

OsmoBTS - Feature #1752

Improve RACH detection / rejection

06/14/2016 11:47 PM - laforge

Status:	Resolved	Start date:	06/14/2016
Priority:	Normal	Due date:	
Assignee:	laforge	% Done:	100%
Category:		Estimated time:	0.00 hour
Target version:			
Spec Reference:			

Description

The current RACH burst detection/rejection logic in osmo-bts is quite sub-optimal.

At least for osmo-bts-sysmo and osmo-bts-lc15, we currently only have a threshold based on the fLinkQuality parameter.

However, there is no threshold based on the RSSI, and particularly none on the BER.

According to some theoretical analysis, it seems like a good choice for the BER threshold is "7/41", i.e. 7 out of the 41 bits of the RACH training sequence can be wrong, but 35bits should be correct.

To quote from *Martin Kollár: METHOD FOR EVALUATION OF OUTAGE PROBABILITY ON RANDOM ACCESS CHANNEL IN MOBILE COMMUNICATION SYSTEMS*

the theoretical BER limits of GMSK and BPSK based on $E_b/N_0 = 0$ dB, the BER of GMSK is 0.16. For the GSM where 41 represent the total number of bits in a RACH synchronization sequence this corresponds to ratio 7/41. So the threshold k can be set to 7.

So we should have a configurable but default fBER limit of $7/41 = 0.17073170$

It probably makes sense to pass BER, Link Quality and RSSI up into the common part via L1SAP, and have the thresholds implemented there. This ensures uniform behavior across hardware.

History

#1 - 06/14/2016 11:53 PM - laforge

laforge wrote:

It probably makes sense to pass BER, Link Quality and RSSI up into the common part via L1SAP, and have the thresholds implemented there. This ensures uniform behavior across hardware.

this is true at least for osmo-bts-{sysmo,octphy,lc15} where we get both BER and RSSI. Not sure how osmo-bts-trx will fit in.

#2 - 06/22/2016 10:12 PM - laforge

- Assignee changed from msuraev to laforge

#3 - 06/27/2016 05:03 PM - laforge

- File 0001-RACH-decoding-Use-BER-threshold-for-RACH-ghost-detec.patch added

- % Done changed from 0 to 30

proposed patch in attachment, untested so far.

#4 - 06/27/2016 05:05 PM - laforge

#5 - 07/01/2016 03:38 PM - laforge

- Status changed from New to In Progress

I've done quite an extensive test series and I cannot reproduce the issue.

I've used a RF pattern generator and tested with

- a PN23 sequence of pseudo-random bits modulated at GSM bitrate
- AWGN at 270kHz and 1MHz bandwidth
- both over a range of -110 dBm to -30 dBm

osmo-bts-sysmo did not report a single ghost RACH in about one hour of testing.

in /dev/rfifio/dsp_trace, we could see RACH being detected, but none of them reached the existing min_qual_rach threshold in osmo-bts-sysmo:

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[3200]____[279612:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 1]____[-75.8 dBm, 49 qbits, LQ = -4.2819, BSIC = 3F, BER = 0.1944 (7/36)]____
[3201]____[279769:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 2]____[-74.7 dBm, -8 qbits, LQ = -3.8764, BSIC = 3F, BER = 0.1111 (4/36)]____
[3202]____[279780:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 2]____[-76.4 dBm, 35 qbits, LQ = -5.3870, BSIC = 3F, BER = 0.2500 (9/36)]____
[3203]____[279893:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 1]____[-74.6 dBm, 64 qbits, LQ = -5.0313, BSIC = 3F, BER = 0.1389 (5/36)]____
[3204]____[279911:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 0]____[-76.3 dBm, 87 qbits, LQ = -5.0002, BSIC = 3F, BER = 0.1389 (5/36)]____
[3205]____[279934:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 0]____[-76.0 dBm, -6 qbits, LQ = -5.3354, BSIC = 3F, BER = 0.1944 (7/36)]____
[3206]____[280046:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 1]____[-76.0 dBm, 11 qbits, LQ = -1.5729, BSIC = 3F, BER = 0.1111 (4/36)]____
[3207]____[280166:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 1]____[-74.8 dBm, 87 qbits, LQ = -7.0291, BSIC = 3F, BER = 0.1944 (7/36)]____
[3208]____[280315:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 2]____[-71.0 dBm, 72 qbits, LQ = -6.1674, BSIC = 3F, BER = 0.1944 (7/36)]____
[3209]____[280632:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 1]____[-63.4 dBm, 60 qbits, LQ = -1.6252, BSIC = 3F, BER = 0.1389 (5/36)]____
[3210]____[280636:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 1]____[-61.4 dBm, 60 qbits, LQ = -7.9217, BSIC = 3F, BER = 0.1667 (6/36)]____
[3211]____[280774:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 1]____[-61.5 dBm, 59 qbits, LQ = -4.0441, BSIC = 3F, BER = 0.1944 (7/36)]____
[3212]____[280891:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 2]____[-59.6 dBm, 34 qbits, LQ = -6.3125, BSIC = 3F, BER = 0.1944 (7/36)]____
[3213]____[280931:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 2]____[-58.6 dBm, 2 qbits, LQ = -3.8033, BSIC = 3F, BER = 0.1389 (5/36)]____
[3214]____[280936:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 2]____[-58.5 dBm, 45 qbits, LQ = -3.7295, BSIC = 3F, BER = 0.1389 (5/36)]____
[3215]____[280981:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 1]____[-58.4 dBm, 48 qbits, LQ = -5.2272, BSIC = 3F, BER = 0.1111 (4/36)]____
[3216]____[281142:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 2]____[-56.1 dBm, 9 qbits, LQ = -5.7374, BSIC = 3F, BER = 0.1111 (4/36)]____
[3217]____[281208:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 1]____[-57.7 dBm, 22 qbits, LQ = -1.4843, BSIC = 3F, BER = 0.1389 (5/36)]____
[3218]____[281464:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 2]____[-53.3 dBm, 11 qbits, LQ = -5.3268, BSIC = 3F, BER = 0.1389 (5/36)]____
[3219]____[281636:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 1]____[-46.3 dBm, 80 qbits, LQ = -5.1819, BSIC = 3F, BER = 0.1944 (7/36)]____
[3220]____[281677:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 0]____[-45.4 dBm, 10 qbits, LQ = -5.4181, BSIC = 3F, BER = 0.1944 (7/36)]____
[3221]____[281694:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 1]____[-44.2 dBm, 4 qbits, LQ = -5.4208, BSIC = 3F, BER = 0.1389 (5/36)]____
[3222]____[281789:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 1]____[-42.4 dBm, 27 qbits, LQ = -1.6029, BSIC
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= 3F, BER = 0.1389 (5/36)]____
[3223]____[281794:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 1]____[-42.5 dBm, 70 qbits, LQ = -1.5491, BSIC
= 3F, BER = 0.1111 (4/36)]____
[3224]____[281843:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 0]____[-40.8 dBm, 2 qbits, LQ = -6.7427, BSIC
= 3F, BER = 0.1389 (5/36)]____
[3225]____[281904:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 1]____[-39.8 dBm, 60 qbits, LQ = -7.0963, BSIC
= 3F, BER = 0.1944 (7/36)]____
[3226]____[281909:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 0]____[-39.7 dBm, 88 qbits, LQ = -7.3934, BSIC
= 3F, BER = 0.1389 (5/36)]____
[3227]____[282098:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 2]____[-33.1 dBm, 56 qbits, LQ = -3.7389, BSIC
= 3F, BER = 0.1111 (4/36)]____
[3228]____[282163:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 2]____[-33.7 dBm, 45 qbits, LQ = -4.1827, BSIC
= 3F, BER = 0.1389 (5/36)]____
[3229]____[282207:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 1]____[-30.9 dBm, -1 qbits, LQ = -5.1973, BSIC
= 3F, BER = 0.1944 (7/36)]____
[3230]____[282212:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 1]____[-31.1 dBm, 42 qbits, LQ = -5.1664, BSIC
= 3F, BER = 0.1389 (5/36)]____
[3231]____[282217:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 1]____[-31.1 dBm, 85 qbits, LQ = -5.2099, BSIC
= 3F, BER = 0.1389 (5/36)]____
[3232]____[282258:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 0]____[-32.2 dBm, 15 qbits, LQ = -5.4180, BSIC
= 3F, BER = 0.1944 (7/36)]____
[3233]____[282304:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 2]____[-30.8 dBm, 20 qbits, LQ = -5.9130, BSIC
= 3F, BER = 0.1389 (5/36)]____
[3234]____[282370:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 1]____[-32.5 dBm, 32 qbits, LQ = -1.6946, BSIC
= 3F, BER = 0.1389 (5/36)]____
[3235]____[282454:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 2]____[-31.1 dBm, 56 qbits, LQ = -6.7238, BSIC
= 3F, BER = 0.1667 (6/36)]____
[3236]____[282512:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 1]____[-32.1 dBm, 32 qbits, LQ = -4.1076, BSIC
= 3F, BER = 0.1667 (6/36)]____
[3237]____[282517:0]____[L1]____[RX]____[RACH]____[ACCESS TYPE 1]____[-32.4 dBm, 75 qbits, LQ = -4.0598, BSIC
= 3F, BER = 0.1944 (7/36)]____

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So we need to understand how to reproduce the bug first.

#6 - 03/10/2017 09:27 PM - laforge

- Status changed from In Progress to New

- Assignee deleted (laforge)

#7 - 05/30/2017 03:32 PM - laforge

- Assignee set to daniel

#8 - 12/03/2017 10:41 AM - laforge

- Assignee changed from daniel to laforge

#9 - 02/26/2018 02:22 PM - laforge

- % Done changed from 30 to 80

A BER based RACH threshold has now been introduced as part of the <https://gerrit.osmocom.org/#/c/6933/> patch. On the positive side, all BTS/PHY models should now have the same behavior in terms of RACH detection threshold.

#10 - 03/24/2018 02:49 PM - laforge

- Status changed from New to Resolved

- % Done changed from 80 to 100

Files

0001-RACH-decoding-Use-BER-threshold-for-RACH-ghost-detec.patc	8.94 KB	06/27/2016	laforge
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