# Preamble Proposal for the 2.4 GHz Frequency Hop Standard

***WITH REVISIONS***

***Changes from Nov 93 Meeting Indicated***

***Slides 2, 10, & 17***

Jim McDonald
Motorola Inc.
Schaumburg, Il., 60173





## Summary

- **This submission provides specific suggestions for the three basic elements of the preamble:**
  - **Ramp up** — **8 bit periods**
  - **Idle pattern** — ~~**72 bit periods**~~ → ***80***
  - **Synchronization word** — **16 bit periods**
- **This discussion draws heavily on the previous contributions of Jerry Socci 93/72 & 93/148 and Francois Le Maut 93/150.**

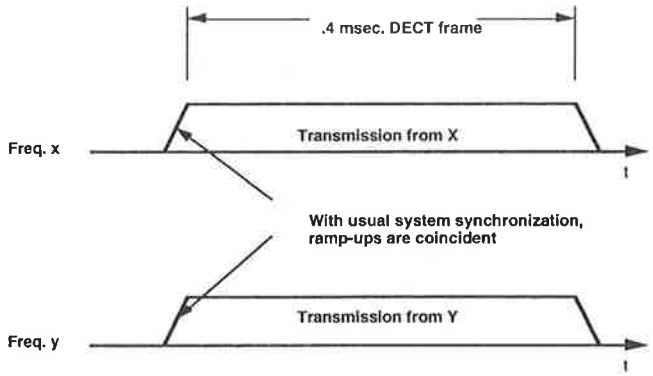
# Ramp-Up

- The purpose of the Ramp-up segment is:
  - Provide an opportunity for the transmitter to power up and stabilize prior to transmission, and
  - Control the rate of power increase to avoid transmitting power in other channels during turn on (or turn off).
- Consider DECT as a point of reference:
  - Physical layer characteristics are similar to 802.11 frequency hop parameters.
  - The DECT ramp-up of power may occur over a 10 bit period.
  - There is no specification limit on the rate of rf power ramp-up.



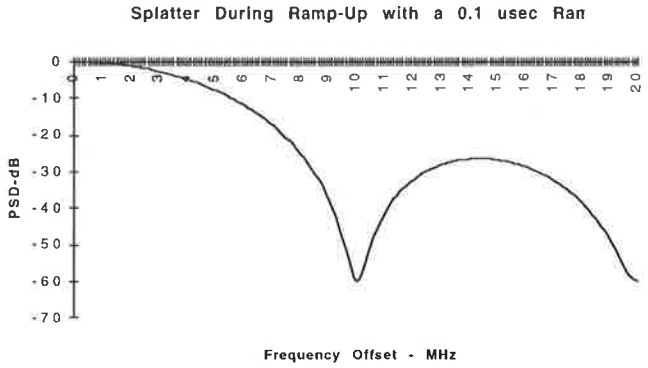


# DECT Example




Since packets are coincident, splatter from ramp-ups or ramp-downs do not generate interference of payload data on other frequency channels.

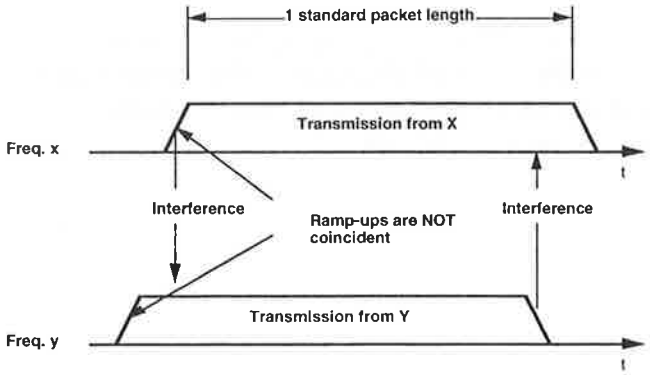
# Splatter with 0.1 usec Ramp-Up





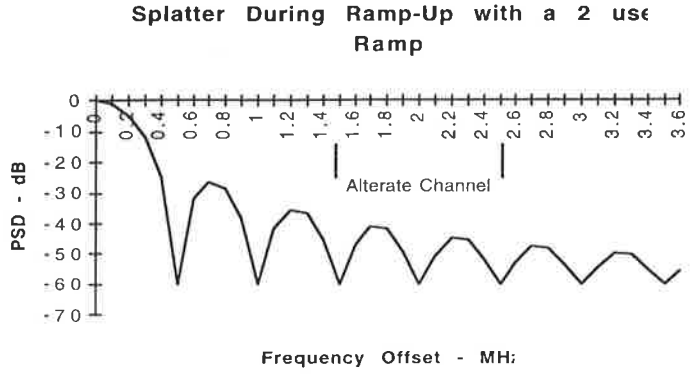



# 2.4 GHz Frequency Hop Example




Since packets are NOT coincident, splatter from ramp-ups or ramp-downs generate interference of payload data on other frequency channels.

# Splatter with 2.0 usec. Ramp-Up








# Proposed Ramp-Up Standard

- The premise of the ramp-up specification is control of the rate of change of the amplitude of the rf during ramp-up and thus control splatter during ramp-up.
- The ramp-up period is confined to one eight bit period. The modulation during this period should be a 0,1 idle pattern starting with a "0" on the first bit.
- The transmitter is off at the start of the first bit, i.e., less than -50 dBm.
- The transmitter power is less than 1 mW at the end of the first bit.

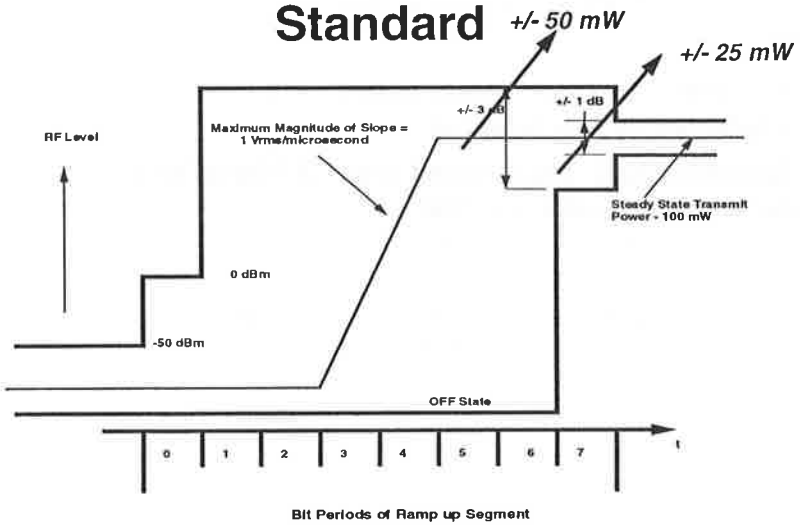
# Proposal Cont'd

- The power at the end of the seventh bit is within 3 dB of the steady state rf power.
- The power at the end of the eighth bit is within 1 dB of the steady state rf power.
- The maximum magnitude of the rate of change of the rf power should be 1 Volt per microsecond as measured by a wideband detector based on the rms. rf voltage of the chassis output at 50 ohms.
  - 100mW @ 50 ohms is 2.236 Volts rms.
  - A 2 microsecongd slope yields 1.118 V/usec.
  - 1 V/us is the logical Spec limit.





# Mask of the Proposed Ramp-Up Standard



# Idle pattern

- The purpose of the Idle pattern is:
  - Provide the opportunity for receivers to sense the presence of a signal.
  - Provide the receiver with opportunity to perform diversity measurement and antenna selection.
  - Provide the opportunity for receivers to synchronize to the carrier and/or clock of the incoming signal.
  - Provide the opportunity for the dc and other transients to dampen prior to reception of data.
- System operation requires that these functions be accomplished without prior knowledge as to when the data packet will occur.





# Idle Pattern Length Determination

- The important technical issues are implementation specific.
- Motorola has determined that 72 bits of idle pattern are sufficient for:
  - antenna diversity selection,
  - bit synchronization, and
  - receiver stabilization prior to reception of the synchronization or unique word.

# Idle Pattern Bit Sequence

- Motorola proposes a 0,1 pattern for the idle pattern.
- The 0,1 pattern provides the maximum number of transitions and is thus most appropriate for purposes of signal detection and synchronization.
- The 0,1 pattern is not burdened with a dc offset.





# Unique Word

- The purpose of the unique (or synchronization ) word is to provide word synchronization, i.e., to point to the first bit of the MAC payload.
- Both 16 and 24 bit synchronization words have been proposed.
- There may be some concern that a 16 bit synchronization word may not provide adequate false alarm protection. For instance, at 1 Mb/s, the false alarm rate with random data would be 15 times per second. This may appear to be too high.

# Unique Word, cond't

- This conclusion is overly pessimistic:
  - The synchronization word detection process may be enhanced with information derived from the idle pattern period in order to reduce the false alarm rate to an acceptable level.
  - The MAC layer will detect false synchronization signals at the end of the MAC header, about 200 microseconds. The impact of false detection is thus minimal .
- It is therefore concluded that a 16 bit synchronization word is sufficient .





# Unique Word Proposal

- From Willard per Doc:P802.11-93/143, Table VI, five 16 bit words with "low probability of false occurrence of the pattern in the received signal" are listed.
- Word, 4657 (0000 1001 1010 1111) from that list is selected as the recommended synchronization word.

# Preamble summary

- Ramp up 8 bit periods (see mask)
- Idle pattern ~~72~~ *80* bit periods (0,1 pattern)
- Unique word 16 bit periods (word 4657)
- Total ~~96~~ *104* bit periods