Technical Note TN-719

Description – T2020 Voting

19th June 2002

Applicability   This Technical Note applies only to the Tait T2020 type of radio. It is a discussion of the general principles of how the T2020 votes and is not a definitive statement of all the options included in the T2020 voting algorithm.

1. Introduction

1) **General Description of mobile voting requirement**
    Mobile voting is a technique used to provide wide area communication with the mobile radio selecting the best channel for communication. The alternative is to have the mobile operator select the best channel based on location or previous experience

    To operate as a mobile voting network it is important that all the base stations in the network transmit the same information at the same time. i.e. the bases, for Transmit purposes at least, are effectively the same all informed communication channel. In addition, for the vote to be effective it is important that all of the base station transmitters are at full power and stable. The faster that the network design is able to accomplish this, the faster the vote in the mobile can be initiated

2) **Operation of the Transceiver on a Simple Voting Group**
    Where mobile voting is used the channels within the network are programmed into the mobile/portable transceiver as a voting group. When the vote group is selected and the transceiver is in the idle state it scans the channels within the group looking for a received signal. Once a signal is detected the transceiver waits for the VOTING LEAD IN DELAY (this is a delay to assure that all the base station transmitters in the network are at full power – as discussed above). After the VOTING LEAD IN DELAY the transceiver checks each of the channels in turn

and measures the RSSI (Received Signal Strength Indicator) of each channel. This RSSI is then used to determine the strongest channel for the transceiver to receive, and the transceiver tunes to that channel. The transceiver then remains locked onto the channel for the duration of the transmission and for a programmable hold time GROUP HOLD TIME afterwards. This hold time is generally programmed for about 5 seconds and means that the mobile does not vote on each and every transmission (simple voting takes between 50 – 100mS per channel depending on where in the idle state scan the radio is when a transmission from the base stations first commences).

Note – if simple voting is used but the rf channels in the radio have CTCSS decode then the audio will only be present if the base station transmission has the correct CTCSS tone. If the correct CTCSS is not present the radio will remain voted to the strongest channel under the normal voting timing but no audio is heard.

When transmitting the mobile will transmit on the transmit frequency associated with the last voted channel. Thus in the absence of normal traffic the network needs to transmit a "voting pulse" or "heartbeat" at regular intervals to ensure that the transceivers are operating on the most valid channel if they need to initiate a call.

Additional Network Information: For some mobile voting equipment (with a small or no group hold time) it is also important to have consistent tail timers across the base station network. This is to prevent false voting on weak signals during the tail period, which would then create a problem if the transceiver initiated a call using this channel.

3) **Voting with Signalling**
Where voting with signalling is used, the mobile will go through the initial voting process, as detailed under simple voting above, until RSSI checking starts. The radio will commence RSSI checking – if the RSSI on the first channel checked is not zero then a CTCSS validation check is done. If the CTCSS tone is incorrect then this channel is discarded, if the CTCSS tone is correct then the RSSI and channel number are stored. The vote then moves to the next channel if the RSSI is less than that previously stored the voting algorithm moves on to the next channel. If the RSSI is greater than that stored, then a CTCSS validation check is done. If the CTCSS tone is incorrect then this channel is discarded, if the CTCSS tone is correct then the RSSI and

channel number are stored. This process continues until all channels in the voting group have been checked.

Once the complete voting channel list has been checked then if a valid channel number has been stored the radio will tune to this channel and the vote is complete. If no valid channels were found then the radio will revert to the HOME CHANNEL and suspend voting until either the GROUP DELAY TIME expires, or if the channel is and remains active until the POLLING INTERVAL TIMER expires – the voting routine is then recommenced.

Note - the HOME CHANNEL is either the last valid voted channel, or if the radio has not had a valid vote since entering the vote channel the first channel in the vote group.

4) **Double Vote and Double Vote with Signalling**
As the name implies the double vote algorithms carry out the vote process twice. This feature is enabled when extra confirmation of the voting channel is required.

5) **T2020 Voting Programming Parameters**
The following parameters that are programmed into a transceiver effect the transceivers voting operation as detailed:

a) Options II page
– OFF HOOK SCANNING, selects if voting will operate with the microphone "off hook".
– GROUP HOLD TIME, sets the delay following channel inactivity that the voting sequence recommences as described above (0 – 15s).
– VOTING LEAD IN DELAY, selects the delay after the radio first detects any channel activity before it starts the RSSI level checking as described above. (1 – 2550ms)
– VOTING POLLING INTERVAL, used to provide a method to prevent the radio locking continually to a signal without valid signalling i.e. interference (1 – 250s).

b) Scan Groups Page
– T (Type), selects the type of voting or scan group. For voting these are:

V – simple vote
VS – vote with signalling
D – double vote
DS – double vote with signalling
– P, selects whether the group is user programmable
– Group membership, selects channels to include in the group
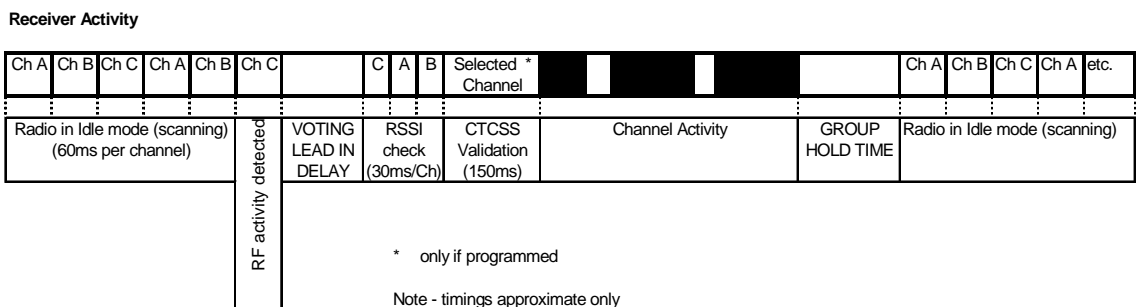
6) **Timing**
Voting timing is as follows:

Idle/Scanning – when the transceiver is idle on the voting group, the radios receiver is scanning between channels in the group (takes approximately 60ms per channel)
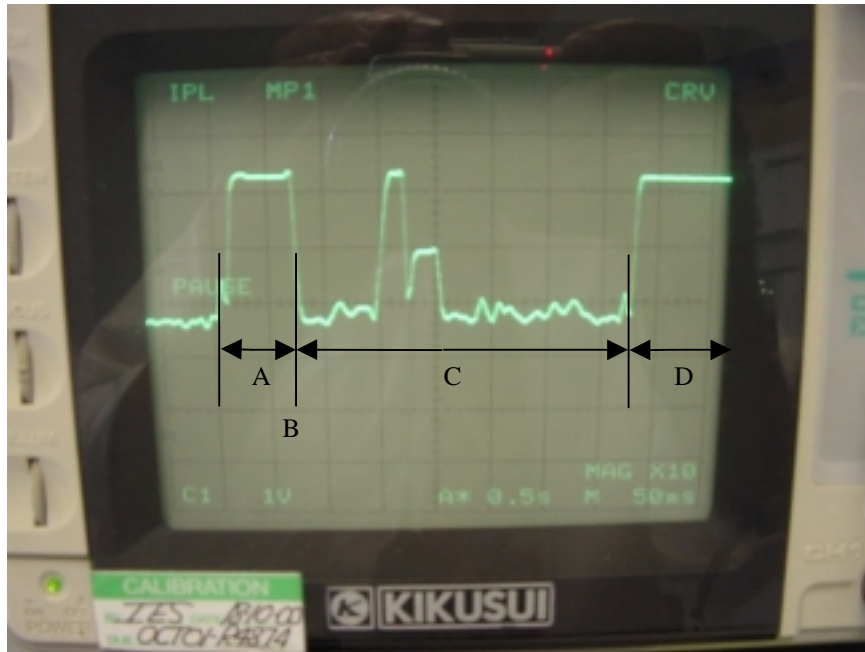
Voting lead in delay – once a valid rf signal is detected, the radio waits the Voting lead in delay period as programmed, before commencing RSSI measurements.

RSSI check – the radio then does an RSSI check on each channel (approximately 30ms per channel).
Group Hold Time – as programmed following mute closure, mute opening or PTT activity resets the timer.

7) A diagrammatic representation of Receiver operation during Voting is as follows:

Receiver Activity

| Ch A | Ch B | Ch C | Ch A | Ch B | Ch C | | | C | A | B | Selected Channel * | | | | | | Ch A | Ch B | Ch C | Ch A | etc. |

| Radio in Idle mode (scanning) (60ms per channel) | RF activity detected | VOTING LEAD IN DELAY | RSSI check (30ms/Ch) | CTCSS Validation (150ms) | Channel Activity | GROUP HOLD TIME | Radio in Idle mode (scanning) |

* only if programmed

Note - timings approximate only

Above shows a storage CRO trace (50ms per division) monitoring the RSSI output of a T2020 voting on 10 channels, with 2 channels applied:

a) the first peak of approx. 60ms is with the radio in the idle mode (scanning at 60ms per channel)
b) after the first signal is detected the radio then waits the VOTING LEAD IN DELAY TIME (0 ms in this case)
c) the radio then does the RSSI checks (approx. 300ms for 10 channels in the above example, i.e. 30ms per channel)
d) finally the radio locks onto the strongest channel

Compliance   There are no compliance issues relating to this Technical Note

CSO Instruction   **CSOs** – Please inform all your technical staff and dealers of this Technical Note

3. Issuing authority

Name and position   Paul Anderson
of issuing officer Mobiles Customer Support Engineer

Confidentiality   Confidential – This message or document contains proprietary information intended only for the person(s) or organisation(s) to whom it is addressed. All Recipients are legally obliged to not disclose Tait technological or business information to any persons or organizations without the written permission of Tait.