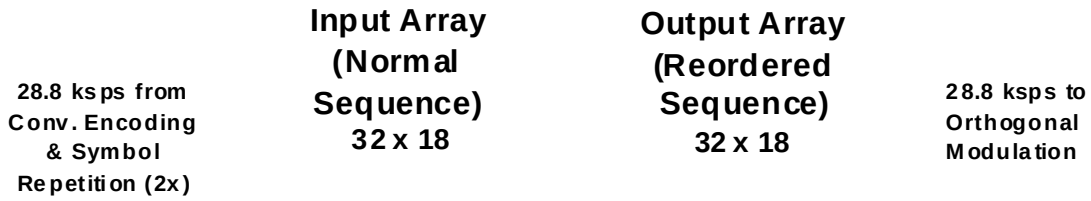
Access Channel Modulation Parameters

Data Rate	4800	bits / second
PN Chip Rate	1.2288	Megachips / second
Code Rate	1/3	bits / code symbol
Transmit Duty Cycle	100	%
Code Symbol Rate	28800	code symbols / second
Modulation	6	code symbols / modulation symbol
Modulation Symbol Rate	4800	mod. symbols / second
Walsh Symbol Rate	307.2	Kilochips / second
Modulation Symbol Duration	208.33	microsecond
PN Chips / Modulation Symbol	256	PN chips / modulation symbol
PN Chips / Walsh Code	4	PN chips / Walsh code

Rate 1/3
Convolutional Encoder



Access Channel Block Interleaving



- 576 modulation symbols (288 x 2) are written sequentially by columns, then read by rows in a particular order (called *"bit-reverse readout of the row addresses"*) every 20 ms
- Block interleaving separates repeated symbols in two identical sets: one set is transmitted during the first 10 ms and the second set, with the repetitions, is transmitted during the second 10 ms
  - Improves survivability of symbol information
  - "Spreads" the effect of spurious interference and fast fading

Access Channel Block Interleaving

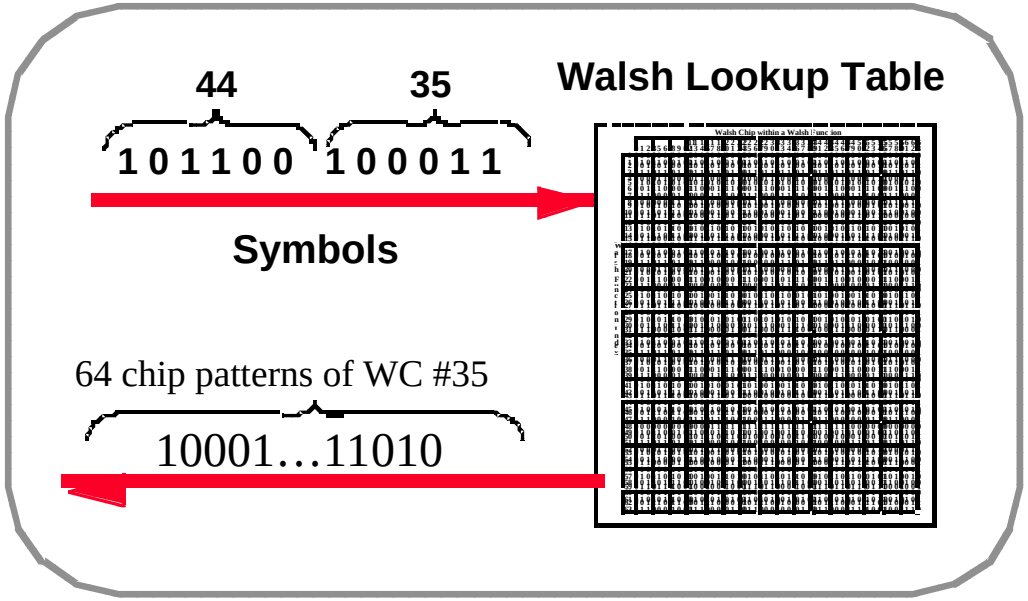
1	17	33	49	65	81	97	113	129	145	161	177	193	209	225	241	257	273
1	17	33	49	65	81	97	113	129	145	161	177	193	209	225	241	257	273
2	18	34	50	66	82	98	114	130	146	162	178	194	210	226	242	258	274
2	18	34	50	66	82	98	114	130	146	162	178	194	210	226	242	258	274
3	19	35	51	67	83	99	115	131	147	163	179	195	211	227	243	259	275
3	19	35	51	67	83	99	115	131	147	163	179	195	211	227	243	259	275
4	20	36	52	68	84	100	116	132	148	164	180	196	212	228	244	260	276
4	20	36	52	68	84	100	116	132	148	164	180	196	212	228	244	260	276
5	21	37	53	69	85	101	117	133	149	165	181	197	213	229	245	261	277
5	21	37	53	69	85	101	117	133	149	165	181	197	213	229	245	261	277
6	22	38	54	70	86	102	118	134	150	166	182	198	214	230	246	262	278
6	22	38	54	70	86	102	118	134	150	166	182	198	214	230	246	262	278
7	23	39	55	71	87	103	119	135	151	167	183	199	215	231	247	263	279
7	23	39	55	71	87	103	119	135	151	167	183	199	215	231	247	263	279
8	24	40	56	72	88	104	120	136	152	168	184	200	216	232	248	264	280
8	24	40	56	72	88	104	120	136	152	168	184	200	216	232	248	264	280
9	25	41	57	73	89	105	121	137	153	169	185	201	217	233	249	265	281
9	25	41	57	73	89	105	121	137	153	169	185	201	217	233	249	265	281
10	26	42	58	74	90	106	122	138	154	170	186	202	218	234	250	266	282
10	26	42	58	74	90	106	122	138	154	170	186	202	218	234	250	266	282
11	27	43	59	75	91	107	123	139	155	171	187	203	219	235	251	267	283
11	27	43	59	75	91	107	123	139	155	171	187	203	219	235	251	267	283
12	28	44	60	76	92	108	124	140	156	172	188	204	220	236	252	268	284
12	28	44	60	76	92	108	124	140	156	172	188	204	220	236	252	268	284
13	29	45	61	77	93	109	125	141	157	173	189	205	221	237	253	269	285
13	29	45	61	77	93	109	125	141	157	173	189	205	221	237	253	269	285
14	30	46	62	78	94	110	126	142	158	174	190	206	222	238	254	270	286
14	30	46	62	78	94	110	126	142	158	174	190	206	222	238	254	270	286
15	31	47	63	79	95	111	127	143	159	175	191	207	223	239	255	271	287
15	31	47	63	79	95	111	127	143	159	175	191	207	223	239	255	271	287
16	32	48	64	80	96	112	128	144	160	176	192	208	224	240	256	272	288
16	32	48	64	80	96	112	128	144	160	176	192	208	224	240	256	272	288

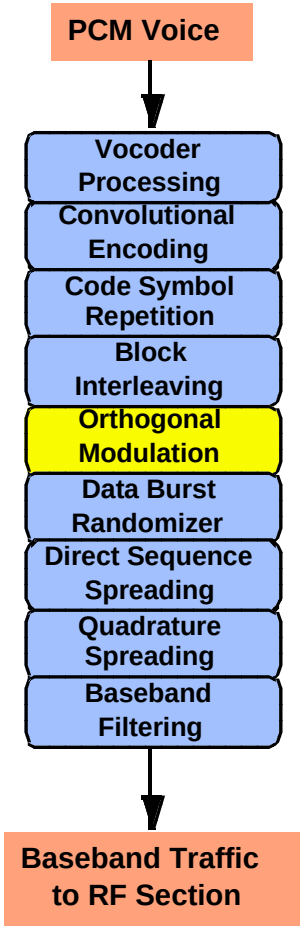
Access Channel Block Interleaving
(4800 X 2 bps – READ MATRIX)

1	17	33	49	65	81	97	113	129	145	161	177	193	209	225	241	257	273
9	25	41	57	73	89	105	121	137	153	169	185	201	217	233	249	265	281
5	21	37	53	69	85	101	117	133	149	165	181	197	213	229	245	261	277
13	29	45	61	77	93	109	125	141	157	173	189	205	221	237	253	269	285
3	19	35	51	67	83	99	115	131	147	163	179	195	211	227	243	259	275
11	27	43	59	75	91	107	123	139	155	171	187	203	219	235	251	267	283
7	23	39	55	71	87	103	119	135	151	167	183	199	215	231	247	263	279
15	31	47	63	79	95	111	127	143	159	175	191	207	223	239	255	271	287
2	18	34	50	66	82	98	114	130	146	162	178	194	210	226	242	258	274
10	26	42	58	74	90	106	122	138	154	170	186	202	218	234	250	266	282
6	22	38	54	70	86	102	118	134	150	166	182	198	214	230	246	262	278
14	30	46	62	78	94	110	126	142	158	174	190	206	222	238	254	270	286
4	20	36	52	68	84	100	116	132	148	164	180	196	212	228	244	260	276
12	28	44	60	76	92	108	124	140	156	172	188	204	220	236	252	268	284
8	24	40	56	72	88	104	120	136	152	168	184	200	216	232	248	264	280
16	32	48	64	80	96	112	128	144	160	176	192	208	224	240	256	272	288

1	17	33	49	65	81	97	113	129	145	161	177	193	209	225	241	257	273
9	25	41	57	73	89	105	121	137	153	169	185	201	217	233	249	265	281
5	21	37	53	69	85	101	117	133	149	165	181	197	213	229	245	261	277
13	29	45	61	77	93	109	125	141	157	173	189	205	221	237	253	269	285
3	19	35	51	67	83	99	115	131	147	163	179	195	211	227	243	259	275
11	27	43	59	75	91	107	123	139	155	171	187	203	219	235	251	267	283
7	23	39	55	71	87	103	119	135	151	167	183	199	215	231	247	263	279
15	31	47	63	79	95	111	127	143	159	175	191	207	223	239	255	271	287
2	18	34	50	66	82	98	114	130	146	162	178	194	210	226	242	258	274
10	26	42	58	74	90	106	122	138	154	170	186	202	218	234	250	266	282
6	22	38	54	70	86	102	118	134	150	166	182	198	214	230	246	262	278
14	30	46	62	78	94	110	126	142	158	174	190	206	222	238	254	270	286
4	20	36	52	68	84	100	116	132	148	164	180	196	212	228	244	260	276
12	28	44	60	76	92	108	124	140	156	172	188	204	220	236	252	268	284
8	24	40	56	72	88	104	120	136	152	168	184	200	216	232	248	264	280
16	32	48	64	80	96	112	128	144	160	176	192	208	224	240	256	272	288

Reverse Traffic Channel: 64-ary Orthogonal Modulation





- For every six symbols in, 64 Walsh Chips are output
- Six symbols are converted to a decimal number from 0-63
- 64 Walsh Chips corresponding to that Walsh Number are output

Access Channel Long Code Mask

An Access Channel is scrambled by the long code, offset by a mask constructed as follows:



Where:

ACN is the Access Channel Number,

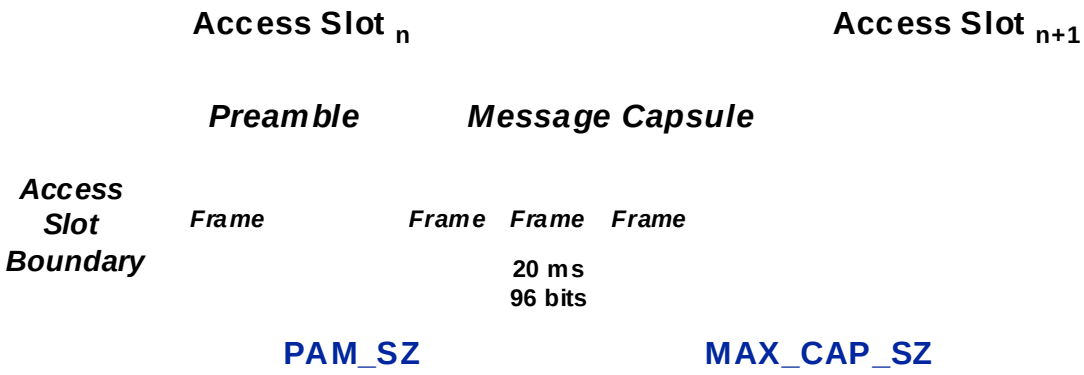
PCN is the Number of the associated Paging Channel

BASE_ID is the base station identification number, and

PILOT_PN is the Pilot short PN code offset index

Access Channel Slot Structure

4800 bps



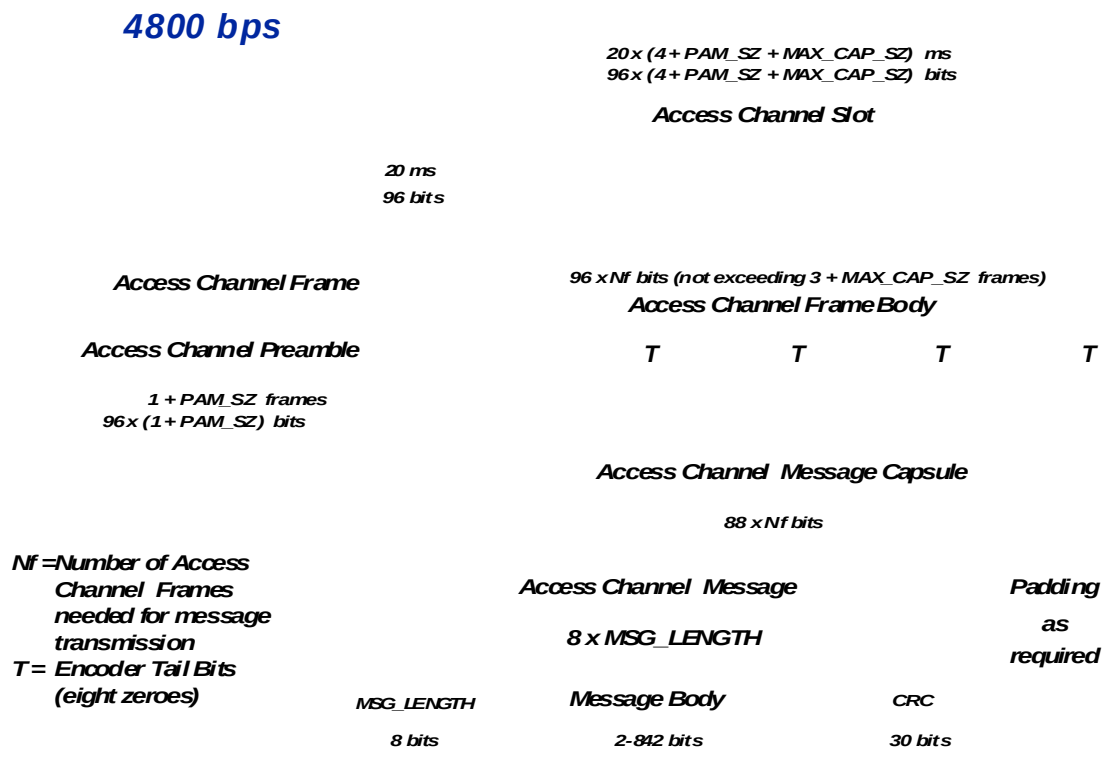
Access transmission max length:

20 x (4 + PAM_SZ + MAX_CAP_SZ) ms
96 x (4 + PAM_SZ + MAX_CAP_SZ) bits

Access Channel Slot Structure

- The PAM_SZ parameter determines the size of the Access Channel Preamble.
- The MAX_CAP_SIZE determines the size of the Access Channel Message Capsule.
- Actual transmission starts with the preamble at the beginning of the slot plus a random amount of time RN, measured in chips, calculated with a hashing algorithm that uses the mobile's ESN and a parameter sent by the base station (discussed later).

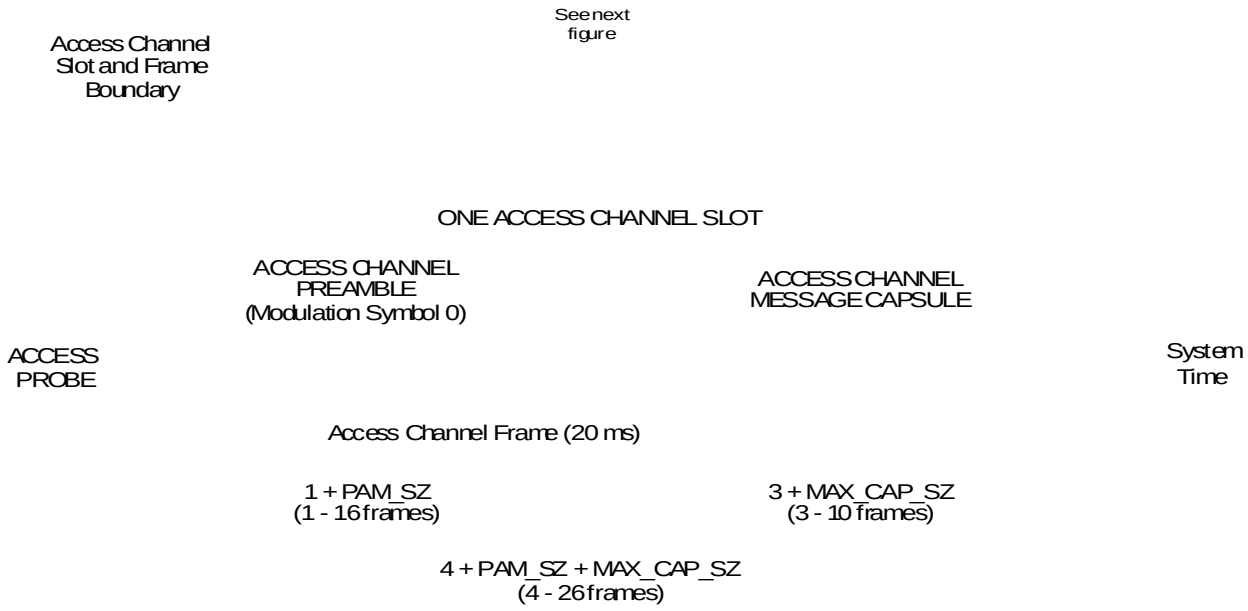
Access Channel Structure



Access Channel Structure

- **ACCESS CHANNEL SLOT** – Group of contiguous Access Channel frames where an Access Channel Message can be contained. As the Access Slot length may differ from base station to base station, a mobile station must determine the beginning and length of the Access Channel slot prior to transmission.
- All access channels associated with a particular Paging Channel have the same slot size, and all the slots begin at the same time.
- Each **Access Channel Frame** contains 96 bits (20 ms frame at 4800 bps). Each Access Channel frame consists of 88 information bits and eight Encoder Tail Bits.
- The **Encoder Tail Bits** are a fixed sequence of bits (eight zeroes) added to the end of a block of data (88 bits) to reset (flush) the convolutional encoder to a known state (all zeroes).
- The **Access Channel Preamble** consists of frames of 96 zeroes that are transmitted at the 4800 bps rate. The access Channel Preamble is transmitted to aid the base station in acquiring an Access Channel transmission.

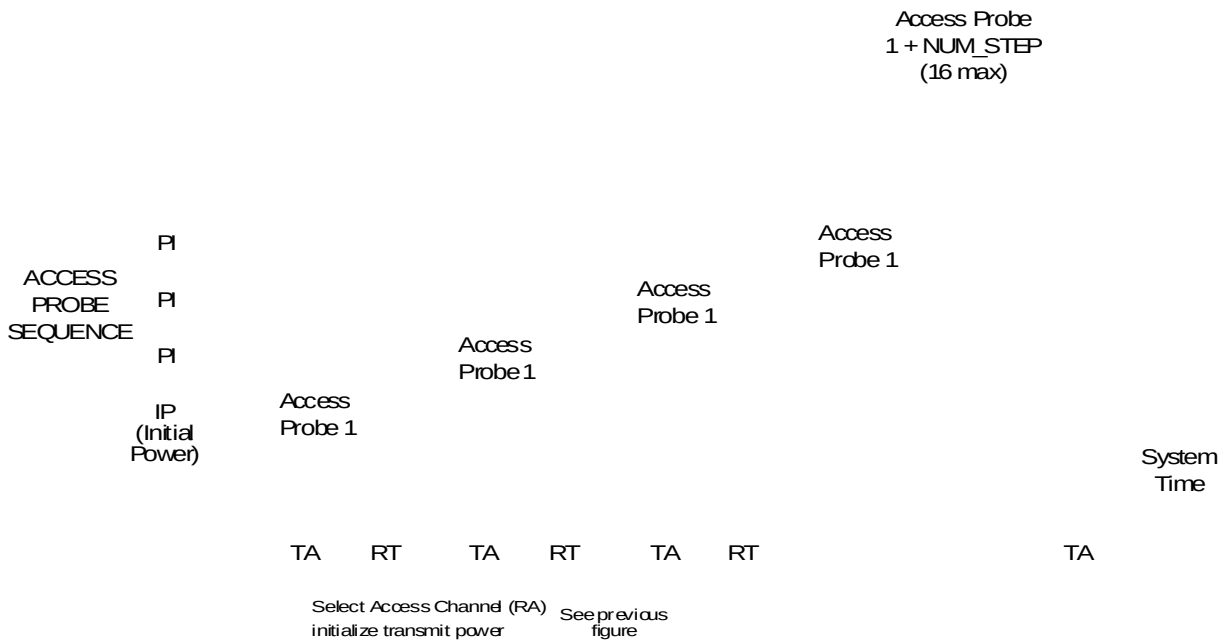
Access Channel Probing



Access Channel Probing

- Each access probe consists of an **Access Channel Preamble** and an **Access Channel Message Capsule**.
- The timing of access probes and access probe sequences is expressed in term of Access Channel slots. The transmission of an access probe begins shortly after the start of an Access Channel Slot. The **precise timing** of the Access Channel transmissions in an access attempt is determined by a procedure called **PN randomization**. For each access attempt, the mobile station computes a delay, RN from 0 to 2 PROBE_PN_RAN - 1 PN chips using a non-random hash function that depends on its ESN. The mobile station delays its transmit time by RN PN chips.
- The RN parameter, which appears on the illustration, is calculated as follows:
- **RN** – PN Randomization Delay (0 to 511 chips). Generated before every sequence,
  between 0 and 2 PROBE_PN_RAN - 1, by hash, using ESN_S.

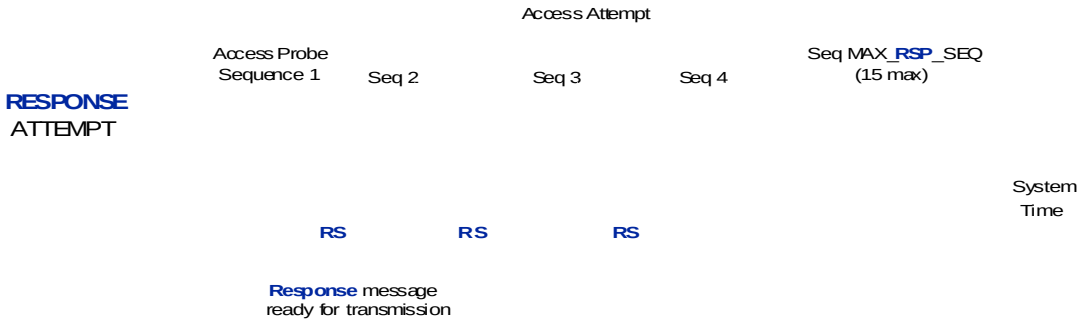
Access Channel Probing

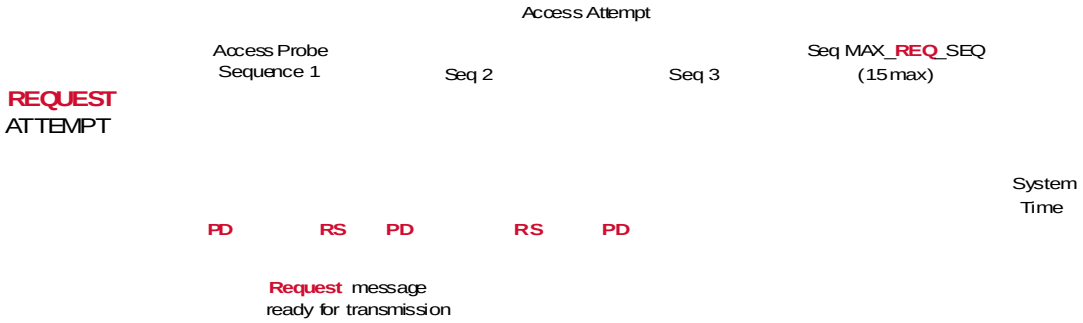


Access Channel Probing

- Within an access attempt, probes are grouped into **access probe sequences**. Each access probe sequence consists of up to 1 + NUM_STEP access probes, all transmitted on the same Access Channel. The Access Channel used for each access probe sequence is chosen pseudorandomly from among the Access Channels associated with the current Paging Channel.
  - The first access probe in an access probe sequence is transmitted at a specified **power level** relative to the nominal open-loop power level (see Lesson 7). Each subsequent access probe is transmitted at a power level that is a specified amount higher than the previous access probe. Between access probes, the mobile station "gates off" the transmitter.
- **IP** – Initial Open-Loop Power.
- **PI** – Power Increment.
- **RA** - Access Channel Number.
- **TA** – Acknowledgment Response Timeout.
- **RT** – Probe Backoff.

Access Channel Probing





Access Channel Probing

- The mobile station transmits on the Access Channel using a **random access procedure.** Many parameters of the random access procedure are supplied by the base station in the Access Parameters Message.
- The entire process of sending one message and receiving (or failing to receive) an acknowledgment for that message is called an **access attempt**. Each transmission on the access attempt is called an **access probe**. The mobile station transmits the same message in each access probe in an access attempt. Within an access attempt, access probes are grouped into **access probe sequences**.
  - The pseudorandom nature of this process reduces the probability that the access attempts of this mobile station will experience contention with the access attempts of another mobile station.
- **MAX_REQ_SEQ** – Maximum number of access probe sequences for an Access Channel request (value must be greater than 0).
- **MAX_RSP_SEQ** – Maximum number of access probe sequences for an Access Channel response (value must be greater than 0).
- **BKOFF** – Access Channel probe sequence backoff range. This parameter is set by the base station to one less than the maximum number of slots a mobile station is to delay due to random backoff between successive access probe sequences and before the first access probe sequence of a response access.
- **RS** – Sequence backoff. Random value between 0 and 1 + BKOFF; generated before every sequence (except the first sequence). Maximum range of values is 0 to 16 slots
- **PD** – Persistence delay. Delay continues slot-by-slot until persistence test (run every slot) passes

Access Parameters Message (Paging Channels)

	Field	Length (bits)
	MSG_TYPE ('00000010')	8
	PILOT_PN	9
	ACC_MSG_SEQ	6
RA	**ACC_CHAN**	**5**
	NOM_PWR	**4**
IP	**INIT_PWR**	**5**
PI	**PWR_STEP**	**3**
	NUM_STEP	**4**
	MAX_CAP_SZ	**3**
	PAM_SZ	**4**
	PSIST(0-9)	**6**
	PSIST(10)	**3**
PD	**PSIST(11)**	**3**
	PSIST(12)	**3**
	PSIST(13)	**3**
	PSIST(14)	**3**
	PSIST(15)	**3**
	MSG_PSIST	**3**
	REG_PSIST	**3**
	PROBE_PN_RAN	**4**
	ACC_TMO	**4**
	PROBE_BKOFF	**4**
	BKOFF	**4**
	MAX_REQ_SEQ	**4**
	MAX_RSP_SEQ	**4**
	AUTH	2
	RAND	0 or 32
	NOM_PWR_EXT	**1**
	RESERVED ('000000')	6

ACCESS PROBING

PD

RN

TA

RT

RS

IP

Access Parameters Message (Paging Channels)

- **PILOT_PN** – Pilot PN sequence offset for this base station, in units of 64 PN chips.
- **ACC_MSG_SEQ** – Access parameters message sequence number.
- **ACC_CHAN** – One less than the number of access channels associated with the paging channel on which this message was received.
- **NOM_PWR** – Nominal Transmit Power Offset. If the correction factor to be used by the mobile stations in the open-loop power estimation is between -24 dB and -9 dB, the NOM_PWR parameter must be set to 16 dB plus the correction factor, and NOM_PWR_EXT must be set to ‘1’. Otherwise (the correction factor is in the range -8 dB to 7 dB inclusive), the NOM_PWR parameter must be set to the correction factor, and NOM_PWR_EXT must be set to ‘0’. The NOM_PWR is expressed as a two’s complement value in units of 1 dB.
- **INIT_PWR** – InitiaL Power. This is the correction factor to be used by the mobile stations in the open-loop power estimation for initial transmission on an Access Channel, expressed as a two’s complement value in units of 1 dB.
- **PWR_STEP** - Power Increment. This is the value by which mobile stations are to increase their transmit power between successive probes in an access probe sequence, in units of 1 dB.

Access Parameters Message (Paging Channels)

- **NUM_STEP** – Number of Access Probes. This parameter is one less than the maximum number of access probes mobile stations are to transmit in a single access probe sequence.
- **MAX_CAP_SZ** – Maximum Access Channel capsule size. The actual max size (in bytes) is the value in this field (0-7) plus three.
  - **PAM_SZ** – Access Channel preamble length. The actual max size (in bytes) is the value in this field (0-15) plus one.
- **PSIST(0-9)** – Persistence value for mobile stations in access overload classes 0 through 9. If set to '111111', a mobile station in overload classes 0 though 9 is not allowed to access the CDMA system. Anything else is the persistence value to be used by the mobile station when attempting to access the system.
  - **PSIST(10) through PSIST(15)** – Persistence value for mobile stations in the corresponding access overload class. If set to '111', a mobile station in this overload class is not allowed to access the CDMA system. Anything else is the persistence value to be used by the mobile station when attempting to access the system.
- **MSG_PSIST** – Persistence modifier for Access Channel attempts for data burst message transmissions. The mobile station multiplies its transmission probability by 2 –MSG_PSIST for such attempts.
- **REG_PSIST** – Persistence modifier for Access Channel attempts for registrations that are not responses to a "Registration Request Order". The mobile station multiplies its transmission probability by 2 –REG_PSIST for such attempts.
- **PROBE_PN_RAN** – Time Randomization for Access Channel Probes. This parameter is used to calculate the number RN of PN chips a mobile station delays its transmission from System Time.
- **ACC_TMO** – Acknowledgment Timeout. This parameter is set to two less than the length of time mobile stations are to wait after the end of an Access Channel transmission before determining that the base station did not receive the transmission (in 80 ms units).
- **PROBE_BKOFF** – Access Channel Probe Backoff Range. This parameter is set to one less than the maximum number of slots mobile stations are to delay due to random backoff between consecutive access probes.
- **MAX_REQ_SEQ** – Maximum number of access probe sequences for an Access Channel request (value must be greater than 0).
- **MAX_RSP_SEQ** – Maximum number of access probe sequences for an Access Channel response (value must be greater than 0).
- **AUTH** – Authentication mode. '01' if mobile stations are to include authentication data in their Access Channel messages; '00' if not.
- **RAND** – If AUTH is set to '01', this field is set to the random challenge value to be used by the mobile station for authentication. Only in this case shall this field be included.
- **NOM_PWR_EXT** – Extended Nominal Transmit Power. If the correction factor to be used by the mobile stations in the open-loop power estimation is between -24 dB and -9 dB, this parameter must be set to '1'. Otherwise (the correction factor is in the range -8 dB to 7 dB inclusive), this parameter must be set to '0'.

Access Channel Probing Parameters

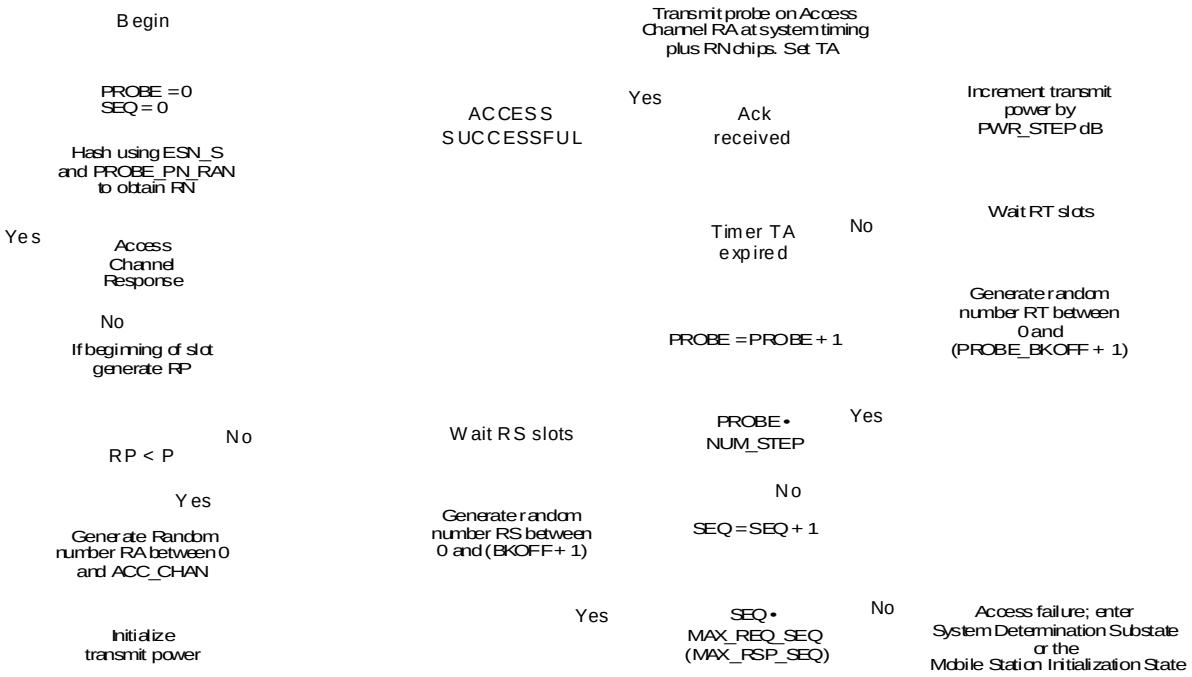
- RA - Access Channel Number. Random value between 0 and ACC_CHAN; generated before every sequence (maximum range is 0 - 31).
- IP – Initial Open-Loop Power. Calculated in dBm as follows:

  IP = k - Mean Input Power (dBm) + NOM_PWR (dB)
  - NOM_PWR_EXT x 16 (dB) + INIT_PWR (dB)

  where k = -73 for 800 MHz Cellular and -76 for 1900 PCS.
- PI – Power Increment. Equal to PWR_STEP in dB (range is 0 to 7 dB).
- TA – Acknowledgment Response Timeout (timeout from the end of the slot). Calculated in ms as follows (range is 160 to 1360 ms):

  TA = 80 x (2 + ACC_TMO)
- RT – Probe Backoff. Random value between 0 and 1 + PROBE_BKOFF; generated before every sequence (maximum range is 0 - 16 slots).
- RS – Sequence backoff . Random value between 0 and 1 + BKOFF; generated before every sequence (except the first sequence). Maximum range of values is 0 to 16 slots
- PD – Persistence delay. (Value used to implement the “persistence test”).
- RN – PN Randomization Delay. (0 to 511 chips) . Generated before every sequence, between 0 and 2 PROBE_PN_RAN - 1, by hash, using ESN_S.

Access Procedure Example



Cont.

- The section of this diagram, where a value is generated for “RP” and then compared to the probability “P”, describes the implementation of the “**persistence test**”.
- “P” is calculated by a formula that varies, according to the type of message being sent in the access probe. This calculation always involve the persistence parameter **PSIST(n)**; where “n” is the overload class assigned to the mobile station. If the Access Channel request is a registration, the **REG_PSIST** parameter is also involved in the calculation. If the Access Channel request is a message transmission, the **MSG_PSIST** parameter is also involved in the calculation.
- All these parameters are contained in the “System Parameters Message”.
- For a certain value of the PSIST (refer to J-STD 008 for details) parameter, the value of “P” is defined to be ‘0’; and when P is ‘0’, the access attempt always fails (by definition), the mobile station stops the access attempt, and enters the System Determination Substate of the Mobile Station Initialization State with an access denied indication.
- If P is not ‘0’, a value “RP” is randomly generated in the 0-1 interval, and compared with the “P”, which is also in the 0-1 interval.
- If RP is less than the current value of P for the type of this access attempt, the test succeeds and the first access probe of the probe sequence is sent; otherwise a new value for RP is calculated and the comparison repeated until it is successful.

Access Channel Messages

The following messages are sent on the Access Channel:

- **Registration Message**
- **Order Message**
- **Data Burst Message**
- **Origination Message**
- **Page Response Message**
- **Authentication Challenge Response Message**
- **Status Response Message**
- **TMSI Assignment Completion Message**

Access Channel Messages

- **Registration Message** - Sent by the mobile station on the Access Channel to register with the system. (Discussed later in the Registration lesson).
- **Order Message** - Sent by the mobile station to the base station on the Access Channel or on the Reverse Traffic Channel, with a request consisting of a 6-bit order code and zero or more order-specific fields.
- **Data Burst Message** - Sent by the mobile station to the base station on the Access Channel or on the Reverse Traffic Channel, containing a “data burst” (as defined by TIA/EIA document TBS-58)
- **Origination Message** - Sent by the mobile station to the base station on the Access Channel with the dialed number and other information like Slotted Mode & Slot Cycle Index, whether the mobile station is willing to accept calls, requested mode of operation (CDMA only, Wide Analog only, etc.).
- **Page Response Message** - Sent by the mobile station to the base station on the Access Channel in response to a Paging Message. Some of the information fields contained in this message are the same as fields contained in the Origination Message.
- **Authentication Challenge Response Message** - This message, sent by the mobile station to the base station on the Access Channel or on the Reverse Traffic Channel, contains the18-bit value AUTH_SIGNATURE calculated at the mobile station by executing the Auth-Signature procedure following reception of an Authentication Challenge Message on the Paging Channel or on the Forward Traffic Channel.
  - **Status Response Message** - Sent by the mobile station to the base station on the Access Channel or on the Reverse Traffic Channel in response to a Status Request Message. It includes all the Information Records requested in a Status Request Message received on the Paging Channel or on the Forward Traffic Channel. (Example of Information Record types are Terminal Information, Roaming Information, IMSI, ESN, etc.)
- **TMSI Assignment Completion Message** - Sent by the mobile station to the base station on the Access Channel or on the Reverse Traffic Channel after completing the process initiated by the reception of a TMSI Assignment Message on the Paging Channel or on the Forward Traffic Channel,

Order Message (Access Channels)

Field	Length (bits)	
MSG_TYPE (‘00000010’)	8	
ACK_SEQ	3	
MSG_SEQ	3	
ACK_REQ	1	Used by the Acknowledgment Procedures (Reverse Direction)
VALID_ACK	1	
ACK_TYPE	3	
MSID_TYPE	3	
MSID_LEN	4	Mobile Station Identification
MSID	8 x MSID_LEN	
RESERVED (‘00’)	2	
ORDER	6	
ADD_RECORD_LEN	3	
Order-specific fields (if used)	8 x ADD_RECORD_LEN	
RESERVED (‘00000’)	5	

Order Message – Access Channel

- **ORDER** – The mobile station sets this field to the Order Code for this type of Order Message.
- **ADD_RECORD_LEN** – This field is set by the mobile station to the number of octets in the order-specific fields contained in this message
- **Order-specific-fields** – Any fields added here by the mobile station (including the Order Qualification **ORDQ**) depend on the specific Order Code present in this message.

Selected Order Codes (Access and Reverse Traffic Channels)

	A	RT		A	RT
Base Station Challenge Order			Release Order (w/wo power down indicator)		
SSD Update Confirmation Order			Long Code Transition Request (request public/private)		
SSD Update Reject Order			Long Code Transition Response (use public/private)		
Request Wide Analog Service Order			Connect Order		
Request Narrow Analog Service Order			Continuous DTMF Tone Order (code indicates tone to play)		
Mobile Station Acknowledgment Order			Continuous DTMF Tone Order (stop playing tone)		

Data Burst Message (Access Channels)

	Field	Length (bits)
	MSG_TYPE (‘00000011’)	8
	ACK_SEQ	3
	MSG_SEQ	3
Ack.	ACK_REQ	1
	VALID_ACK	1
	ACK_TYPE	3
	MSID_TYPE	3
Addr.	MSID_LEN	4
	MSID	8 x MSID_LEN
	AUTH_MODE	2
Auth.	AUTHR	0 or 18
	RANDC	0 or 8
	COUNT	0 or 6

MSG_NUMBER	**8**
BURST_TYPE	**6**
NUM_MSGS	**8**
NUM_FIELDS	**8**
NUM_FIELD occurrences of the following field:	
CHARi	**8**

Data Burst Message (Access Channel)

- **MSG_NUMBER** – The base station sets this field to the number of this message within the data burst stream.
- **BURST_TYPE** – This field contains the value defined in document TSB-58 for this type of data burst.
  - **NUM_MSGS** – Number of messages in this data burst stream.
- **CHARi** – The message contains NUM_FIELD occurrences of this field, each containing a corresponding octet of the data burst stream.

Origination Message (Access Channels)

	Field	Length (bits)
	MSG_TYPE ('00000100')	8
Acknowledgment	ACK_SEQ	3
	MSG_SEQ	3
	ACK_REQ	1
	VALID_ACK	1
	ACK_TYPE	3
Mobile Station ID	MSID_TYPE	3
	MSID_LEN	4
	MSID	8 x MSID_LEN
Authentication	AUTH_MODE	2
	AUTHR	0 or 18
	RANDC	0 or 8
	COUNT	0 or 6
	MOB_TERM	1
	SLOT_CYCLE_INDEX	3
	MOB_P_REV	8
	EXT_SCM	1
	RESERVED ('0')	1
	SLOTTED_MODE	1
	RESERVED ('00000')	5
	REQUEST_MODE	**3**
	SPECIAL_SERVICE	1
	SERVICE_OPTION	0 or 16
	PM	1
	DIGIT_MODE	**1**
	NUMBER_TYPE	**0 or 3**
	NUMBER_PLAN	**0 or 4**
	MORE_FIELDS	**1**
	NUM_FIELDS	**8**
	NUM_FIELD occurrences of the following field:	
	CHARi	**4 or 8**
	NAR_AN_CAP	1
	RESERVED ('0's)	0-7 (as needed)

Origination Continuation

- **DIGIT_MODE –** Digit mode indicator. The mobile station sets this field to the DIGIT_MODE value from the Access Channel Origination Message for which this message is a continuation.
- **NUM_FIELDS –** Number of dialed digits in this message. The mobile station sets this field to the number of dialed digits included in this message.
- **CHARi –** A dialed digit or character. The mobile station includes NUM_FIELDS occurrences of this field, one for each dialed digit after those sent in the Access Channel Origination Message of which this message is a continuation. If the DIGIT_MODE field is set to ‘0’, the mobile station sets each occurrence of this field to the DTMF code value corresponding to the dialed digit (see previous slide). If the DIGIT_MODE field is set to ‘1’, the personal station sets each occurrence of this field to the ASCII representation corresponding to the dialed digit, with the most significant bit set to ‘0’.

Origination Continuation Message (Reverse Traffic Channels)

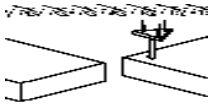


Field	Length (bits)
MSG_TYPE (‘00001001’)	8
ACK_SEQ	3
MSG_SEQ	3
ACK_REQ	1
ENCRYPTION	2
DIGIT_MODE	**1**
NUM_FIELDS	**8**
NUM_FIELDS occurrences of the following field:	
CHARi	**4 or 8**
RESERVED (‘0’s)	0 - 7 (as needed)

Reverse Traffic Channel

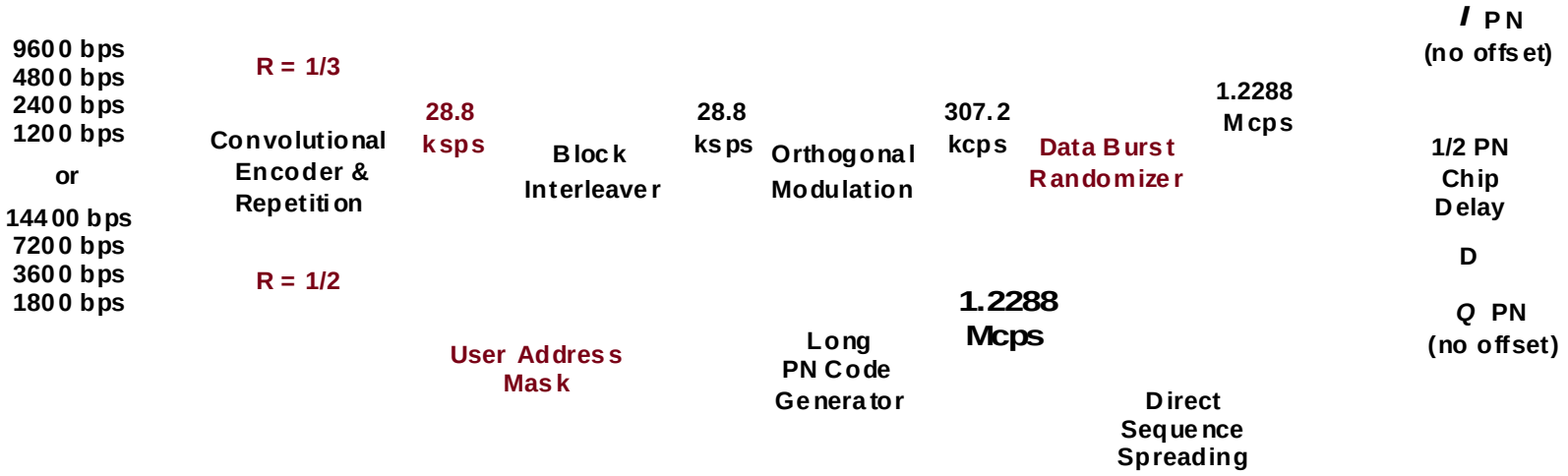


Reverse Traffic Channel



- Used when a call is in progress to send
  - Voice traffic from the subscriber
  - Response to commands/queries from the base station
  - Requests to the base station
- Supports variable data rate operation for
  - 8 Kbps vocoder
    - Rate Set 1 - 9600, 4800, 2400 and 1200 bps
    - Multiplex Option 1
  - 13 Kbps vocoder
    - Rate Set 2 - 14400, 7200, 3600, 1800 bps
    - Multiplex Option 2

Reverse Traffic Channel Generation



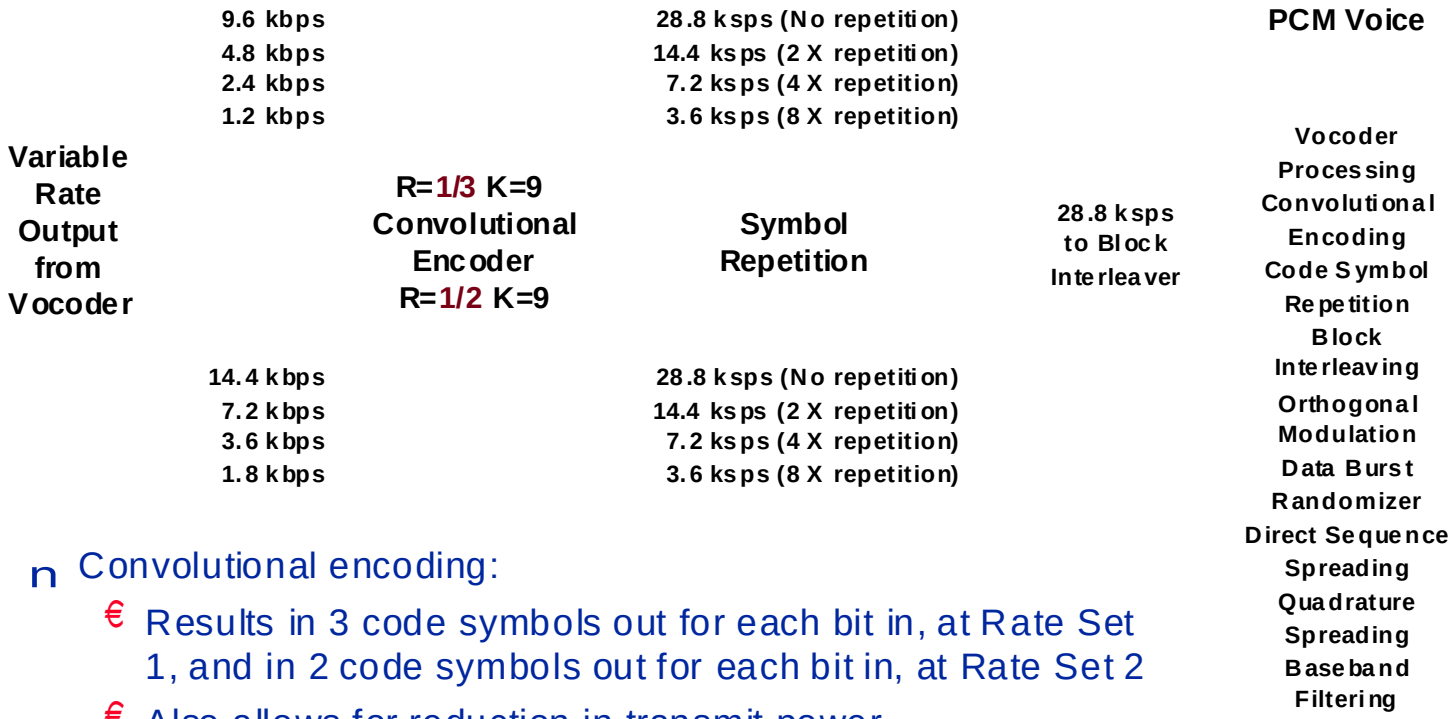
Reverse Traffic Channel Modulation Parameters

Data Rate (8 Kb vocoder) (13 Kb vocoder)	9600 14400	4800 7200	2400 3600	1200 1800	Bits / Second
PN Chip Rate	1.2288	1.2288	1.2288	1.2288	Mega Chips / Second
Code Rate (8 Kb) (13 Kb)	1 / 3 1 / 2	1 / 3 1 / 2	1 / 3 1 / 2	1 / 3 1 / 2	Bits Per Code Symbol
Transmit Duty Cycle	100	50	25	12.5	%
Code Symbol Rate	28800	14400	7200	3600	Code Symbols / Second
Modulation	6	6	6	6	Code Symbols / Mod. Symbols
Mod. Symbol Rate	4800	4800	4800	4800	Mod. Symbols / Second
Walsh Chip Rate	307.2	307.2	307.2	307.2	Kilo chips / Second
Mod. Symbol Duration	208.33	208.33	208.33	208.33	Microseconds
PN Chips / Mod. Symbol	256	256	256	256	PN Chips / Mod. Symbol
PN Chips / Walsh Chip	4	4	4	4	PN Chips / Walsh Chip

Reverse Traffic Channel Frame Structure

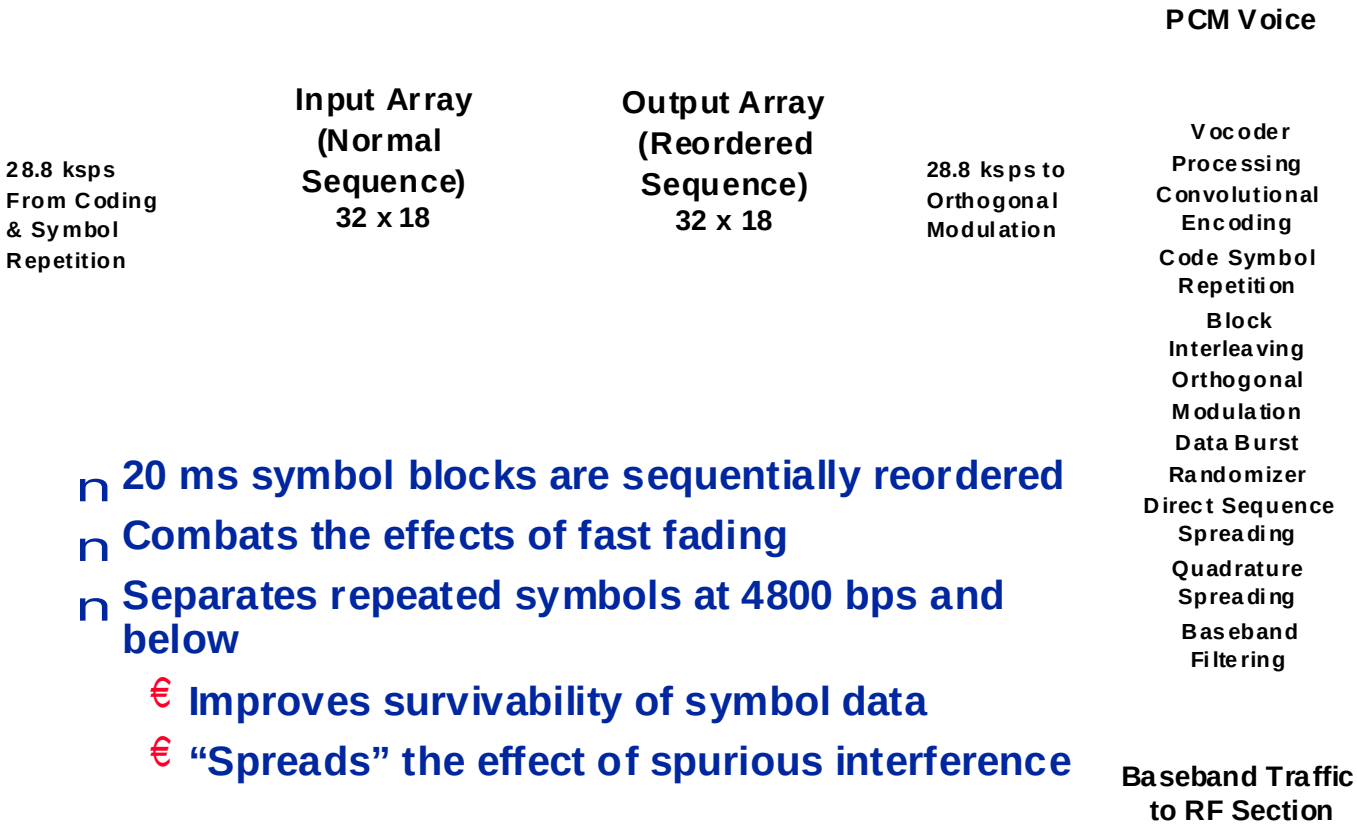
Rate Set	Transmission Rate	Number of Bits per Frame				
		Total	Erasure	Information	CRC	Tail Bits
1	9600	192	—	172	12	8
	4800	96	—	80	8	8
	2400	48	—	40	—	8
	1200	24	—	16	—	8
2	14400	288	1	267	12	8
	7200	144	1	125	10	8
	3600	72	1	55	8	8
	1800	36	1	21	6	8

Reverse Traffic Channel Convolutional Encoder



- Convolutional encoding:
  - Results in 3 code symbols out for each bit in, at Rate Set 1, and in 2 code symbols out for each bit in, at Rate Set 2
  - Also allows for reduction in transmit power
  - Reduces overall noise & increases capacity
- Symbol repetition maintains a constant 28.8 ksps output to block interleaver

Reverse Traffic Channel: Block Interleaving



- 20 ms symbol blocks are sequentially reordered
- Combats the effects of fast fading
- Separates repeated symbols at 4800 bps and below
  - Improves survivability of symbol data
  - “Spreads” the effect of spurious interference

Reverse Traffic Channel Block Interleaving (9600 and 14400 bps)

WRITE	READ																
1	33	65	97	129	161	193	225	257	289	321	353	385	417	449	471	503	535
2	34	66	98	130	162	194	226	258	290	322	354	386	418	450	472	504	536
3	35	67	99	131	163	195	227	259	291	323	355	387	419	451	473	505	537
4	36	68	100	132	164	196	228	260	292	324	356	388	420	452	474	506	538
5	37	69	101	133	165	197	229	261	293	325	357	389	421	453	475	507	549
6	38	70	102	134	166	198	230	262	294	326	358	390	422	454	476	508	540
7	39	71	103	135	167	199	231	263	295	327	359	391	423	455	477	509	541
8	40	72	104	136	168	200	232	264	296	328	360	392	424	456	478	510	542
9	41	73	105	137	169	201	233	265	297	329	361	393	425	457	479	511	543
10	42	74	106	138	170	202	234	266	298	330	362	394	426	458	470	512	544
11	43	75	107	139	171	203	235	267	299	331	363	395	427	459	481	513	545
12	44	76	108	140	172	204	236	268	300	332	364	396	428	460	482	514	546
13	45	77	109	141	173	205	237	269	301	333	365	397	429	461	483	515	547
14	46	78	110	142	174	206	238	270	302	334	366	398	430	462	484	516	548
15	47	79	111	143	175	207	239	271	303	335	367	399	431	463	485	517	559
16	48	80	112	144	176	208	240	272	304	336	368	400	432	464	486	518	550
17	49	81	113	145	177	209	241	273	305	337	369	401	433	465	487	519	551
18	50	82	114	146	178	210	242	274	306	338	370	402	434	466	488	520	552
19	51	83	115	147	179	211	243	275	307	339	371	403	435	467	489	521	553
20	52	84	116	148	180	212	244	276	308	340	372	404	436	468	480	522	554
21	53	85	117	149	181	213	245	277	309	341	373	405	437	469	491	523	555
22	54	86	118	150	182	214	246	278	310	342	374	406	438	470	492	524	556
23	55	87	119	151	183	215	247	279	311	343	375	407	439	471	493	525	557
24	56	88	120	152	184	216	248	280	312	344	376	408	440	472	494	526	558
25	57	89	121	153	185	217	249	281	313	345	377	409	441	473	495	527	569
26	58	90	122	154	186	218	250	282	314	346	378	410	442	474	496	528	570
27	59	91	123	155	187	219	251	283	315	347	379	411	443	475	497	529	571
28	60	92	124	156	188	220	252	284	316	348	380	412	444	476	498	530	572
29	61	93	125	157	189	221	253	285	317	349	381	413	445	477	499	531	573
30	62	94	126	158	190	222	254	286	318	350	382	414	446	478	500	532	574
31	63	95	127	159	191	223	255	287	319	351	383	415	447	479	501	533	575
32	64	96	128	160	192	224	256	288	320	352	384	416	448	470	502	534	576

Reverse Traffic Channel Block Interleaving (4800 and 7200 bps)

READ

WRITE

1	17	33	49	65	81	97	113	129	145	161	177	193	209	225	241	257	273
1	17	33	49	65	81	97	113	129	145	161	177	193	209	225	241	257	273
2	18	34	50	66	82	98	114	130	146	162	178	194	210	226	242	258	274
2	18	34	50	66	82	98	114	130	146	162	178	194	210	226	242	258	274
3	19	35	51	67	83	99	115	131	147	163	179	195	211	227	243	259	275
3	19	35	51	67	83	99	115	131	147	163	179	195	211	227	243	259	275
4	20	36	52	68	84	100	116	132	148	164	180	196	212	228	244	260	276
4	20	36	52	68	84	100	116	132	148	164	180	196	212	228	244	260	276
5	21	37	53	69	85	101	117	133	149	165	181	197	213	229	245	261	277
5	21	37	53	69	85	101	117	133	149	165	181	197	213	229	245	261	277
6	22	38	54	70	86	102	118	134	150	166	182	198	214	230	246	262	278
6	22	38	54	70	86	102	118	134	150	166	182	198	214	230	246	262	278
7	23	39	55	71	87	103	119	135	151	167	183	199	215	231	247	263	279
7	23	39	55	71	87	103	119	135	151	167	183	199	215	231	247	263	279
8	24	40	56	72	88	104	120	136	152	168	184	200	216	232	248	264	280
8	24	40	56	72	88	104	120	136	152	168	184	200	216	232	248	264	280
9	25	41	57	73	89	105	121	137	153	169	185	201	217	233	249	265	281
9	25	41	57	73	89	105	121	137	153	169	185	201	217	233	249	265	281
10	26	42	58	74	90	106	122	138	154	170	186	202	218	234	250	266	282
10	26	42	58	74	90	106	122	138	154	170	186	202	218	234	250	266	282
11	27	43	59	75	91	107	123	139	155	171	187	203	219	235	251	267	283
11	27	43	59	75	91	107	123	139	155	171	187	203	219	235	251	267	283
12	28	44	60	76	92	108	124	140	156	172	188	204	220	236	252	268	284
12	28	44	60	76	92	108	124	140	156	172	188	204	220	236	252	268	284
13	29	45	61	77	93	109	125	141	157	173	189	205	221	237	253	269	285
13	29	45	61	77	93	109	125	141	157	173	189	205	221	237	253	269	285
14	30	46	62	78	94	110	126	142	158	174	190	206	222	238	254	270	286
14	30	46	62	78	94	110	126	142	158	174	190	206	222	238	254	270	286
15	31	47	63	79	95	111	127	143	159	175	191	207	223	239	255	271	287
15	31	47	63	79	95	111	127	143	159	175	191	207	223	239	255	271	287
16	32	48	64	80	96	112	128	144	160	176	192	208	224	240	256	272	288
16	32	48	64	80	96	112	128	144	160	176	192	208	224	240	256	272	288

Power Control Groups

1	17	33	49	65	81	97	113	129	145	161	177	193	209	225	241	257	273
2	18	34	50	66	82	98	114	130	146	162	178	194	210	226	242	258	274
1	17	33	49	65	81	97	113	129	145	161	177	193	209	225	241	257	273
2	18	34	50	66	82	98	114	130	146	162	178	194	210	226	242	258	274
3	19	35	51	67	83	99	115	131	147	163	179	195	211	227	243	259	275
4	20	36	52	68	84	100	116	132	148	164	180	196	212	228	244	260	276
3	19	35	51	67	83	99	115	131	147	163	179	195	211	227	243	259	275
4	20	36	52	68	84	100	116	132	148	164	180	196	212	228	244	260	276
5	21	37	53	69	85	101	117	133	149	165	181	197	213	229	245	261	277
6	22	38	54	70	86	102	118	134	150	166	182	198	214	230	246	262	278
5	21	37	53	69	85	101	117	133	149	165	181	197	213	229	245	261	277
6	22	38	54	70	86	102	118	134	150	166	182	198	214	230	246	262	278
7	23	39	55	71	87	103	119	135	151	167	183	199	215	231	247	263	279
8	24	40	56	72	88	104	120	136	152	168	184	200	216	232	248	264	280
7	23	39	55	71	87	103	119	135	151	167	183	199	215	231	247	263	279
8	24	40	56	72	88	104	120	136	152	168	184	200	216	232	248	264	280
9	25	41	57	73	89	105	121	137	153	169	185	201	217	233	249	265	281
10	26	42	58	74	90	106	122	138	154	170	186	202	218	234	250	266	282
9	25	41	57	73	89	105	121	137	153	169	185	201	217	233	249	265	281
10	26	42	58	74	90	106	122	138	154	170	186	202	218	234	250	266	282
11	27	43	59	75	91	107	123	139	155	171	187	203	219	235	251	267	283
12	28	44	60	76	92	108	124	140	156	172	188	204	220	236	252	268	284
11	27	43	59	75	91	107	123	139	155	171	187	203	219	235	251	267	283
12	28	44	60	76	92	108	124	140	156	172	188	204	220	236	252	268	284
13	29	45	61	77	93	109	125	141	157	173	189	205	221	237	253	269	285
14	30	46	62	78	94	110	126	142	158	174	190	206	222	238	254	270	286
13	29	45	61	77	93	109	125	141	157	173	189	205	221	237	253	269	285
14	30	46	62	78	94	110	126	142	158	174	190	206	222	238	254	270	286
15	31	47	63	79	95	111	127	143	159	175	191	207	223	239	255	271	287
16	32	48	64	80	96	112	128	144	160	176	192	208	224	240	256	272	288
15	31	47	63	79	95	111	127	143	159	175	191	207	223	239	255	271	287
16	32	48	64	80	96	112	128	144	160	176	192	208	224	240	256	272	288

Notice that, with this scheme, every FOUR rows produce TWO identical sequences of 36 modulation symbols:

(1-2), (1-2), (3-4), (3-4), (5-6), (5-6), (7-8), (7-8), (9-10, (9-10), (11-12), (11-12), (13-14), (13-14), (15-16), (15-16)

Reverse Traffic Channel Block Interleaving (2400 and 3600 bps)

READ

WRITE

1	9	17	25	33	41	49	57	65	73	81	89	97	105	113	121	129	137
1	9	17	25	33	41	49	57	65	73	81	89	97	105	113	121	129	137
1	9	17	25	33	41	49	57	65	73	81	89	97	105	113	121	129	137
1	9	17	25	33	41	49	57	65	73	81	89	97	105	113	121	129	137
2	10	18	26	34	42	50	58	66	74	82	90	98	106	114	122	130	138
2	10	18	26	34	42	50	58	66	74	82	90	98	106	114	122	130	138
2	10	18	26	34	42	50	58	66	74	82	90	98	106	114	122	130	138
2	10	18	26	34	42	50	58	66	74	82	90	98	106	114	122	130	138
3	11	19	27	35	43	51	59	67	75	83	91	99	107	115	123	131	139
3	11	19	27	35	43	51	59	67	75	83	91	99	107	115	123	131	139
3	11	19	27	35	43	51	59	67	75	83	91	99	107	115	123	131	139
3	11	19	27	35	43	51	59	67	75	83	91	99	107	115	123	131	139
4	12	20	28	36	44	52	60	68	76	84	92	100	108	116	124	132	140
4	12	20	28	36	44	52	60	68	76	84	92	100	108	116	124	132	140
4	12	20	28	36	44	52	60	68	76	84	92	100	108	116	124	132	140
4	12	20	28	36	44	52	60	68	76	84	92	100	108	116	124	132	140
5	13	21	29	37	45	53	61	69	77	85	93	101	109	117	125	133	141
5	13	21	29	37	45	53	61	69	77	85	93	101	109	117	125	133	141
5	13	21	29	37	45	53	61	69	77	85	93	101	109	117	125	133	141
5	13	21	29	37	45	53	61	69	77	85	93	101	109	117	125	133	141
6	14	22	30	38	46	54	62	70	78	86	94	102	110	118	126	134	142
6	14	22	30	38	46	54	62	70	78	86	94	102	110	118	126	134	142
6	14	22	30	38	46	54	62	70	78	86	94	102	110	118	126	134	142
6	14	22	30	38	46	54	62	70	78	86	94	102	110	118	126	134	142
7	15	23	31	39	47	55	63	71	79	87	95	103	111	119	127	135	143
7	15	23	31	39	47	55	63	71	79	87	95	103	111	119	127	135	143
7	15	23	31	39	47	55	63	71	79	87	95	103	111	119	127	135	143
7	15	23	31	39	47	55	63	71	79	87	95	103	111	119	127	135	143
8	16	24	32	40	48	56	64	72	80	88	96	104	112	120	128	136	144
8	16	24	32	40	48	56	64	72	80	88	96	104	112	120	128	136	144
8	16	24	32	40	48	56	64	72	80	88	96	104	112	120	128	136	144
8	16	24	32	40	48	56	64	72	80	88	96	104	112	120	128	136	144

Power Control Groups (2400 and 3600 bps)

1	17	33	49	65	81	97	113	129	145	161	177	193	209	225	241	257	273
2	18	34	50	66	82	98	114	130	146	162	178	194	210	226	242	258	274
1	17	33	49	65	81	97	113	129	145	161	177	193	209	225	241	257	273
2	18	34	50	66	82	98	114	130	146	162	178	194	210	226	242	258	274
1	17	33	49	65	81	97	113	129	145	161	177	193	209	225	241	257	273
2	18	34	50	66	82	98	114	130	146	162	178	194	210	226	242	258	274
1	17	33	49	65	81	97	113	129	145	161	177	193	209	225	241	257	273
2	18	34	50	66	82	98	114	130	146	162	178	194	210	226	242	258	274
3	19	35	51	67	83	99	115	131	147	163	179	195	211	227	243	259	275
4	20	36	52	68	84	100	116	132	148	164	180	196	212	228	244	260	276
3	19	35	51	67	83	99	115	131	147	163	179	195	211	227	243	259	275
4	20	36	52	68	84	100	116	132	148	164	180	196	212	228	244	260	276
3	19	35	51	67	83	99	115	131	147	163	179	195	211	227	243	259	275
4	20	36	52	68	84	100	116	132	148	164	180	196	212	228	244	260	276
3	19	35	51	67	83	99	115	131	147	163	179	195	211	227	243	259	275
4	20	36	52	68	84	100	116	132	148	164	180	196	212	228	244	260	276
5	21	37	53	69	85	101	117	133	149	165	181	197	213	229	245	261	277
6	22	38	54	70	86	102	118	134	150	166	182	198	214	230	246	262	278
5	21	37	53	69	85	101	117	133	149	165	181	197	213	229	245	261	277
6	22	38	54	70	86	102	118	134	150	166	182	198	214	230	246	262	278
5	21	37	53	69	85	101	117	133	149	165	181	197	213	229	245	261	277
6	22	38	54	70	86	102	118	134	150	166	182	198	214	230	246	262	278
5	21	37	53	69	85	101	117	133	149	165	181	197	213	229	245	261	277
6	22	38	54	70	86	102	118	134	150	166	182	198	214	230	246	262	278
7	23	39	55	71	87	103	119	135	151	167	183	199	215	231	247	263	279
8	24	40	56	72	88	104	120	136	152	168	184	200	216	232	248	264	280
7	23	39	55	71	87	103	119	135	151	167	183	199	215	231	247	263	279
8	24	40	56	72	88	104	120	136	152	168	184	200	216	232	248	264	280
7	23	39	55	71	87	103	119	135	151	167	183	199	215	231	247	263	279
8	24	40	56	72	88	104	120	136	152	168	184	200	216	232	248	264	280
7	23	39	55	71	87	103	119	135	151	167	183	199	215	231	247	263	279
8	24	40	56	72	88	104	120	136	152	168	184	200	216	232	248	264	280

Reverse Traffic Channel Block Interleaving (1200 and 1800 bps)

READ

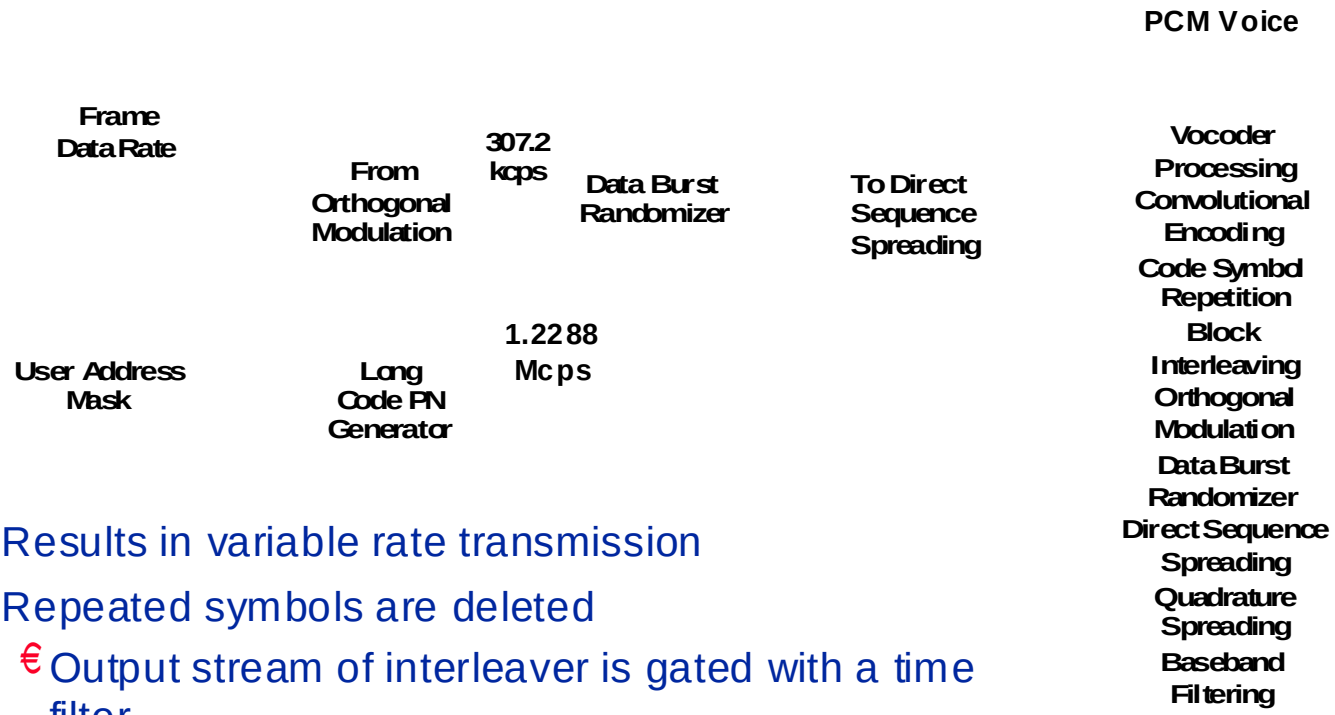
WRITE

1	5	9	13	17	21	25	29	33	37	41	45	49	53	57	61	65	69
1	5	9	13	17	21	25	29	33	37	41	45	49	53	57	61	65	69
1	5	9	13	17	21	25	29	33	37	41	45	49	53	57	61	65	69
1	5	9	13	17	21	25	29	33	37	41	45	49	53	57	61	65	69
1	5	9	13	17	21	25	29	33	37	41	45	49	53	57	61	65	69
1	5	9	13	17	21	25	29	33	37	41	45	49	53	57	61	65	69
1	5	9	13	17	21	25	29	33	37	41	45	49	53	57	61	65	69
1	5	9	13	17	21	25	29	33	37	41	45	49	53	57	61	65	69
2	6	10	14	18	22	26	30	34	38	42	46	50	54	58	62	66	70
2	6	10	14	18	22	26	30	34	38	42	46	50	54	58	62	66	70
2	6	10	14	18	22	26	30	34	38	42	46	50	54	58	62	66	70
2	6	10	14	18	22	26	30	34	38	42	46	50	54	58	62	66	70
2	6	10	14	18	22	26	30	34	38	42	46	50	54	58	62	66	70
2	6	10	14	18	22	26	30	34	38	42	46	50	54	58	62	66	70
2	6	10	14	18	22	26	30	34	38	42	46	50	54	58	62	66	70
2	6	10	14	18	22	26	30	34	38	42	46	50	54	58	62	66	70
3	7	11	15	19	23	27	31	35	39	43	47	51	55	59	63	67	71
3	7	11	15	19	23	27	31	35	39	43	47	51	55	59	63	67	71
3	7	11	15	19	23	27	31	35	39	43	47	51	55	59	63	67	71
3	7	11	15	19	23	27	31	35	39	43	47	51	55	59	63	67	71
3	7	11	15	19	23	27	31	35	39	43	47	51	55	59	63	67	71
3	7	11	15	19	23	27	31	35	39	43	47	51	55	59	63	67	71
3	7	11	15	19	23	27	31	35	39	43	47	51	55	59	63	67	71
3	7	11	15	19	23	27	31	35	39	43	47	51	55	59	63	67	71
4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72
4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72
4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72
4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72
4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72
4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72
4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72
4	8	12	16	20	24	28	32	36	40	44	48	52	56	60	64	68	72

Power Control Groups (1200 and 1800 bps)

1	17	33	49	65	81	97	113	129	145	161	177	193	209	225	241	257	273
2	18	34	50	66	82	98	114	130	146	162	178	194	210	226	242	258	274
1	17	33	49	65	81	97	113	129	145	161	177	193	209	225	241	257	273
2	18	34	50	66	82	98	114	130	146	162	178	194	210	226	242	258	274
1	17	33	49	65	81	97	113	129	145	161	177	193	209	225	241	257	273
2	18	34	50	66	82	98	114	130	146	162	178	194	210	226	242	258	274
1	17	33	49	65	81	97	113	129	145	161	177	193	209	225	241	257	273
2	18	34	50	66	82	98	114	130	146	162	178	194	210	226	242	258	274
1	17	33	49	65	81	97	113	129	145	161	177	193	209	225	241	257	273
2	18	34	50	66	82	98	114	130	146	162	178	194	210	226	242	258	274
1	17	33	49	65	81	97	113	129	145	161	177	193	209	225	241	257	273
2	18	34	50	66	82	98	114	130	146	162	178	194	210	226	242	258	274
1	17	33	49	65	81	97	113	129	145	161	177	193	209	225	241	257	273
2	18	34	50	66	82	98	114	130	146	162	178	194	210	226	242	258	274
3	19	35	51	67	83	99	115	131	147	163	179	195	211	227	243	259	275
4	20	36	52	68	84	100	116	132	148	164	180	196	212	228	244	260	276
3	19	35	51	67	83	99	115	131	147	163	179	195	211	227	243	259	275
4	20	36	52	68	84	100	116	132	148	164	180	196	212	228	244	260	276
3	19	35	51	67	83	99	115	131	147	163	179	195	211	227	243	259	275
4	20	36	52	68	84	100	116	132	148	164	180	196	212	228	244	260	276
3	19	35	51	67	83	99	115	131	147	163	179	195	211	227	243	259	275
4	20	36	52	68	84	100	116	132	148	164	180	196	212	228	244	260	276
3	19	35	51	67	83	99	115	131	147	163	179	195	211	227	243	259	275
4	20	36	52	68	84	100	116	132	148	164	180	196	212	228	244	260	276
3	19	35	51	67	83	99	115	131	147	163	179	195	211	227	243	259	275
4	20	36	52	68	84	100	116	132	148	164	180	196	212	228	244	260	276

Reverse Traffic Channel: Data Burst Randomizing



- Results in variable rate transmission
- Repeated symbols are deleted
  - Output stream of interleaver is gated with a time filter
  - Gate duty cycle varies with the transmit data rate
- A pseudorandom masking pattern masks duplicate data generated by the code symbol repetition

Data Burst Randomizing: How and Why

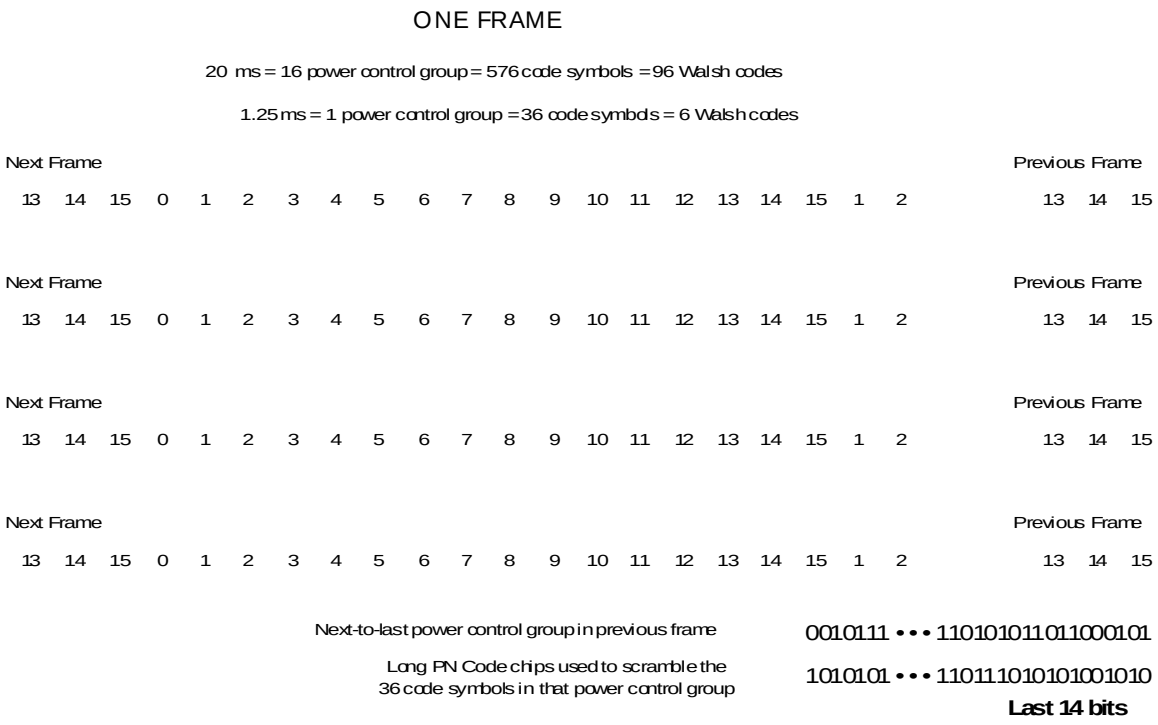
HOW?

- **All symbols are transmitted at full rate power**
  - **During “gate-off” periods, transmit power is reduced by at least 20dB**
  - **Every code symbol inputted to the repetition process is transmitted only once**

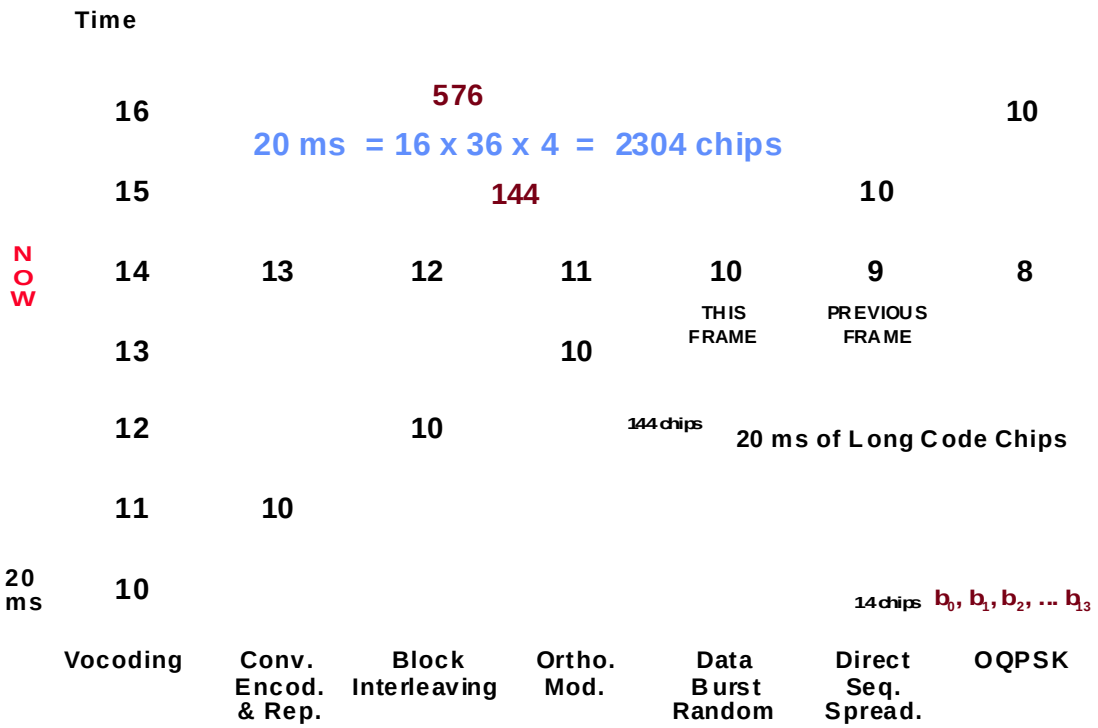
WHY?

- **Power control of the reverse link must be more tightly coupled**
  - **The base station receiver can more quickly determine symbol strength since it only has to integrate 36 symbols (1.25 ms) at a time (unlike in the forward link processing)**
  - **Quick determination allows for more accurate power control signals sent via power control bit puncturing technique on forward link (Reverse Closed Loop Power Control)**
- **Randomizing transmitted data provides the effect of dispersing in time the power received at the cell site from the mobile stations**
  - **easier de-spreading can occur when fewer interfering signals are present**

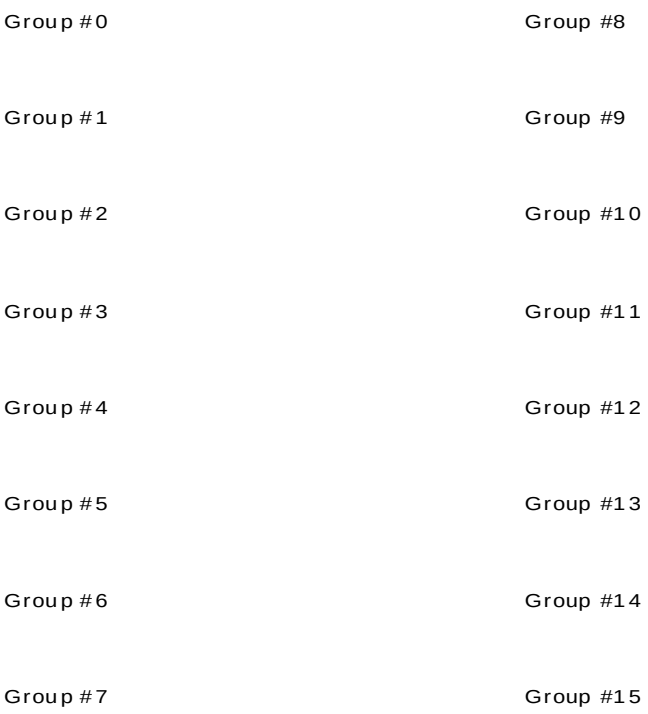
Power Control Groups



Data Burst Randomizing



Full Rate Gating (transmit all groups)



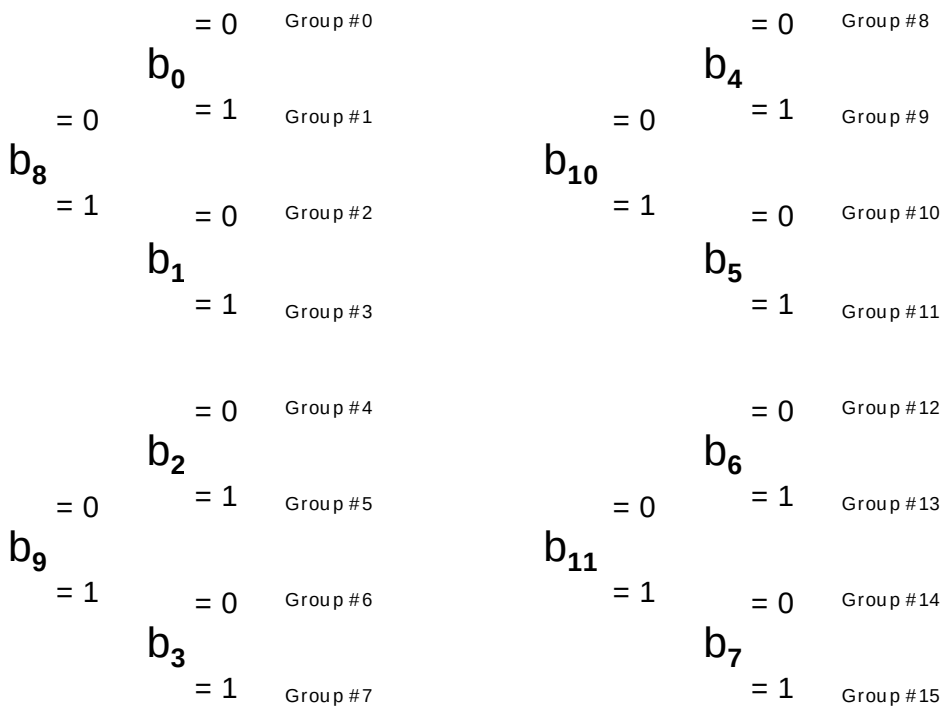
At full rate, all power control groups are transmitted.

1/2 Rate Gating (transmit 1 out of each 2 groups)

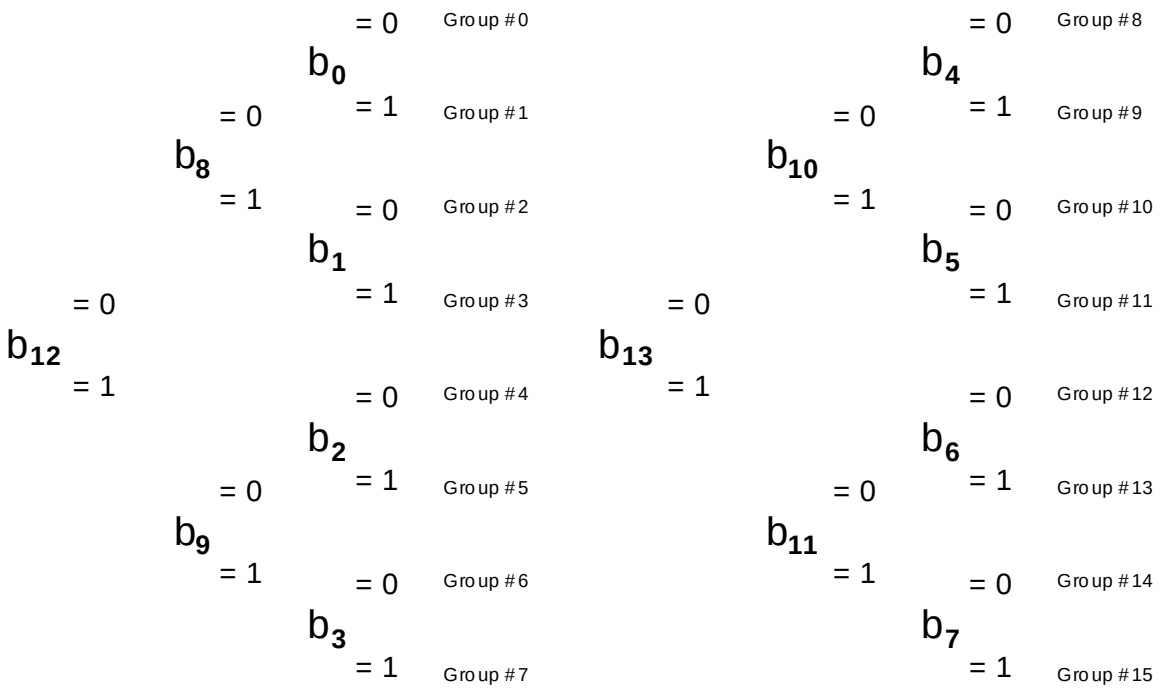
b_0	= 0	Group #0	b_4	= 0	Group #8
	= 1	Group #1		= 1	Group #9
b_1	= 0	Group #2	b_5	= 0	Group #10
	= 1	Group #3		= 1	Group #11
b_2	= 0	Group #4	b_6	= 0	Group #12
	= 1	Group #5		= 1	Group #13
b_3	= 0	Group #6	b_7	= 0	Group #14
	= 1	Group #7		= 1	Group #15

One bit is required to select one out of two power control groups.
At 1/2 rate, eight bits are used to select one out of each of the eight pairs of power control groups independently.

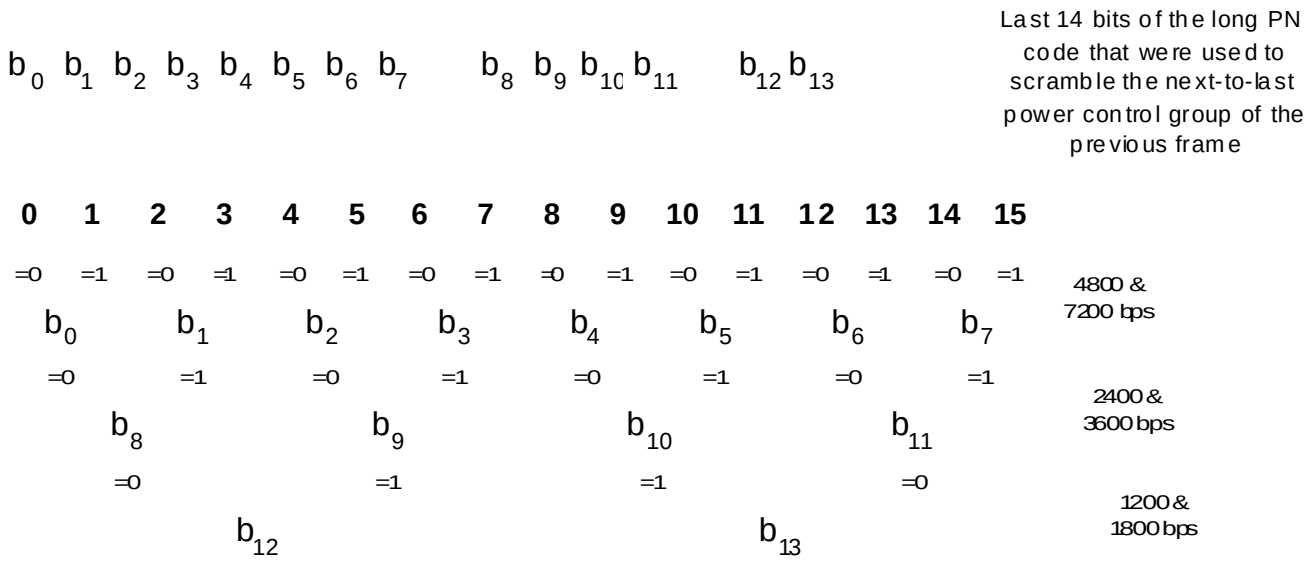
1/4 Rate Gating (transmit 1 out of each 4 groups)



1/8 Rate Gating (transmit 1 out of each 8 groups)

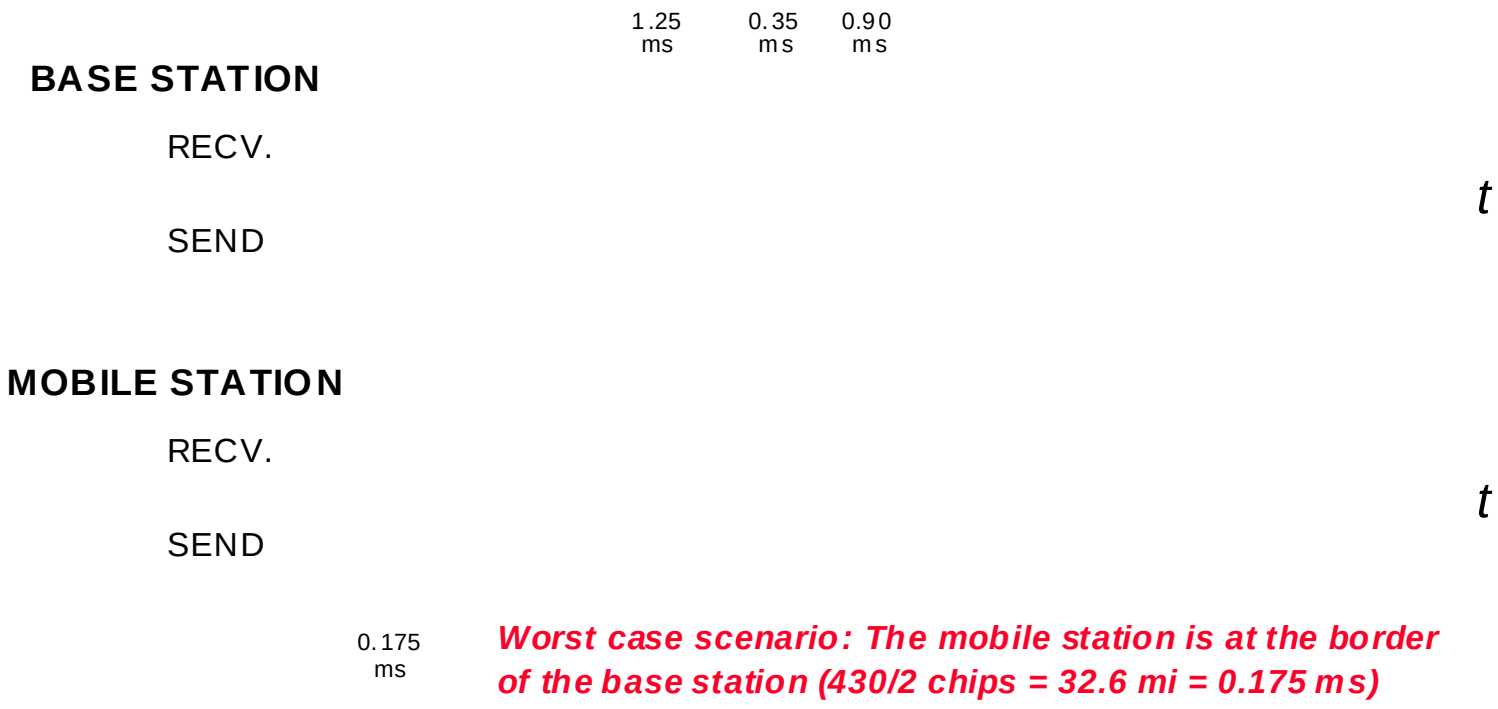


Rates and Gating

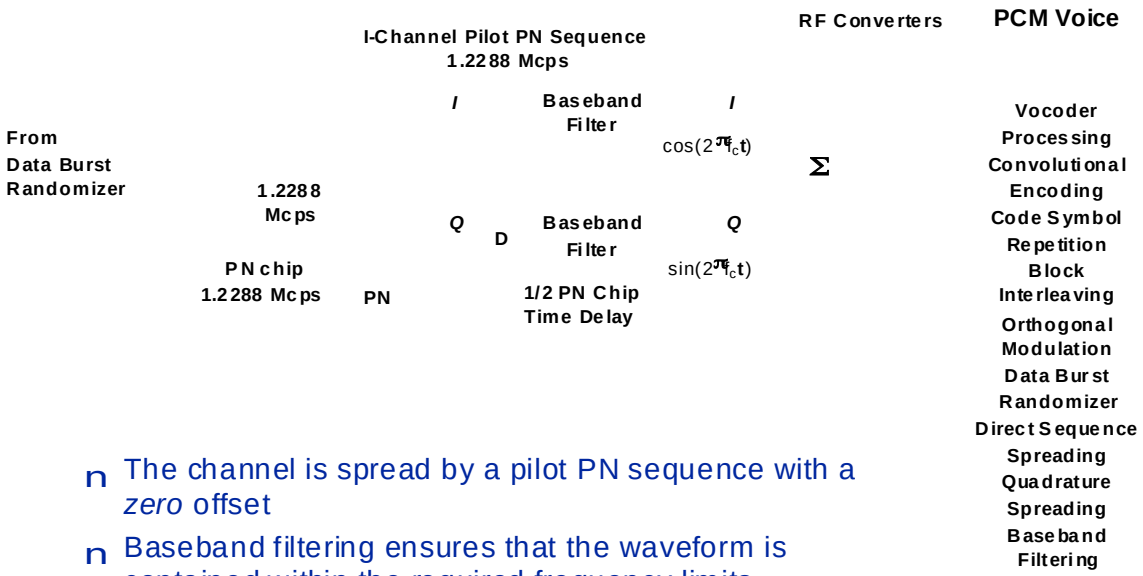


- 9600 & 14400 bps – transmit all power groups
- 4800 & 7200 bps – transmit selected power groups based on bits 0-7
- 2400 & 3600 bps – transmit selected power groups based on bits 0-11
- 1200 & 1800 bps – transmit selected power groups based on bits 0-13

“Valid” Power Control Commands

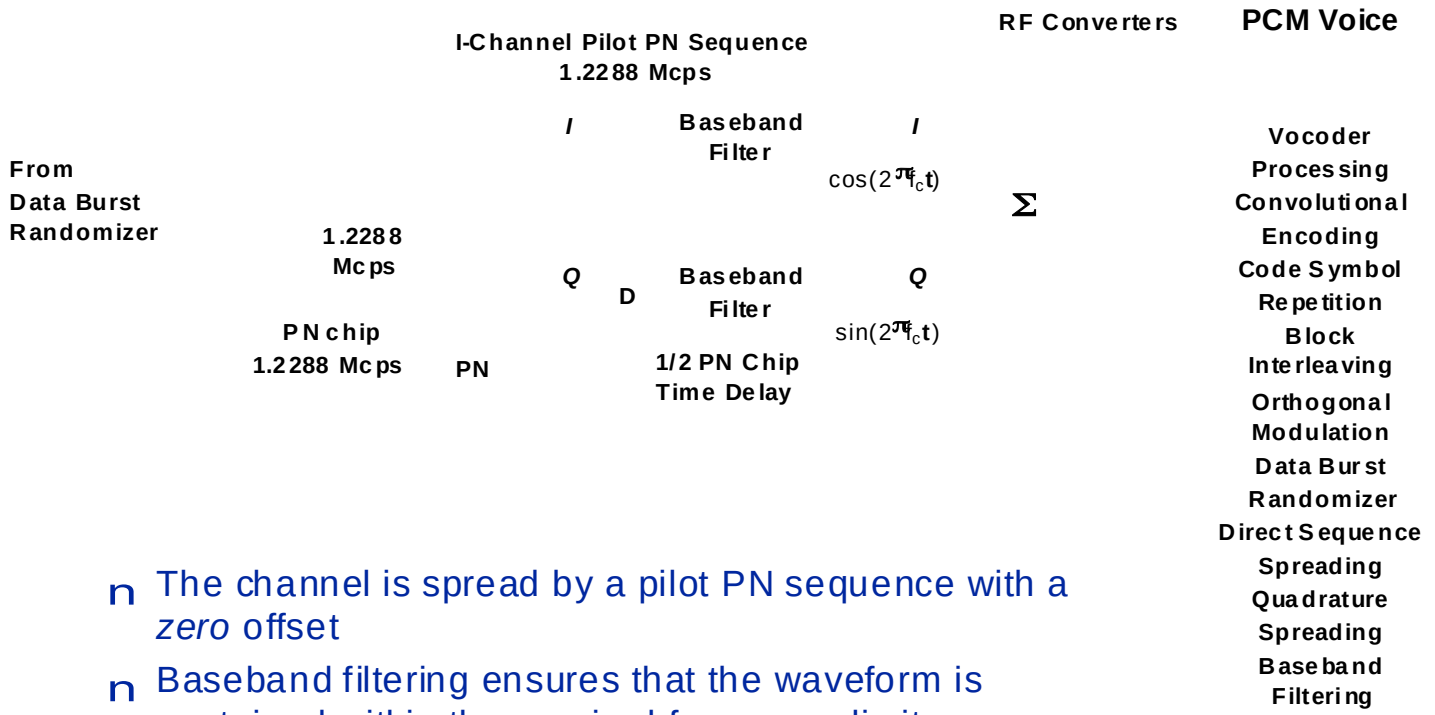


Reverse Traffic Channel: Direct Sequence Spreading



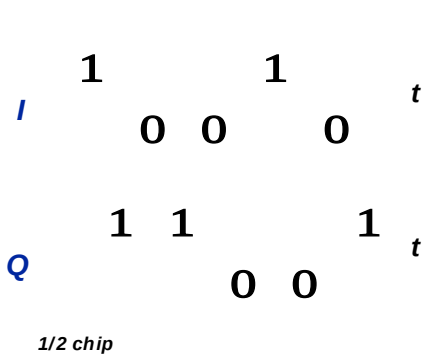
- The channel is spread by a pilot PN sequence with a *zero* offset
- Baseband filtering ensures that the waveform is contained within the required frequency limits
- Baseband signals converted to radio frequency (RF) in the 800 MHz or 1900 MHz range

Reverse Traffic Channel:
Offset Quadrature Spreading & Baseband Filtering



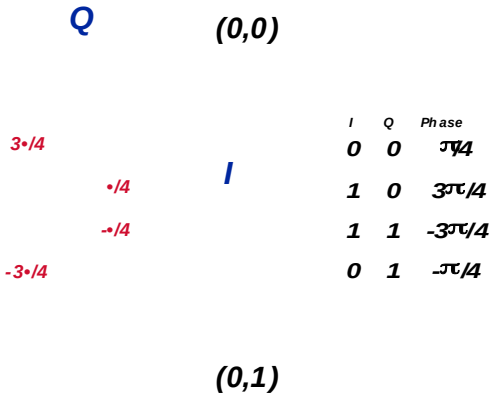
- The channel is spread by a pilot PN sequence with a *zero* offset
- Baseband filtering ensures that the waveform is contained within the required frequency limits
- Baseband signals converted to radio frequency (RF) in the 800 MHz or 1900 MHz range

Reverse Traffic Channel:
Why a Half Chip Delay in the Q Component?



(1,0)

(1,1)



(0,0)

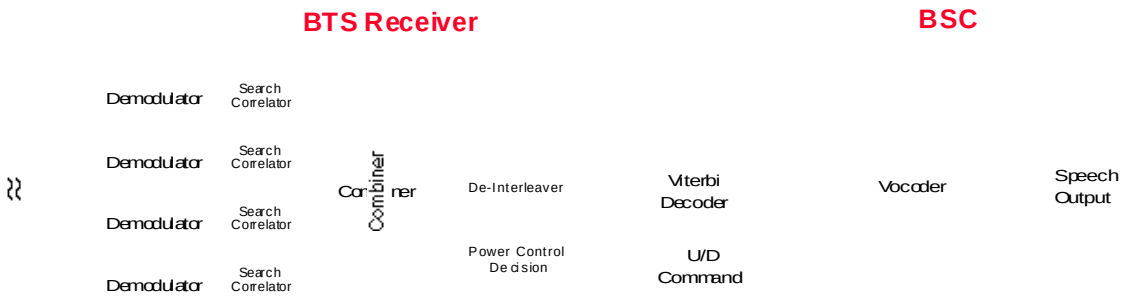
(0,1)

By introducing a half-chip delay in the "Q", simultaneous transitions of "I" and "Q" are eliminated.

Why Bother?

An amplifier that does not have to deal with diagonal changes of state is simpler and cheaper to implement!

Reverse Channel Demodulation



- IS-95A/J-STD-008 requires a process that is complementary to the mobile station modulation process
- CDMA processing benefits from multipath components
  - Signals from several receive elements can be combined to improve receive signal quality