

MESHCOMMANDS REFERENCE MANUAL



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1. Radio Level Information

Radio level information is available for each radio card present in the unit. The information is available through the following command:

cat /proc/net/atheros/wlanX/...

1.1 bmiss

"bmiss" stands for Beacon Miss. The full command for this information is shown below.

cat /proc/net/atheros/wlanX/bmiss

The information is available in two forms, one for downlink/ap radios and the other for uplink radios.

1.1.1 bmiss for Downlink Radios

For downlink radios, 'bmiss' provides information about outgoing beacons.

The bmiss information can be used to determine if there is interference in the area.

The information is formatted as shown below:



If 'Skip Count' is increasing consistently, it means that there is too much CSMA/CA back-off taking place.

The description of various fields is given below:

Last Beacon	The time in mill-seconds since the last outgoing beacon
Skip Count	Number of beacons skipped because the previous one was
	pending
Max Beacon Interval	The maximum number of milli-seconds between two consecutive
	outgoing beacons

1.1.2 bmiss for Uplink Radios

For uplink radios "bmiss" provides information about <u>incoming</u> beacons from the parent's downlink radio.

The information is formatted as shown below:

Miss Count : 000000

Deauth Count : 000000

Last Beacon : 000010

If Miss Count is constantly increasing, there is too much noise, or the signal is very weak.

The description of various fields is given below:

Miss Count	The number of times enough beacons were missed to constitute a dead link
Last Beacon	The time in mill-seconds since the last outgoing beacon



1.2 calib

"calib" stands for *Noise-level and Impedance Calibration*. The full command for this information is shown below.

cat /proc/net/atheros/wlanX/calib

The information is formatted as shown below.

Noise-level is a function of the temperature of the environment and the impedance match between the various connections.

The third column (INTRVL) specifies the current calibration interval.

Normally, calibration is done every 30 seconds. If this interval is set to 1 consistently, there is an impedance mismatch problem, or a high noise problem.



1.3 debug

"debug" provides data on various error counters maintained by the unit for the specified radio.

The full command for this information is shown below.

cat /proc/net/atheros/wlanX/debug (for wlan0, wlan1, wlan2, wlan3)

FATAL INTERUPTS	+	+
FATAL INTERUPTS	TYPE	COUNT
RX OVERRUN INTERRUPTS	FATAL INTERUPTS	
RX END OF LIST INTERRUPTS	FATAL INTERUPTS	000000000000000000000000000000000000000
SOFTWARE BEACON ALERTS	RX OVERRUN INTERRUPTS	100000000000000000000000000000000000000
MIB INTERRUPTS	RX END OF LIST INTERRUPTS	000000000000000000000000000000000000000
TX UNDERRUN INTERRUPTS	SOFTWARE BEACON ALERTS	00000000000000027374
TX DONE INTERRUPTS	MIB INTERRUPTS	000000000000000000000000000000000000000
OTHER INTERRUPTS	TX UNDERRUN INTERRUPTS	[0000000000000000000]
RX INTERRUPTS	TX DONE INTERRUPTS	00000000000000029560
CRC ERRORS	OTHER INTERRUPTS	0000000000000066396
CRC BYTES	RX INTERRUPTS	00000000000000009474
CRC ERR RATE	CRC ERRORS	0000000000000003182
PHY ERROR BYTES	CRC BYTES	0000000000004777868
PHY ERROR BYTES	CRC ERR RATE	0000000000000000000000001
PHY ERR RATE	PHY ERRORS	000000000000000000000000000000000000000
PHY_ERR_TX_URN	PHY ERROR BYTES	000000000000000000000000000000000000000
PHY_ERR_PANIC	PHY ERR RATE	000000000000000000000000000000000000000
PHY_ERR_RADAR	PHY_ERR_TX_URN	00000000000000000000000000000000000000
PHY_ERR_ABORT	PHY_ERR_PANIC	00000000000000000000000000000000000000
PHY_ERR_TX_OVR_RX	PHY_ERR_RADAR	00000000000000000000000000000000000000
PHY_ERR_OFFM_TIMING	PHY_ERR_ABORT	00000000000000000000000000000000000000
PHY_ERR_OFDM_SIGNAL_PARITY	PHY_ERR_TX_OVR_RX	00000000000000000000000000000000000000
PHY_ERR_OFDM_ILLEGAL_RATE		00000000000000000000000000000000000000
PHY_ERR_OFDM_ILLEGAL_LENGTH		
PHY_ERR_OFDM_POWER_DROP		
PHY_ERR_OFDM_SERVICE		1
PHY_ERR_OFDM_RESTART		1
PHY_ERR_CCK_TIMING		!
PHY_ERR_CCK_HDR_CRC		
PHY_ERR_CCK_ILLEGAL_RATE		
PHY_ERR_CCK_SERVICE		
PHY_ERR_CCK_RESTART		1
PHY_ERR_OTHER		1
CTRL FRAME RX COUNT		1
PROBE REQ RX COUNT		!
PROBE RESP TX COUNT	!	1
MR RETRY ENABLED (48)	! ~	1
MR RETRY ENABLED (48)	· ·	00000000000000000000000000000000000000
TX ERR PRINT ENABLED (46)		++
BEACON MUTED (45)		1
IQ CALIBRATION STOPPED (44)	· ·	1
PROBE RESPONSE MUTED (43)	· · · · · · · · · · · · · · · · · · ·	1
BEACON DMA CHECK DISABLED (42)	1 ~	1
TX DROP ENABLED (41) 00000000000000000000000000000000000		
RX DROP ENABLED (40) 0000000000000000000000000000000000		
OLDING DEWCOM EMWEDTED (20/21)	!	1
++	+	+



1.4 noise

"noise" provides the current noise floor information for the radio.

The full command for this information is shown below.

cat /proc/net/atheros/wlanX/noise

The format of the information is show below:

```
Noise Floor : -92, Noise Floor Threshold : -54
```

The "Noise Floor" field specifies the current noise floor in dBm.

The standard 'Noise Floor' is -96dBm. A Noise-Floor reading that is significantly higher than –96dBm for a consistent amount of time indicates the presence of interference (for both 802.11 and non-802.11 traffic)



1.5 ps-info

"ps-info" stands for *Power-Save Information*. This entry shows the information about all client devices associated with the radio in power-save mode. The entry is only relevant for downlink and client AP radios.

The full command for this information is:

cat /proc/net/atheros/wlanX/ps-info

The format of the information is show below:									
ADDRESS	PS AID	COUNT TOTALQ	TOTALDR	TOTALSW POLLCNT					

The description of various fields is given below:

ADDRESS	The MAC-ADDRESS of the client
PS	I=Asleep, 0 = Awake
COUNT	Total number of packets queued yet
TOTALQ	Total number of packets currently queued when asleep
TOTALDR	Total number of queued packets drained out due to timeout
TOTALSW	Total number of times the client switched between Awake and
	Asleep
POLLCNT	Total number of PS-POLL packets received from client

Use the ps-info entry for troubleshooting applications with battery-operated client devices. Spectralink phones make use of this feature and depend on the PS-POLL mechanism.



1.6 rt-ctrl

"rt-ctrl" stands for *Rate Control information*. This entry shows the rate-control algorithm information for all the devices to which the radio has transmitted packets.

The full command for this information is:

cat /proc/net/atheros/wlanX/rt-ctrl

The format of the information is show below:

ADDRESS	 RI	 C	TCH	TEL	SGN	NH	succ	ERROR	RETR	LSTTX	AID	 P
00:12:ce:00:00:b2	07	100	0001	0073	001	00001	000000	000000	000000	00000	0000	1
00:12:ce:00:11:98	07	100	0001	0058	001	00001	800000	000000	000000	00057	0000	11
00:12:ce:00:20:da	07	100	0001	0131	001	00001	000049	000000	000000	00032	0000	11
00:12:ce:00:00:02	07	100	0001	0139	001	00001	000042	000000	000000	00044	0000	11
00:12:ce:00:00:6e	07	100	0001	0012	001	00001	000011	000000	000000	00000	0000	11

The description of various fields is given below:

ADDRESS	The MAC-ADDRESS of the device				
RI	The rate index 0 is the lowest rate, 7 is the highest for 802.11a				
С	Confidence level at the current rate				
TCH	Number of seconds before the rate is re-evaluated				
TEL	Time elapsed in seconds since last check				
SGN	Current outlook (-1 is negative, 1 is positive)				
NH	Number of times the algorithm got hurt going to higher rate and had				
	to come back				
SUCC	Number of successful transmissions				
ERROR	Number of erroneous transmissions				
RETRIES	Number of packets that resulted in at least 1 retry				
LASTTX	Last time a packet was transmitted to the device				

Use the rt-ctrl entry to troubleshoot transmit-rate issues, especially when the signal strength is reported satisfactory by the NMS.



1.7 rxinfo

This entry shows the receive-signal and packet-count information for the antenna ports on the radio.

The full command for this information is:

cat /proc/net/atheros/wlanX/rxinfo (for wlan0, wlan1, wlan2, wlan3)

The format of the information is show below:

ANT RMIN RMAX SMIN SAVG SMAX SGNL TSTMP PACKCOUNT
000 0000 0000 0000 0000 0000 59941 000000000 001 0006 0024 0002 0034 0056 0043 00000 00000304 002 0000 0000 0000 0000 0000 59941 000000000

The description of various fields is given below:

ANT	The Antenna Index
RMIN	The lowest rate packet received by the antenna
RMAX	The highest rate packet received by the antenna
SMIN	The minimum signal RSSI received by the antenna
SMAX	The maximum signal RSSI received by the antenna
SAVG	The average signal RSSI received by the antenna
SGNL	The signal RSSI of the last packet received
TSTMP	The number of milli-seconds since the last packet
PACKCOUNT	The number of packets received over the antenna

Use the rxinfo entry to troubleshoot signal strength/link issues. For e.g., by default, the transmission antenna is ANT 1. If you observe ANT 2 receiving packets, it means the pigtail is connected to the wrong antenna port on the radio card.



1.8 tx-intr

This entry shows the status of the last 16 packets transmitted by the radio.

The full path for this information is:

cat /proc/net/atheros/wlanX/tx-intr (for wlan0, wlan1, wlan2, wlan3)

The format of the information is show below:

MS AGO	 ADDRESS	 ST	RI	SR	 LR	SEQ	QN	VCOL LATENCY
0000000000880	00:12:ce:00:00:6e	000	48	000	000	000674	04	0000
	00:12:ce:00:00:b2							
0000000000880	00:12:ce:00:00:b2	000	48	000	000	000676	04	0000
0000000000880	00:12:ce:00:00:b2	000	48	000	000	000677	04	0000
0000000000880	00:12:ce:00:00:b2	000	48	000	001	000678	04	0000
0000000000880	00:12:ce:00:00:b2	000	48	000	002	000679	04	0000
00000000000880	00:12:ce:00:00:b2	000	48	000	000	000680	04	0000
00000000000880	00:12:ce:00:00:b2	000	48	000	001	000681	04	0000
00000000000880	00:12:ce:00:00:b2	000	48	000	000	000682	04	0000
00000000000880	00:12:ce:00:00:b2	000	48	000	000	000683	04	0000
00000000000870	00:12:ce:00:00:b2	000	48	000	003	000684	04	0000
00000000000870	00:12:ce:00:00:6e	000	48	000	000	000685	04	0000
00000000000690	00:12:ce:00:00:6e	000	48	000	000	000686	04	0000
00000000000450	00:12:ce:00:00:6e	000	48	000	000	000687	04	0000
0000000000300	00:12:ce:00:00:6e	000	48	000	000	000688	04	0000
00000000000010	00:12:ce:00:00:6e	000	48	000	000	000689	04	0000

The description of various fields is given below:

MS AGO	The number of milli-seconds since the transmission
ADDRESS	The destination address of the packet
ST	The status of the transmission (0=SUCCESS,1=FAILURE)
RI	The transmit rate used
LR	Number of retries
SEQ	The sequence number of the packet
QN	The 802.11e queue used for transmission
	0 = Background, 1 = Best Effort, 2 = Video, 3 = Voice, 4 = Regular

Use the tx-intr entry to troubleshoot QoS or transmission issues. By using the ST, RI, LR and QN fields, one can determine if QoS rules are correctly being followed, and whether transmissions are successful.



1.9 txpool

This entry shows the status of the transmission-packet pool for the radio.

The full command for this information is:

cat /proc/net/atheros/wlanX/txpool (for wlan0, wlan1, wlan2, wlan3)

The description of various fields is given below:

LOWEST	The lowest level reached during operation
HIGHEST	The level of the pool before operation began
CURRENT	The current level

Use the txpool entry to troubleshoot packet storm issues. If the ingress rate of the packets is much higher than the egress through the radio, the transmission-packet pool will overflow. If the CURRENT level is significantly lower than the HIGHEST for a consistent period of time, it indicates that the ingress rate is higher than egress.

Think of the radio's transmission-packet pool as a bucket that can hold "HIGHES" level of packets. Think of the ingress as a tap adding packets to this bucket. Think of the egress as another tap that is removing packets from the bucket. If the ingress tap is opened fully (higher rate), whereas the egress tap is opened just slightly (lower rate), the bucket will overflow.

This entry is most useful when the packet storm is a broadcast/multicast storm. The downlink radios are programmed to transmit broadcast/multicast packets at the lowest rate of the medium since the same packet needs to reach all the children at the same time (Uplink radios do not behave this way). If the storm ingress is through the wired side, this will cause the transmission pool of the downlink radios to overflow, after which they will not accept packets until the transmission pool is replenished (i.e. all packet buffers queued for transmission are returned).

Egress rates can be lower for various reasons:

- Link quality
- CSMA/CA back-off due to Noise
- Lower transmission rates



1.10 txqueue

This entry shows the status of four QOS queues (Background, Best Effort, Video and Voice), the Regular queue, and the CAB (Content after Beacon) queue.

The full command for this information is: *cat /proc/net/atheros/wlanX/txqueue*The format of the information is show below:

							-
TYPE NO ST TX		TX OUT	AIFS	CWMIN	CWMAX	BURST TIME	
	·		· ·	- <u>-</u>	- <u>-</u>	·	-
DATA 00 00 000000000000000000000000	00000	000000000	0000006	0000063	0001023	000000000	
DATA 01 01 000000000000000000000000000000							
DATA 02 02 000000000000000000000000000000	00000	000000000	0000002	0000015	0001023	0000007000	
DATA 03 03 00000000000000000000000000	00000	000000000	0000002	0000003	0000127	000000000	
BEAC 09 00 000000000000000	00000	000000000	0000002	-000001	0001023	000000000	
CAB 08 00 00000000000000000000000000	00000	000000000	0000002	-000001	0001023	000000000	
REG 04 01 00000000382136	100000	000343662	0000002	-000001	0001023	000000000	

The description of various fields is given below:

TYPE,NO						
,	DATA,00 BACKGROUND					
	DATA,01	BEST EFFORT				
	DATA,02	VIDEO				
	DATA,03	VOICE				
	CAB,08	Content After Beacon				
	REG,04 Regular					
TX	The number of packets inserted into the queue for transmission					
TXOUT	The number of packets that the chipset reported a status after the					
	transmission					
AIFS	The Arbitration Inter Frame Spacing setting for the queue					
CWMIN	The Minimum contention window for the queue					
CWMAX	The Maximum contention window for the queue					
BURST TIME	The packet	burst time in micro-seconds				

Use the txqueue entry to troubleshoot QOS issues. By inspecting the TX and TXOUT fields of the various queues, one can determine if the QOS rules are being correctly applied.

Additionally, the AIFS, CWMIN, CWMAX and BURST TIME fields can be inspected to see if the settings from the NMS are being applied to the radio.

The CAB-queue values can be inspected to troubleshoot issues with broadcast/multicast transmission to power-save devices. If there is at least one associated client in power-save mode, all broadcast/multicast packets need to be inserted in the CAB queue and the TX, TXOUT fields for the CAB queue must reflect this. Refer to ps-info for information in power-save devices.



2. Transient Radio Commands

The transient radio commands in this section have immediate effect on the radio card, but these changes are not persistent across reboots.

2.1 freq

This command sets the frequency of the radio card. The full command for this information is:

iwconfig wlanX freq <<frequency in MHZ>>M

2.2 txpower

This command sets the power of the radio card. The full command for this information is:

iwconfig wlanX txpower <<index>> The index is a number between 0 and 63.



3. Node Level Information

3.1 sta-list

This entry provides details of all the connected client devices and child mesh nodes.

The full command for this information is:

cat /proc/net/meshap/access-point/sta-list

The format of the information is show below:

STATION ADDR	IFNAME VTAG SI	G RATE LAST	PACKET RX	REFCOUNT	ACL BUF	COMP	KI	
00:07:ba:a3:7e:33	wlan2 0000 03	 4 0036 0000	0000060460	 00000002	No No	 No	0001	
00:1d:e0:ae:df:e5								
00:0b:85:55:9c:3e	wlan2 0000 00	3 0001 0000	0000545690	00000002	No No	No	000	

The description of various fields is given below:

STATION ADDR	The MAC address of the connected device
IFNAME	The radio interface on which the device is connected
VTAG	The VLAN tag associated with the device
SIG	The average RSSI of the packets received from the device
RATE	The transmit rate of the last packet received from the device
LAST PACKET RX	The milli-seconds since the last received packet
ACL	Set to 'YES' if the device was connected using a ACL rule
KI	The encryption key index if security is enabled for the device

Use the sta-list entry to troubleshoot client device connectivity issues. Using the SIG and RATE fields, one can determine the signal and rate of the packets received from the device.

The VTAG field can be used to determine if the client device is being assigned a VLAN tag.

The LAST PACKET RX field can be used to determine if any packets are being received from the client.



3.2 downlink-stat

This entry provides details and statistics for all the downlinks on the node.

The full command for this information is:

cat /proc/net/meshap/access-point/downlink-stat

The format of the information is show below:

IFNAME MCC DCC UBCAST	 TBCAST	UBCASTR
wlan0 000 000 000000155958 wlan2 000 004 000000165455 wlan3 000 000 000000059544 ixp1 000 000 000000173245	000000000000000000000000000000000000000	000000000000000000000000000000000000000

The description of various fields is given below:

IFNAME	The interface name of the downlink
MCC	Number of mesh child nodes connected to the downlink
DCC	Number of client devices connected to the downlink
UBCAST	Number of untagged broadcast/multicast packets transmitted by the downlink
TBCAST	Number of tagged broadcast/multicast packets transmitted by the downlink
UBCASTR	
	Number of untagged broadcast/multicast packets transmitted by the downlink using the MESH IGNORE bit turned on.
	MESH IGNORE bit is used to send broadcast/multicast packets to client devices when a corresponding tagged version of the same packet was broadcast for child mesh nodes. When the MESH IGNORE bit is set, the child mesh nodes shall ignore the packet as they have already received its tagged version.

Use the downlink-stat entry to troubleshoot applications that make use of broadcast/multicast packets.

E.g. Spectralink push-to-talk uses multicast packets so that all phones in the network will hear the voice.

The UBCASTR field is relevant if such applications are used over a VLAN.



3.3 vlan-stat

This entry provides statistics for all the VLANs configured on the node.

The full command for this information is:

cat /proc/net/meshap/access-point/vlan-stat

The format of the information is show below:	
VTAG ENCS ENCB wlan0 wlan2 wlan3	ixp1

The description of various fields is given below:

VTAG	The VLAN tag
ENCS	'Yes' if security is enabled on the settings for this VLAN
ENCB	'Yes' if security is currently activated for this VLAN
wlanX	The count of the number of associated client devices for this VLAN
	on the given wireless downlink
ixpX	The count of the number of associated client devices for this VLAN
	on the given wired downlink



3.4 adhoc

This entry provides information for disjoint-adhoc mode operation.

The full command for this information is:

cat /proc/net/meshap/mesh/adhoc

The format of the information is show below:

NODE OPERATING AS FFN STEP SCAN INDEX 0

											_
PARENT ADDR	CHN SIG	RATE	TRATE	FLAG	S			FN	C F	LAV-9	
											-
00:12:ce:00:00:6e	060 046	0054	00100	Р -	_	-	_	- FF	R C	8192	
00:12:ce:00:20:da	157 085	0006	00100		_	_	_	- FF	$R \mid C$	14096	ĺ
00:12:ce:00:00:b2	060 046	0048	00054		_	_	_	- FF	N 2	24576	ĺ
00:12:ce:00:00:02	165 033	0006	00054		_	-	_	- FF	N C	0000	ĺ
00:12:ce:00:11:98	149 036	0006	00054		_	_	_	- FF	N 2	24576	ĺ

The first line of the information provides the current operating mode for the node and also provides the current channel being used for the "STEP SCAN" process.

The description of various fields is given below:

PARENT ADDR	The MAC address of the prospective parent
CHN	Channel
SIG	RSSI
RATE	The transmit rate
TRATE	The parent's RATE to its parent. A root node's TRATE is set to 100.
FLAGS	'P': PREFERRED PARENT
	'M': MOBILE NODE
	'C': CHILD
	'D': DISABLED
	'L': LIMITED FUNCTIONALITY
	'W': DISABLED FOR LFR ARBITRATION
	'Q': QUESTIONABLE PARENT
FNC	The node functionality
R-VAL	DHCP random value



3.5 reboot

This entry displays the status of the last reboot operation.

The full command for this information is: cat /proc/net/meshap/reboot

The format of the information is show below:

Code: 5 Flag: 1

Process:

Mem Used: 0 MB

Temp: 30 Voltage: 23 PC REG: FFFFFFF CALLER REG: FFFFFFF STACK DUMP: 0

Difficit Doill 0

The table below lists the various Code values and their meaning.

CODE	DESCRIPTION
1	One of the downlink radio cards was not detected
2	Out of primary packet buffers for a long time (improbable)
3	Out of radio hardware packets for a long time (improbable)
4	Out of radio hardware descriptors for a long time (improbable)
5	Rebooted via software
6	Firmware crashed
128	Heartbeat thread was stalled
129	Root node ixp0 ETHERNET link was down and rebooted to become RELAY
130	Relay node ixp0 ETHERNET link was up and rebooted to become ROOT
131	FIPS 140-2 POST failure for AES (improbable)
132	FIPS 140-2 POST failure for HMAC-SHA1 (improbable)
133	Routing tables corrupted (improbable)
134	FIPS 140-2 RNG repeated (improbable)
135	General watchdog wake-up (improbable)

The STACK DUMP is present only when the Code value is 6.



3.6 coord

This entry displays the status of the current GPS coordinates for the node. The full command for this information is: *cat/proc/brdinfo/coord*

3.7 speed

This entry displays the speed in km/h
The full command for this information is: cat /proc/brdinfo/speed

3.8 temp

This entry displays the current temperature of the node.

The full command for this information is: *cat /proc/brdinfo/temp*

3.9 voltage

This entry displays the input voltage of the node.

The full command for this information is: cat /proc/brdinfo/voltage



3.10 kap

This entry provides information about all the known neighboring nodes.

The full command for this information is: cat /proc/net/meshap/mesh/kap

3.10.1 Information format for Stationary nodes

PARENT ADDR	CHN SIG RATE	 TRATE NEXTSAMPLE D	ISC FLAGS	SAMCNT MAXSAM
		00100 0000012850 0		
00:12:ce:00:20:da	157 032 0036	00100 0000056520 0	000000	000000 000000
00:12:ce:00:00:14	052 014 0024	00054 00000000000000	000000 - M	000020 000050

The command lists the known neighboring nodes in the order of their preference.

The description of various fields is given below:

PARENT ADDR	The MAC address of the prospective parent
CHN	Channel
SIG	RSSI
RATE	The transmit rate
TRATE	The parent's RATE to its parent. A root node's TRATE is set to 100.
NEXTSAMPLE	The number of milli-seconds left until the parent is scheduled for link sampling
DISC	The number of times the node has been disconnected from the parent
FLAGS	'P': PREFERRED PARENT 'M': MOBILE NODE 'C': CHILD 'D': DISABLED 'L': LIMITED FUNCTIONALITY 'W': DISABLED FOR LFR ARBITRATION 'Q': QUESTIONABLE PARENT (MESH-INIT or Rebooted)

The criteria used by stationary nodes in choosing the "Best" parents is as follows:

- Lower of RATE and TRATE values are used for calculating score
- The DISC value is used to decrease the score.
- For two parent's with the same score
 - o If one of them is the current parent, it gets preference
 - o If one of them is mobile, then the stationary node gets preference
 - o The one with the higher tree bit rate gets preference
 - o If tree bit rates are the same, then the higher direct bit rate gets preference
 - If the direct bit rates are the same, then the higher SIG value gets preference
 - o If the SIG values are the same the lower hop count gets preference.
- Child mesh nodes (direct and in-direct) cannot be considered as a parent
- "Disabled" and "Questionable" are not considered until their status changes.



3.10.2 Information format for Mobile nodes

PARENT ADDR	CHN S	SIG	RATE	TRATE	LAST	SEEN	PATCNT	_
00:12:ce:00:00:6e	060	047	0054	00100	00000	00650	0000012	
00:12:ce:00:20:da	157 (086	0054	00100	00000	00650	0000000	
00:12:ce:00:00:b2	060	048 İ	0054	00054	00000	00650	0000000	
00:12:ce:00:00:02	165 0	038 İ	0054	00054	00000	00650	0000000	
00:12:ce:00:11:98	149 (037 İ	0054	00054	00000	00650	0000000	
00:12:ce:00:22:d8	052	015 İ	0048	00018	00000	05270	0000000	
00:12:ce:00:25:ea	052	013 İ	0006	00100	00000	12200	0000000	

The command lists the known neighboring nodes in the order of their preference.

The description of various fields is given below:

PARENT ADDR	The MAC address of the prospective parent
CHN	Channel
SIG	RSSI
RATE	The transmit rate
TRATE	The parent's RATE to its parent. A root node's TRATE is set to 100.
LAST SEEN	The number of milli-seconds since the parent's beacon was heard
PATCNT	The number of consecutive times the parent was the 'best parent' in
	the current scan window.



4. Mobile Node Configuration Options

4.1 Sliding Scan Window and "winning" Parent Nodes

<u>Sliding Scan Window:</u> To make switching decisions, the scanner radio of a mobile node measures the beacons received from the downlink or AP radios of potential parent nodes.

Mobile nodes maintain a **sliding window** of scan results. The default size of the **sliding window** is 12 *scan intervals*. An individual *scan interval* lasts for 250ms (by default). This provides the mobile node with a sliding history of the last 3 seconds (12 scans x 250ms/scan = 3 seconds).

During the *scan interval*, equal time is spent on the each channel in the Scan Channel List of the mobile node's scanner radio. For example, if there are 5 channels in the Scan Channel List, then the scanner radio will listen on each channel for 50ms.

Winning Parent Nodes:

- After each scan, a "snapshot" will be taken of the prior 12 scans.
- Within this snapshot, there will be a list of "winners" for the 12 scans (for example, parent "A" wins 6 times, parent "B" wins 4 times, and parent "C" wins 2 times ...6 + 4 + 2 = 12).
 A "winner" is defined by the parameters in section 4.2. A parent with a missed beacon will lose for the interval.
- The parent node that has the most number of wins in the snapshot will be the overall winner of the snapshot.
- If a particular parent is the **overall winner** of four consecutive snapshots, this will become the new <u>actual</u> parent.

4.2 Default Preferences and Selection Criteria

<u>Mobile Node's Default Preference</u>: By default, mobile nodes prefer *stationary* nodes as parents over *mobile* nodes. If the mobile node sees both stationary and mobile nodes as potential parents, it will associate to stationary nodes even if the signal strength is considerably lower than those of nearby mobile nodes. A mesh command provides the flexibility to modify this behavior. This is covered in the next section.

<u>Mobile Node's Best Parent Selection Criteria</u>: The criteria used for selecting the winning parent for each scan is based on the following criteria (in order of priority):

- Strongest signal is preferred.
- Two parents with signal strengths within a DAMPING FACTOR of each other are considered to have the same *signal value*. The default value of the DAMPING FACTOR is 6dB. (for example, if the signal from parent "A" is -60dB and the signal from parent "B" is -66dB, they have the same *signal value*).
- If two parents have the same signal value, and one of them is the current parent, then the current parent remains preferred.
- If two potential parents have equal signal values, the potential parent with the higher connectivity is preferred.
- If the connectivity values are the same, the parent with the lower hop count is preferred.
- Child mesh nodes (direct and indirect) cannot be considered as parents. This prevents loops from being formed within the mesh.
- "Disabled" and "Questionable" nodes (see section 3.10.1 under "FLAGS") are not considered until their status changes.
- Parents with a LAST SEEN time (see section 3.10.2) that is outside of the current scan window are not considered.



MobParams

The following mesh command is used to modify the parent-selection process:

alconfset mobparams patcnt[4] patmax[12] sigdamp[6] [static_thres=0] [scanint=250] [prefstatic=1 (0/1)] [downscan=2] [adv_root_mobile=1]

The first three parameters are mandatory:

- **1. patcnt**: The number of consecutive times a parent node has to be the **overall winner** of the sliding-window snapshot (see section 4.1) in order to become the **actual** parent. The default **patcnt** value is 4, and valid values are >=1.
- 2. patmax: The length of the sliding window. The default value is 12, and valid values are >=2.
- **3. sigdamp**: The signal damping factor when a mobile node is measuring the relative beacons of two parents. Signal strengths of two parent nodes that are within the damping factor are considered to have equal *signal values* (for example, if the signal damping factor is 6dB, and the signal from parent "A" is -60dB and the signal from parent "B" is -66dB, they have the same *signal value*). The default value is 6, and valid values are >=0.

The next five parameters are optional:

- **4. static_thresh**: A signal strength in dB *above* the noise floor (for example, if a signal is -86dB, and the noise floor is -96dB, the **static_thresh** is <u>10dB</u>). For **static_thresh** values > 0, a static (non-mobile) node is preferred as a parent over a mobile node as long as its signal is greater than [noise floor + static_thresh]. The default value is 0, and valid values are >=0.
- Scenario 1: Static Parent Node Signal = -80dB, Mobile Parent Node Signal =-50dB, noise floor = -96dB, static_thresh = 0: The Static Parent Node is preferred even though the Mobile Parent Node has a better signal strength.
- Scenario 2: Static Parent Node Signal = -80dB, Mobile Parent Node Signal =-50dB, noise floor = -96dB, static_thresh = 20dB: The Mobile Parent Node is preferred since the Parent Node Signal is less than [noise floor + static_thresh = -76dB].
- **5. scanint**: The duration in milliseconds a scanner radio spends listening on the channels in its Scan Channel List. Each channel gets the same amount of scan time (for example, if the **scanint** = 250ms, and there are 5 channels in the Scan Channel List, then each channel gets 50ms of scan time). The default value is 250ms, and valid values are >=1.

Configuring the **scanint** such that each channel gets less than 50ms of scan time is not recommended. This will reduce the dwell time on a channel, and therefore, increase the probability of a beacon miss.

It is important to remember that increasing the number of channels in the Scan Channel List of a mobile node's scanner radio will decrease the scan time for each channel. In this case, two things can be done to counter this effect: the **scanint** can be increased, or, the beacon interval of the parent nodes' downlinks/APs can be decreased. To decrease the beacon interval of the parent nodes' downlink/AP radios, the **alconfset beacint wlan<0/1/2/3>> << integer >> command can be used**.

6. prefstatic: The mobile node will prefer *static* parent nodes over *mobile* parent nodes. The default value is 1 (a value of "1" means that the mobile node prefers a *static* parent node over a *mobile* parent node), and valid values are 0 or 1. ***<u>If</u> the value is 1, then static and mobile nodes are evaluated by the criteria described by the **static_thresh** setting.

[Note: regardless of the Prefstatic setting, the static_thres setting >0 takes precedence. If the value is greater than 0 then the prefstatic setting is ignored. Consider the following four cases:



- Static_thres =0 and PrefStatic =1. Static parent nodes will *always* be preferred over mobile parent nodes regardless of the signal strength from either.
- Static_thres =0 and PrefStatic =0. Static parent nodes will *not* always be preferred over mobile parent nodes. If mobile parent nodes have a stronger signal strength, they will be preferred.
- Static_thres =20 and PrefStatic =1. Static nodes will be preferred as long their signal strength is stronger than -96dB+20dB= -76dB. Else, both static parent nodes and mobile parent nodes will be evaluated on the same criteria.

7. downscan: Controls how the mobile node changes channels dynamically on its downlinks:

- 0: No scanning during operation (downlink will continue use channel selected upon boot-up).
- 1: Scan on every parent shift. When the mobile node's uplink makes a change in association to another parent node, its downlink will select another channel on which to transmit (if needed) such that its uplink and downlink are transmitting on different channels.
- 2: Scan on every scan interval. This is the default behavior –which provides the most dynamic reaction to changing interference from external sources.

8. adv_root_mobile: When a mobile node is a *root* node, it will advertise itself as a <u>static</u> node by default. This can effect the *preference of association* for its surrounding nodes (as per the "**prefstatic**" setting). In certain applications, such as convoys, it is often desired that none of the nodes in the mesh advertise themselves as being static. The default setting is 1, where a mobile root *will* advertise itself as being static, and valid values 0/1.

4.2.1 Usage Considerations

A. The order of optional parameters is important. For example, if it is desired that the **static_thres** option be configured, the values for the preceding parameters of **patcnt**, **patmax**, and **sigdamp** must be included in the command. The succeeding parameters of **scanint**, **prefstatic**, **downscan**, **adv_root_mobile** do *not* have to be included. Examples:

- alconfset mobparams 3 12 3 ← Change patcnt to 3 overall wins, change damping factor to 3 db. Optional settings are unchanged.
- **alconfset mobparams 4 12 6 0 500 0** ← scan interval changed to 500ms, do not prefer static nodes, remaining optional settings are unchanged.
- **alconfset mobparams 4 12 6 20 250 1** ← prefer static nodes, but only ones that are 20dB above the noise floor, else, no node preference. Remaining optional settings are unchanged.
- alconfset mobparams 4 12 6 0 250 1 0 1 ← prefer static nodes, no scanning on the downlink(s) during operation, advertise mobile-root node as "static".
- B. A node whose last beacon heard was outside of the sliding scan window [scan_interval x patmax] is not considered as a possible parent by the mobile node. To see the current sliding window, use the command: *cat/proc/net/meshap/mesh/mobwin*.
- C. If the sliding scan window is set (by default) at 250ms and there are 5 channels being scanned (5 channels in the scan list) then each channel is scanned for 50 ms. If the beacon is at 100 ms then the probability of hearing the beacon is 50% (note that it is not necessary for a beacon from a particular parent to be heard on every scan interval, but the beacon must be heard a sufficient number of times in the sliding scan window). To increase the probability, consider:
- Reducing all prospective parent downlink beacon intervals by using alconfset beacint wlan
 <0/1/2/3>> << integer >>
- Reducing the number of channels being scanned. The number of channels being scanned is controlled by populating, or depopulating the Scan Channel List of the mobile node's scanner radio. These channels correlate to the channels being provided by the downlinks of the parent nodes in the mesh.



- Increasing the patmax (number of scans in the sliding window).
- Increasing the **scanint** ("scan interval" -the amount of time spent scanning the channels in the Scan Channel List of mobile node's scanner radio).

These options are also helpful for noisy/dynamic RF environments, where the probability of detecting beacons is reduced due to external RF interference.

D. To see when last beacon from a specific parent was received, execute the following command: *cat/proc/net/meshap/mesh/kap*. This will show the time (in 'ms') since the last beacon as heard, and also, the number of consecutive wins the node has in the sliding scan window.

E. When mobile nodes display preference to static nodes over mobile nodes, change static node preferences (**pref_static**), or adjust the **static_thresh** setting.

F. All "alconfset mobparams" settings will be set back to default after rebooting the node. Typing in the following command after each "alconfset mobparams" command is entered can avert this: alconfset save For example:

Type "alconfset mobparams 4 12 5 0 250 1 0 1", click "Enter"
Type "alconfset save", click "Enter"



4.3 Mobwin

This entry displays the current status of the Sliding Scan Window for mobile nodes.

The full command for this information is: cat /proc/net/meshap/mesh/mobwin

The format of the information is show below:

					-
PARENT ADDR	CHN	SIG	ITEM ID	CNT	
					-
00:12:ce:00:00:6e	060	046	C2AA3FC0	012	
00:12:ce:00:00:6e	060	046	C29091E0	012	
00:12:ce:00:00:6e	060	046	C2909200	012	
00:12:ce:00:00:6e	060	046	C2909220	012	
00:12:ce:00:00:6e	060	046	C2909240	012	
00:12:ce:00:00:6e	060	046	C2909260	012	
00:12:ce:00:00:6e	060	046	C29092A0	012	
00:12:ce:00:00:6e	060	046	C29092E0	012	
00:12:ce:00:00:6e	060	046	C2909300	012	
00:12:ce:00:00:6e	060	046	C2AA3B20	012	
00:12:ce:00:00:6e	060	046	C2AA3F20	012	
00:12:ce:00:00:6e	060	046	C2AA3F80	012	

The evaluation results of each scan in the current window are listed in the output.

PARENT ADDR	The MAC address of the best parent for the scan
CHN	Channel
SIG	RSSI
CNT	The number of consecutive times the parent was the 'best parent' in
	the current scan window.



5. Miscellaneous Commands

5.1 pref

This command sets the preferred parent for the node without changing its settings. Since the settings are not changed, the preferred parent will not be maintained after a node is rebooted.

The full command is: meshd pref <<enable>> <<mac_address>>

where

enable: Set to 1 to enable the feature and 0 to disable the feature mac address: Set to the desired preferred parent's downlink mac address.

For disabling the feature the mac_address value needs to match the one provided when enabling. The command takes a minimum of 3 heartbeat intervals to take effect.

5.2 kick

This command disassociates a client device or a mesh node and forces the node to execute all procedures when a client device or a mesh node disconnects. The full command is: **meshd kick** <<**mac_address>>**

5.3 fwupdate

This command is used to determine whether a unit's firmware can be upgraded via the NMS. The full command is: *cat /proc/mtd | grep fwupdate* If the node's firmware can be upgraded from the NMS, the output of this command will be something like:

mtd7: 00140000 00020000 "fwupdate"

5.4 gpsd

This command is used to determine whether the GPS feature on the node has been activated. The full command is: *pidof gpsd*. If the GPS feature is not active, the output will be a blank line.

5.5 meminfo

This command is used to determine the amount of free SDRAM on the unit. The full command is: *cat/proc/meminfo* Typically, the free memory is between 14 and 19 MB. If the node's firmware has been upgraded, and it has not been rebooted, the amount of free memory is less than 10 MB.

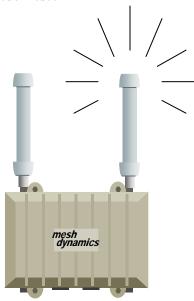
5.6 telnetd

This command enables the Telnet daemon on the node. The full command is: *cp /bin/otelnetd /bin/telnetd* Enabling the telnet daemon on the unit exposes the node to security risks, hence, only enable telnet for troubleshooting purposes. After usage, reboot the node to disable telnet access.





A scanner radio constantly repeats scan intervals, listening on each channel in its *Scan Channel List*.

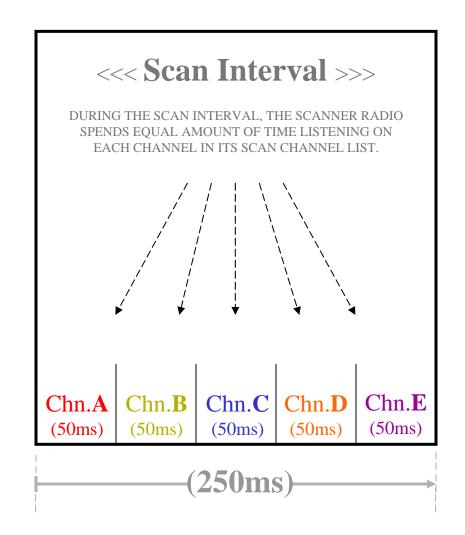


***NOTE THAT TWO QUANTITIES ARE BEING DEFINED HERE:

SCAN INTERVAL = 250ms (default)

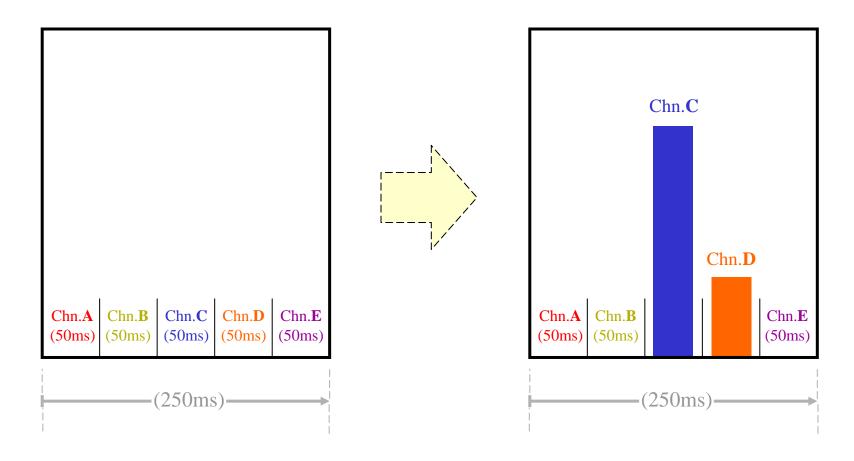
DWELL TIME = 50ms (default)

(DWELL TIME = SCAN INTERVAL DIVIDED BY NUMBER OF CHANNELS IN THE SCAN CHANNEL LIST ...5 CHNS. BY DEFAULT)



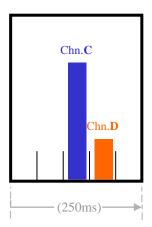


During the Scan Interval, the scanner radio may hear beacons from the downlinks/APs of parent nodes. In the example below, two beacons are heard, one on channel **C**, and one on channel **D**. Channel C has the highest received signal strength of the two channels, so channel **C** is the "winner" of the scan interval.



^{***}There are more factors taken into account when a beacon "wins" a scan interval, but for the purposes of maintaining IP, *signal strength* is the only property needed for, and used in the explanation.

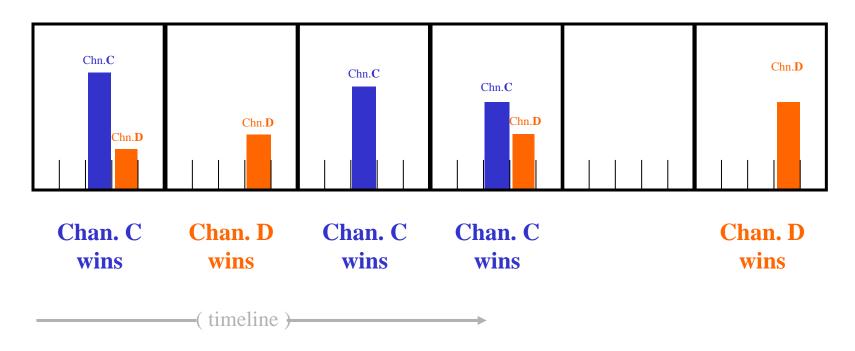




Since beacons are sent by the downlinks/APs of the parent nodes every 100ms (by default), there is a fair chance that not <u>all</u> beacons will be heard during a scan interval. The reason for this is because the dwell time for each channel is only 50ms.

In the illustration below, it is seen how some scan intervals miss beacons altogether. These intervals do not have "winners".

Other scan intervals only see *one* beacon -making this beacon the winner by default.





After each scan interval, a *snapshot* is taken of the past **12** scan intervals. Within these 12 scan intervals will be an **overall winner** of the snapshot as seen below.

With each consecutive snapshot, there will be a new **overall winner**. A sequence of three consecutive snapshots are shown on this page, along with each respective overall winner. In order for a *potential* parent node to become the new *actual* parent node, this potential parent node must be the overall winner for *4 consecutive snapshots*.

