UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

ZTE (USA) Inc.,
HTC Corporation, and
HTC America, Inc.

Petitioners

v.

Evolved Wireless LLC,

Patent Owner

DECLARATION OF ZUO ZHISONG

Case No. IPR2016-00758

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1. My name is Zuo Zhisong. I am a Standard Engineer at ZTE Corporation. I have been employed by ZTE Corporation since 2005.

2. For more than 10 years, since February 2005, I have served as one of ZTE's delegates to the Third Generation Partnership Project ("3GPP") in a subgroup of 3GPP's Technical Specification Group - Radio Access Network ("TSG-RAN") known as Working Group 1 ("WG1").

3. During this period, I have attended dozens of WG1's meetings and subscribed to WG1's reflector list (3GPP_TSG_RAN_WG1@list.etsi.org), to which I have sent hundreds of e-mail messages and through which I have received thousands of e-mail messages. In general, before each WG1 meeting that I attended, I received e-mail messages from delegates of other companies through WG1's reflector list, providing technical documents, called contributions, for discussion at the meeting. Some of those e-mail messages provided the technical documents as e-mail attachments, while other e-mail messages provided links to the locations where the technical documents were stored on 3GPP's publicly available website <http://www.3gpp.org>. Regardless of how the e-mail messages provided access to the technical documents, those documents were also uploaded to and available for download at 3GPP's publicly available website.

4. As a delegate for WG1, I sent e-mail messages submitting technical documents on ZTE's behalf to WG1's reflector list hundreds of times before

meetings for which the documents were submitted for discussion. I also uploaded technical documents to 3GPP's publicly available website more than 200 times before meetings for which the technical documents were submitted for discussion.

5. In my 10 years as a delegate for WG1, I have also regularly accessed the location on 3GPP's website storing technical documents submitted to WG1. That location is available at the uniform resource identifier <http://www.3gpp.org/ftp/tsg_ran/WG1_RL1/>, which I refer to in this declaration as "WG1's public directory." Since 2005, I have accessed WG1's public directory in several ways, such as, for example, by entering the uniform resource identifier of WG1's public directory into an Internet browser and by accessing 3GPP's homepage <http://www.3gpp.org> and then navigating to the uniform resource identifier of WG1's public directory. Regardless of which method I used to access WG1's public directory, I have never encountered a password requirement or any other restriction that would prevent me or a member of the general public from accessing WG1's public directory or any intermediate location. Based on my 10 years of experience as a WG1 delegate, since 2005 to the present, any member of the public could freely access WG1's public directory, browse it, and download technical documents stored to it without restriction.

6. I attended WG1 Meeting #44bis, which was held on March 27-31, 2006, in Athens, Greece. Attached as Exhibit 1 is a true and correct copy of an e-mail

message dated March 21, 2006, shortly before Meeting #44bis. I obtained this e-mail message from 3GPP's public e-mail website, which is available at <https://list.etsi.org/> and with which I have become familiar as a WG1 delegate. Like all other members of WG1, I received this e-mail message from Mr. Katsuhiko Hiramatsu through WG1's reflector list along with five ZIP file attachments, including a ZIP file titled "R1-060792.zip." That ZIP file contained a single Microsoft Word document, a true and correct copy of which is attached as Exhibit 2. Neither the ZIP file nor the Word document enclosed in the ZIP file had a password or anything else that would have restricted my ability to access its contents.

7. In preparing this declaration, I accessed <www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_44bis/Docs/>, the location on 3GPP's web site at which R1-060792.zip is accessible to any member of the public without restriction. Attached as Exhibit 3 is a true and correct copy of a printout from that website. Exhibit 3 lists several ZIP files, including R1-060792.zip, as shown in the following excerpt.

3/21/2006 10:41 AM	963139	R1-060789.zip
3/21/2006 10:20 AM	468156	R1-060790.zip
3/21/2006 9:04 AM	124590	R1-060792.zip
3/21/2006 9:04 AM	17727	R1-060793.zip
3/21/2006 9:04 AM	35394	R1-060794.zip

(Ex. 3 at 1.) The text “R1-060792.zip” provides a link to a ZIP filed titled R1-060792.zip. I downloaded and opened this ZIP file and found that it contains a single Microsoft Word file, a true and correct copy of which is attached as Exhibit 4. I compared Exhibit 4 to Exhibit 2, the Word file in the attachment that I received from Mr. Hiramatsu on March 21, 2006, and found that those two exhibits are identical.

8. In the excerpt from the 3GPP website printout shown above, there is also a date stamp (3/21/2006) to the left of the link to R1-060792.zip. Based on my 10 years of experience as a delegate for WG1, having uploaded more than 200 ZIP files to 3GPP’s publicly available server, I understand this date stamp to mean that R1-060792.zip was uploaded to 3GPP’s publicly available website on March 21, 2006, and that any member of the public could have downloaded the ZIP file, extracted the Word document it enclosed, and viewed the contents of that Word document without restriction on March 21, 2006 and thereafter. I have no reason to believe this date stamp is inaccurate.

9. I also attended WG1 Meeting #45, which was held on May 8-12, 2006 in Shanghai, China. Attached as Exhibit 5 is a true and correct copy of an e-mail message dated May 2, 2006, shortly before Meeting #45. I obtained this e-mail message from 3GPP’s public e-mail website, which is available at <https://list.etsi.org/>, and with which I have become familiar as a WG1 delegate.

Like all other members of WG1, I received this e-mail message from Mr. Hiramatsu through WG1's reflector list along with two ZIP file attachments, including a ZIP file titled "R1-061114.zip." That ZIP file contained a single Microsoft Word document, a true and correct copy of which is attached as Exhibit 6. Neither the ZIP file nor the Word document enclosed in the ZIP file had a password or anything else that would have restricted my ability to access its contents.

10. In preparing this declaration, I accessed <http://www.3gpp.org/ftp/tsg_ran/WG1_RL1/TSGR1_45/Docs/>, the location on 3GPP's website in which R1-061114.zip is accessible to any member of the public without restriction. Attached as Exhibit 7 is a true and correct copy of a printout from that website. Exhibit 7 lists several ZIP files, including R1-061114.zip, as shown in the following excerpt.

5/12/2006	3:14 PM	431339	R1-061111.zip
5/2/2006	8:31 AM	174601	R1-061112.zip
5/2/2006	7:20 AM	71687	R1-061114.zip
5/2/2006	7:20 AM	93032	R1-061115.zip
5/3/2006	4:13 PM	231279	R1-061116.zip

(Ex. 7 at 1.) The text "R1-061114.zip" is a link that, when selected, initiates a download of a ZIP file titled R1-061114.zip. I downloaded and opened this ZIP file and found that it contains a single Microsoft Word file, a true and correct copy of which is attached as Exhibit 8. I compared Exhibit 8 to Exhibit 6, the Word file in the attachment that I received from Mr. Hiramatsu on May 2, 2006, and found that those two exhibits are identical.

11. In the excerpt above, there is also a date stamp (5/2/2006) to the left of the link to R1-061114.zip. Based on my 10 years of experience as a delegate for WG1, having uploaded more than 200 ZIP files to 3GPP's publicly available server, I understand this date stamp to mean that R1-061114.zip was uploaded to 3GPP's publicly available website on May 2, 2006, and that any member of the public could have downloaded the ZIP file, extracted the Word document it enclosed, and viewed the contents of that Word document without restriction on May 2, 2006 and thereafter. I have no reason to believe this date stamp is inaccurate.

12. I declare under penalty of perjury that the statements made herein are believed to be true based upon either my personal knowledge or to the best of my knowledge, information, and belief.

Date: February 3, 2016

Zuo Zhisong

Zuo Zhisong

EXHIBIT 1

3GPP_TSG_RAN_WG1 Archives

3GPP_TSG_RAN_WG1@LIST.ETSI.ORG

Subject: Panasonic contribution for LTE
From: Katsuhiko HIRAMATSU <[log in to unmask]>
Reply-To: Katsuhiko HIRAMATSU <[log in to unmask]>
Date: Tue, 21 Mar 2006 15:58:26 +0900
Content-Type: multipart/mixed
Parts/Attachments: text/plain (23 lines) , R1-060793.zip (23 lines) , R1-060794.zip (23 lines) , R1-060795.zip (23 lines) , R2-060902.zip (23 lines) , R1-060792.zip (23 lines)

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Dear all,

Please find the attached Panasonic contributions on
LTE.

Best regards,
Katsuhiko Hiramatsu

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RAN1:

  R1-060792 Random access burst evaluation in E-UTRA
uplink
  R1-060793 Indication of combination between L1/L2
control
            signaling and uplink data
  R1-060794 Channel Coding Structure for LTE
downlink
  R1-060795 Feedback of UE measurement for MIMO

RAN1/2 joint:

  R2-060902 Channel Coding Structure for LTE
downlink
  (same contents as in R1-060794)
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EXHIBIT 2

TSG-RAN WG1 Meeting#44bis **R1-060792**
Athens, Greece, March 27-31, 2006

Source: **Panasonic**
Title: **Random access burst evaluation in E-UTRA uplink**
Agenda Item: **10.2.3**
Document for: **Discussion**

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1. Introduction

Random access burst is used for the initial physical connection on initial cell access, handover and the resource allocation when the UE uplink has not been time synchronized. Several discussions on random access burst to achieve short initial physical connection setup have also been reported in [4] - [7] . Random access burst sub-frame may be composed of a preamble part and a message part. We evaluate the preamble performance. Based on the evaluation results, we discuss the inclusion of message part on random access burst.

2. Discussion

2.1. Random access burst requirements

In random access burst structure design, the following requirements have been considered [1] [3] - [10] .

- Reliable acquisition of preamble
- Estimation of arrival timing
- Reduction in the whole process delay
- To minimize the usage of time-frequency resources regarding spectrum efficiency

The most important requirement of the above is reliable acquisition and estimation of arrival timing because the success rate of random access burst attempt should be high enough. The inclusion of message part on random access burst has been considered to shorten physical connection setup delay [4] - [7] .

2.2. Discussion on preamble length

In TR [2] , E-UTRA is required to support at least 30km cell size. Therefore, we showed the link budget and achievable number of bits per TTI (0.5ms) to estimate how many bits can be contained on random access burst in [10] . The result would be useful in the case coverage is critical although the result is still preliminarily. On the other hand, we also need the discussion in the case that interference is critical. Ref. [6] reports that approximately -13 dB and -18 dB of the average received Es/No were derived from the system level evaluation. As mentioned above, the most important random access burst functions are reliable acquisition and estimation of arrival timing. For these reasons, first, we evaluate the required preamble length that corresponds to the required average received Es/No. Next we discuss the possibility of the inclusion of message part.

In the preamble evaluation, we assume the followings:

- Random access burst TTI is a multiple of 0.5msec. Preamble, guard time and possibly message part share a random access burst TTI
- Random access burst is time/frequency multiplexed with other channels [3] [4] .

Preamble structure

A preamble sequence should have a good auto-correlation and good-cross correlation. General chirp-like (GCL) sequence has been considered to satisfy these requirements [5] [8] [9] . In our preamble performance evaluation, Zadoff-Chu CAZAC sequence [13] , a special case of GCL sequence, is used. RACH preamble structure is shown in Figure 1.

We evaluated 1.25MHz and 5MHz as transmission bandwidth of the random access burst. The preamble structure consists of M-times repetition of N=73 (1.25MHz) or N=293(5MHz) CAZAC sequence. Cyclic prefix and guard time are also included within a random access burst TTI.

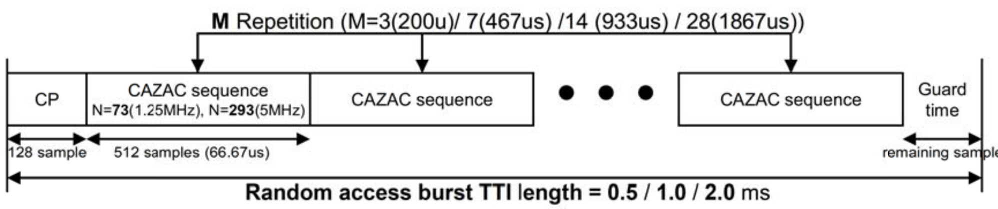

Figure 1 – preamble structure

Performance of preamble

The simulation parameters are shown in Table 1. As preamble performance evaluation criteria, we used false alarm and miss detection probability to the average received Es/No. The definition is as follows:

- **False alarm (Pfa)**: the probability of a particular code being detected when nothing, or different code was transmitted
- **Miss detection (Pmd)**: the probability of a particular code not being detected when the code was transmitted

Although time domain preamble detection would also possible, in our evaluation, the RACH preamble detection is performed in frequency domain, which is similar to the detection algorithm described in [8] .

1. Repeated CAZAC sequences of the received signal are combined in time domain.
2. The combined CAZAC sequence is processed by FFT.
3. A transmitted CAZAC code is detected by using coherent detection in frequency domain.
4. A delay profile response is obtained after IDFT processing.

Table 1 – Simulation parameters

Transmission Bandwidth	1.25MHz	5MHz
Transmission scheme	Localized FDMA	
RACH TTI length	0.5 ms / 1.0ms / 2.0ms	
Signature pattern	CAZAC sequence (Zadoff-Chu CAZAC[13])	
Length of CAZAC sequence (N)	73	293
Repetition factor (M) of CAZAC sequence	3 (total preamble length: 200usec) 7 (total preamble length: 467usec) 14 (total preamble length: 933usec) 28 (total preamble length: 1867usec)	
Number of multiplexed users	1	
Antenna configuration	1 transmit antenna, 2 receive antenna (combined non-coherently)	
Detector	Coherent detection in frequency-domain Preamble detaction in time-domain (after IDFT)	
Channel model	AWGN Typical Urban model, 120km/h	

Figure 2 and Figure 3 illustrate the miss detection probability (Pmd) to the average received Es/No of 1.25MHz and 5MHz bandwidth to achieve the false alarm Pfa = 10^{-3} under AWGN channel and TU 120km/h, respectively.

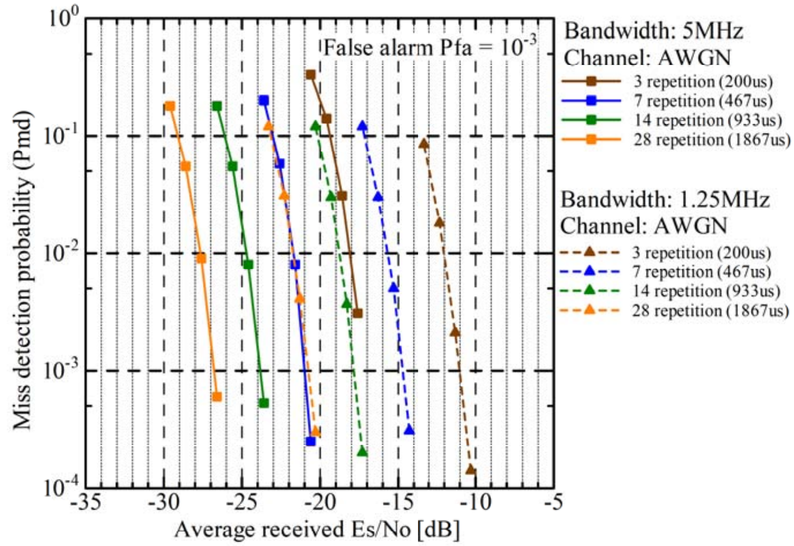

Figure 2 Miss detection probability (Pmd) to the average received Es/No (AWGN)

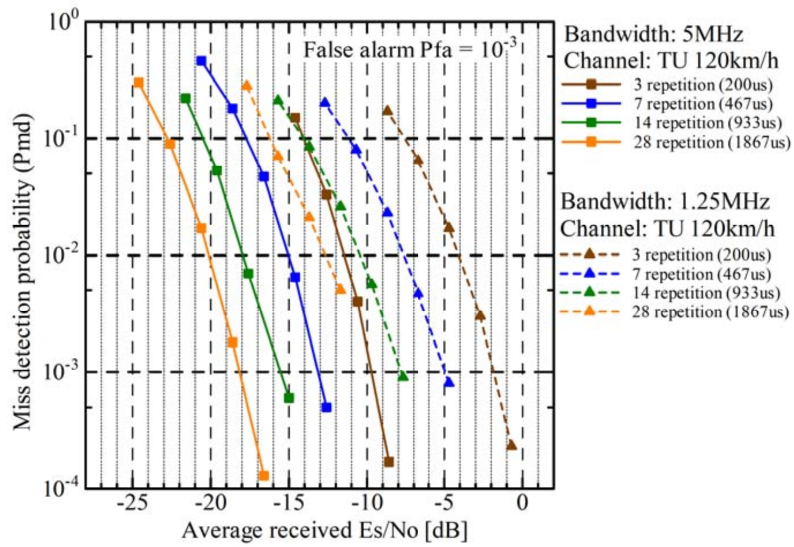

Figure 3 Miss detection probability (Pmd) to the average received Es/No (TU 120km/h)

Target value of the false alarm is ≤ 10^{-3} and the target value of miss detection is ≤ 10^{-2} and 10^{-3} in WCDMA [11] . We think similar target also would be required in LTE. Therefore, if we use the same target values from the above results, we can derive the required preamble length to fulfill the average received Es/No. The required preamble length in 1.25MHz bandwidth is illustrated in Figure 4 to the average received Es/No to achieve Pmd ≤ 10^{-3} and Pmd ≤ 10^{-2} with false alarm Pfa = 10^{-3}. Figure 5 shows the case of 5MHz bandwidth.

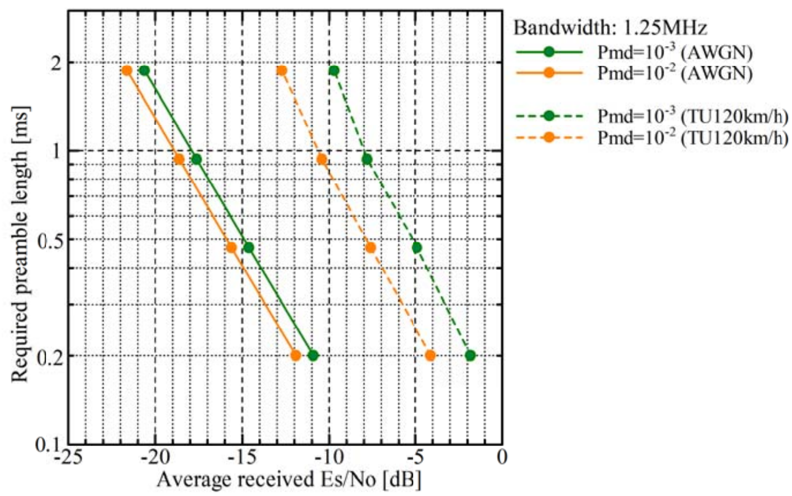

Figure 4 Preamble length to Es/No of false alarm probability = 10^{-3} (1.25MHz)

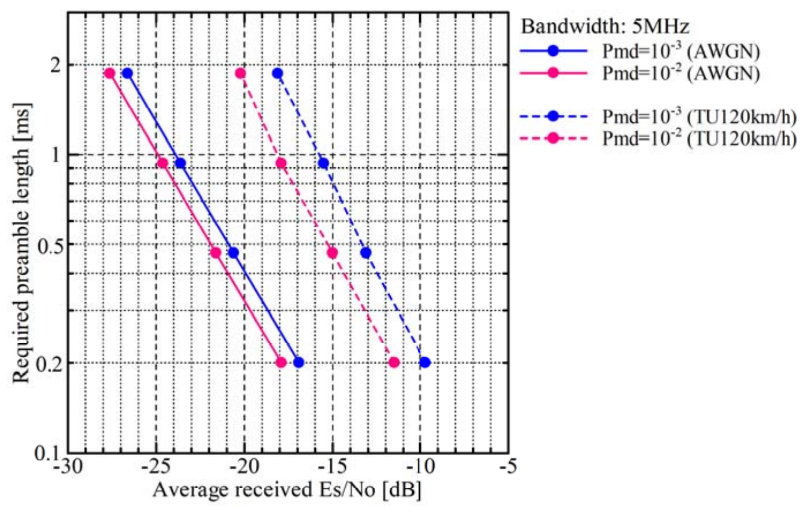

Figure 5 Preamble length to Es/No of false alarm probability = 10^{-3} (5MHz)

According to [6] , approximately -13 dB and -18 dB of the average received Es/No were derived from the system level evaluation for the ISD 500m and 1732m, respectively, when using open-loop TPC and 5MHz transmission bandwidth. Table 2 shows preamble length required for -13dB and -18dB of Es/No under AWGN and TU120km/h.

Table 2 Required preamble length to the average received Es/No (5MHz bandwidth)

Average received Es/No	AWGN		TU-120 km/h	
	Pmd = 10^{-2}	Pmd = 10^{-3}	Pmd = 10^{-2}	Pmd = 10^{-3}
-13 dB (ISD=500m)	1-repetition (67 usec)	2-repetition (133 usec)	5-repetition (333 usec)	7-repetition (467 usec)
-18 dB (ISD=1732m)	3-repetition (200 usec)	4-repetition (267 usec)	14-repetition (933 usec)	28-repetition (1867 usec)

In this evaluation, only one preamble is transmitted. If multiple preambles are transmitted and multiple preambles are also received at the same time, additional preamble length would be required due to multiple access interference (MAI).

2.3. Random access procedure

For non-synchronized random access procedure, we introduced the four methods in the Denver meeting [10] . We extended the discussion to following five methods. In the figure "preamble" could be randomly chosen signature sequence

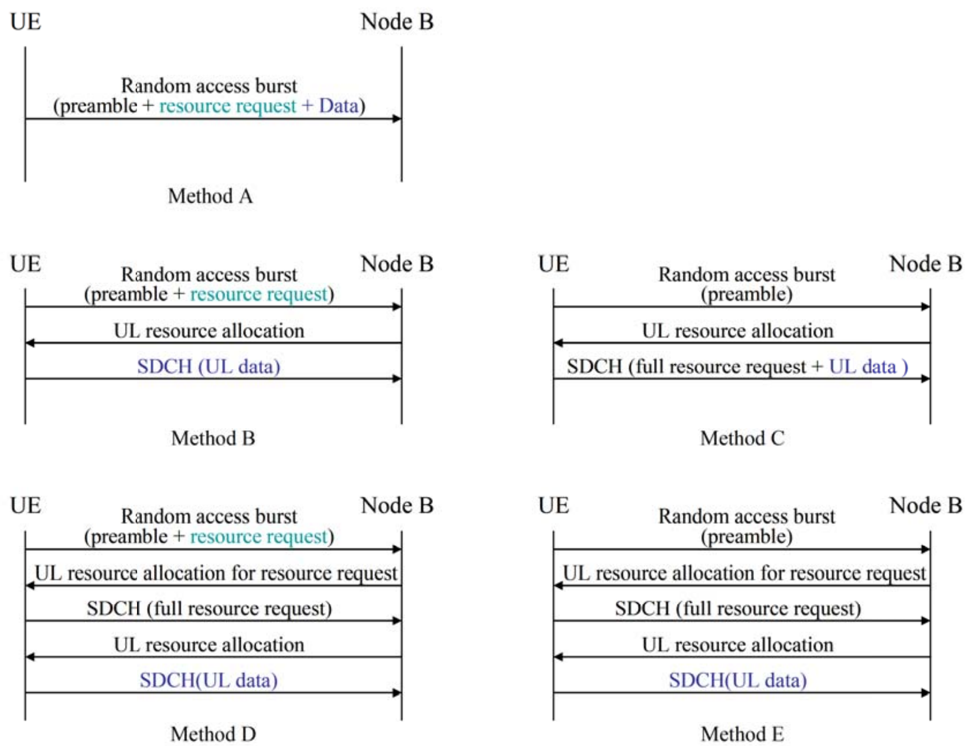

Figure 6 Initial resource allocation sequence

- Method A

The random access burst contains preamble, resource request and data. The delay for data transmission could be shortest.

- Method B

The random access burst contains preamble and resource request. The resource request could tell the amount of UE buffer and/or transmitter status. We assume only one or a few bits for this. The allocated amount of UL resource could be based on this resource request. The actual data is transmitted after one round trip time (RTT).

- Method C

The random access burst contains preamble only. The allocated amount of UL resource could be based without UE buffer and/or transmitter status. Therefore, the uplink resource allocation is not so accurate and could be waste of time-frequency resource in the uplink. The actual data is transmitted after one RTT.

- Method D

The random access burst contain preamble and resource request. The allocated amount of UL resource in the first SDCH would be relatively small because only a few information bits are obtained at Node B. The next SDCH contains UL data. The actual data is transmitted after two RTT.

- Method E

The random access burst contain preamble and resource request. The allocated amount of UL resource in the first SDCH is small because only resource request is transmitted. The next SDCH contains UL data. The actual data is transmitted after two RTT. Although the delay of SDCH transmission, the benefit of this scheme would be a appropriate amount of time-frequency resource to the second SDCH is based on more detailed information of resource request in the first SDCH. Therefore, accurate resource allocation is possible.

Method A requires different design of random access burst from the others. From the discussion of the previous sections, it would be difficult to include a large number of control information bits in a random access burst. Method B, C, D and E are almost similar on the design of random access burst.

We prefer method B/D than method C/E, because to include a few bits of the control information is beneficial in order to shorten the delay. The difference of B/D and C/E is whether to have a few bits on UE resource status (buffer and/or transmission status). On the actual resource status signaling method, there are two approaches. One is short message part is included as shown in Figure 7(a). The other is preamble pattern itself is chosen from the large number of preamble set shown in Figure 7(b). The choice of preamble pattern itself indicates the signaling.

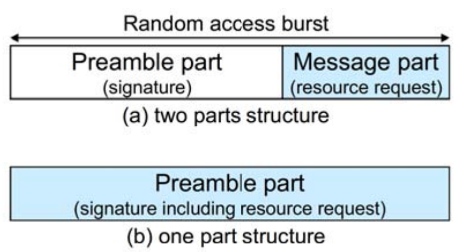

Figure 7 Inclusion of short message in random access burst

We don't see so much difference between B and D. The difference between B and D is the amount of uplink resource allocation in the first SDCH. Depending on cell level traffic situation, the scheduler could control the amount of allocation in the first SDCH. In method B, not only cell level traffic situation, but also the scheduler can control the amount of uplink resource based on the resource request from each UE. If UL resource allocation is relatively large, method B is applied. If UL resource allocation is relatively small, method D is applied. We think this handling of procedure looks useful approach because this enables trade off between delay and efficiency.

As a conclusion, we propose to take method B/D. The difference of B and D can be considered as the difference of the scheduler operation.

3. Conclusion

In this contribution, we evaluated the preamble performance. Based on the evaluation results, we discussed the inclusion of message part on RACH. Our current view is that it would be difficult to include a large massage part in RACH due to the limitations imposed by the link budget and preamble performance. However, we think that the inclusion of a few number of control information bits on random access burst is still beneficial from process delay point of view. A small size of message part may be included depending on target Es/No.

References

[1] TR 25.814 V1.0.2, "Physical layer aspects for evolved UTRA"

[2] TR25.913 V2.0.0, "Requirements for Evolved UTRA and UTRAN"

[3] R1-051445, Ericsson, "E-UTRA Random Access"

[4] R1-051391, NTT DoCoMo, "Random Access Transmission for Scalable Multiple Bandwidths in Evolved UTRA Uplink"

[5] R1-060025, Motorola, "RACH Design for EUTRA"

[6] R1-060047, NTT DoCoMo, NEC, Sharp, "Random Access Transmission in E-UTRA Uplink"

[7] R1-060181, Qualcomm, "Characteristics of UL Access Channel"

[8] R1-060152, Nortel, "Consideration on UL RACH scheme for LTE"

[9] R1-060226, Huawei, "EUTRA RACH preambles"

[10] R1-060699, Panasonic, "Inclusion of additional data on RACH"

[11] R1-060061, "LTE L1 related questions to RAN1"

[12] TR25.104 V6.11.0, "Base Station (BS) radio transmission and reception (FDD) (Release 6)"

[13] D. C. Chu, "Ployphase codes with good periodic correlation properties," IEEE Trans. Information Theory, vol.18, pp531-532, July 1972.

EXHIBIT 3

www.3gpp.org - /ftp/tsg_ran/WG1_RL1/TSGR1_44bis/Docs/

[To Parent Directory]

3/15/2006	2:16 PM	8661	R1-060765.zip
3/15/2006	2:16 PM	9206	R1-060766.zip
3/20/2006	1:14 PM	151547	R1-060767.zip
3/20/2006	1:14 PM	286701	R1-060768.zip
3/15/2006	2:15 PM	86378	R1-060769.zip
3/15/2006	2:15 PM	39374	R1-060770.zip
3/20/2006	4:41 PM	188915	R1-060771.zip
3/20/2006	4:41 PM	15515	R1-060772.zip
3/21/2006	7:08 AM	382471	R1-060773.zip
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4/1/2006	8:33 PM	12150	R1-061090.zip
4/1/2006	8:33 PM	22909	R1-061091.zip
4/1/2006	8:33 PM	60922	R1-061092.zip
4/1/2006	8:33 PM	60930	R1-061093.zip
4/1/2006	8:33 PM	61693	R1-061094.zip
4/1/2006	8:33 PM	13451	R1-061095.zip
4/20/2006	11:10 AM	20871	R1-061096.zip
4/1/2006	8:34 PM	283453	R1-061097.zip
4/26/2006	7:55 AM	2860879	R1-061098.zip
4/1/2006	9:16 PM	286793	R1-061099.zip
4/13/2006	12:01 PM	37521	R1-061100.zip
4/26/2006	7:55 AM	2862682	R1-061101.zip
4/26/2006	7:55 AM	2861263	R1-061102.zip
5/3/2006	9:19 AM	17592	R1-061103.zip
5/3/2006	9:21 AM	29312	Tdoclist_RAN1#44bis(March_2006).zip

EXHIBIT 4

TSG-RAN WG1 Meeting#44bis **R1-060792**
Athens, Greece, March 27-31, 2006

Source: **Panasonic**
Title: **Random access burst evaluation in E-UTRA uplink**
Agenda Item: **10.2.3**
Document for: **Discussion**

---

1. Introduction

Random access burst is used for the initial physical connection on initial cell access, handover and the resource allocation when the UE uplink has not been time synchronized. Several discussions on random access burst to achieve short initial physical connection setup have also been reported in [4] - [7] . Random access burst sub-frame may be composed of a preamble part and a message part. We evaluate the preamble performance. Based on the evaluation results, we discuss the inclusion of message part on random access burst.

2. Discussion

2.1. Random access burst requirements

In random access burst structure design, the following requirements have been considered [1] [3] - [10] .

- Reliable acquisition of preamble
- Estimation of arrival timing
- Reduction in the whole process delay
- To minimize the usage of time-frequency resources regarding spectrum efficiency

The most important requirement of the above is reliable acquisition and estimation of arrival timing because the success rate of random access burst attempt should be high enough. The inclusion of message part on random access burst has been considered to shorten physical connection setup delay [4] - [7] .

2.2. Discussion on preamble length

In TR [2] , E-UTRA is required to support at least 30km cell size. Therefore, we showed the link budget and achievable number of bits per TTI (0.5ms) to estimate how many bits can be contained on random access burst in [10] . The result would be useful in the case coverage is critical although the result is still preliminarily. On the other hand, we also need the discussion in the case that interference is critical. Ref. [6] reports that approximately -13 dB and -18 dB of the average received Es/No were derived from the system level evaluation. As mentioned above, the most important random access burst functions are reliable acquisition and estimation of arrival timing. For these reasons, first, we evaluate the required preamble length that corresponds to the required average received Es/No. Next we discuss the possibility of the inclusion of message part.

In the preamble evaluation, we assume the followings:

- Random access burst TTI is a multiple of 0.5msec. Preamble, guard time and possibly message part share a random access burst TTI
- Random access burst is time/frequency multiplexed with other channels [3] [4] .

Preamble structure

A preamble sequence should have a good auto-correlation and good-cross correlation. General chirp-like (GCL) sequence has been considered to satisfy these requirements [5] [8] [9] . In our preamble performance evaluation, Zadoff-Chu CAZAC sequence [13] , a special case of GCL sequence, is used. RACH preamble structure is shown in Figure 1.

We evaluated 1.25MHz and 5MHz as transmission bandwidth of the random access burst. The preamble structure consists of M-times repetition of N=73 (1.25MHz) or N=293(5MHz) CAZAC sequence. Cyclic prefix and guard time are also included within a random access burst TTI.

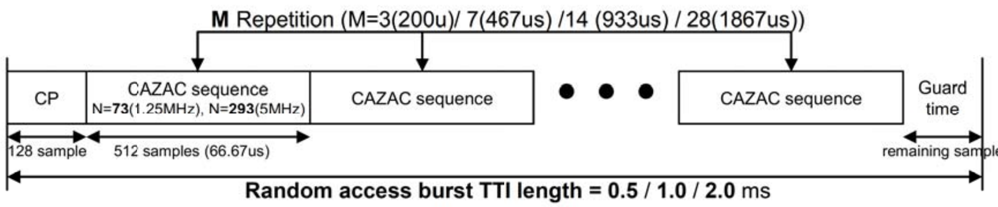

Figure 1 – preamble structure

Performance of preamble

The simulation parameters are shown in Table 1. As preamble performance evaluation criteria, we used false alarm and miss detection probability to the average received Es/No. The definition is as follows:

- **False alarm** (**Pfa**): the probability of a particular code being detected when nothing, or different code was transmitted
- **Miss detection** (**Pmd**): the probability of a particular code not being detected when the code was transmitted

Although time domain preamble detection would also possible, in our evaluation, the RACH preamble detection is performed in frequency domain, which is similar to the detection algorithm described in [8] .

1. Repeated CAZAC sequences of the received signal are combined in time domain.
2. The combined CAZAC sequence is processed by FFT.
3. A transmitted CAZAC code is detected by using coherent detection in frequency domain.
4. A delay profile response is obtained after IDFT processing.

Table 1 – Simulation parameters

Transmission Bandwidth	1.25MHz	5MHz
Transmission scheme	Localized FDMA	
RACH TTI length	0.5 ms / 1.0ms / 2.0ms	
Signature pattern	CAZAC sequence (Zadoff-Chu CAZAC[13])	
Length of CAZAC sequence (N)	73	293
Repetition factor (M) of CAZAC sequence	3 (total preamble length: 200usec) 7 (total preamble length: 467usec) 14 (total preamble length: 933usec) 28 (total preamble length: 1867usec)	
Number of multiplexed users	1	
Antenna configuration	1 transmit antenna, 2 receive antenna (combined non-coherently)	
Detector	Coherent detection in frequency-domain Preamble detaction in time-domain (after IDFT)	
Channel model	AWGN Typical Urban model, 120km/h	

Figure 2 and Figure 3 illustrate the miss detection probability (Pmd) to the average received Es/No of 1.25MHz and 5MHz bandwidth to achieve the false alarm Pfa = 10^{-3} under AWGN channel and TU 120km/h, respectively.

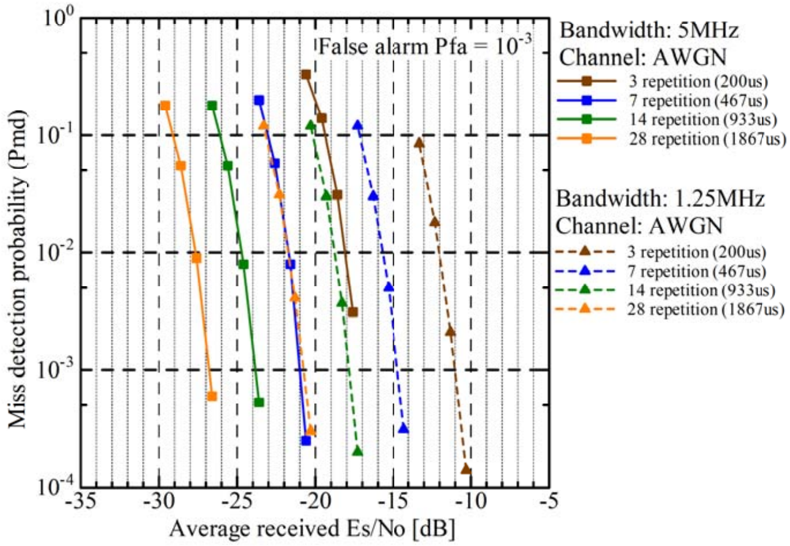

Figure 2 Miss detection probability (Pmd) to the average received Es/No (AWGN)

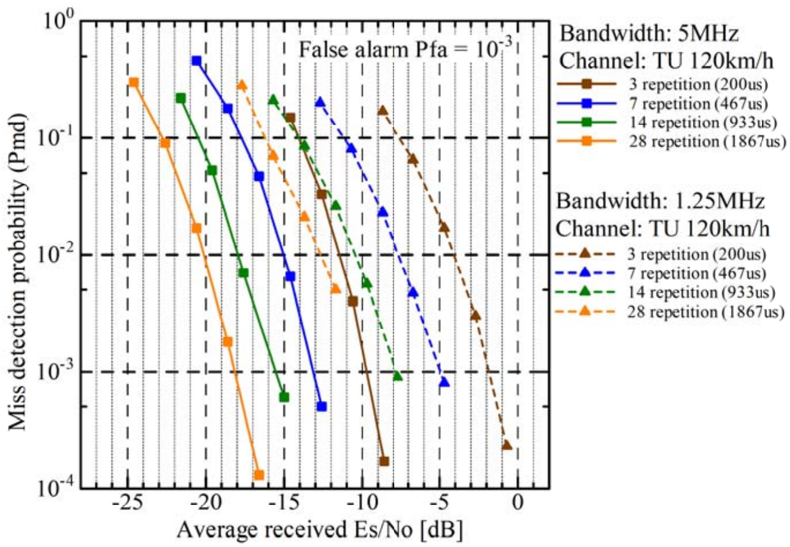

Figure 3 Miss detection probability (Pmd) to the average received Es/No (TU 120km/h)

Target value of the false alarm is ≤ 10^{-3} and the target value of miss detection is ≤ 10^{-2} and 10^{-3} in WCDMA [11] . We think similar target also would be required in LTE. Therefore, if we use the same target values from the above results, we can derive the required preamble length to fulfill the average received Es/No. The required preamble length in 1.25MHz bandwidth is illustrated in Figure 4 to the average received Es/No to achieve Pmd ≤ 10^{-3} and Pmd ≤ 10^{-2} with false alarm Pfa = 10^{-3}. Figure 5 shows the case of 5MHz bandwidth.

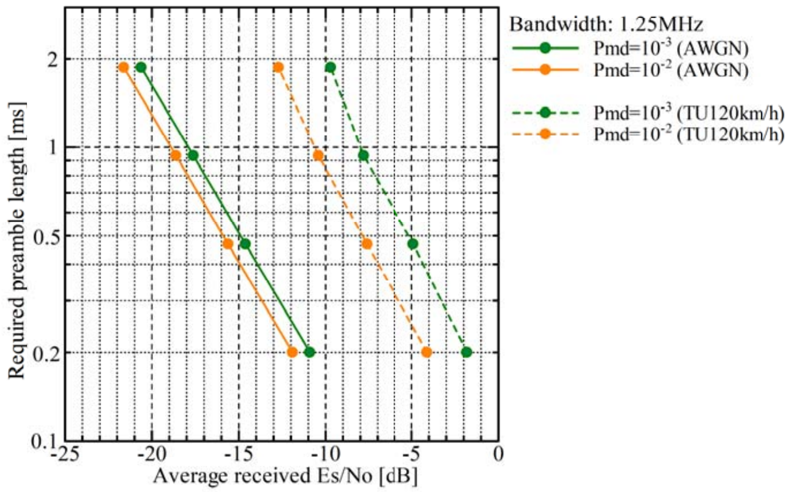

Figure 4 Preamble length to Es/No of false alarm probability = 10^{-3} (1.25MHz)

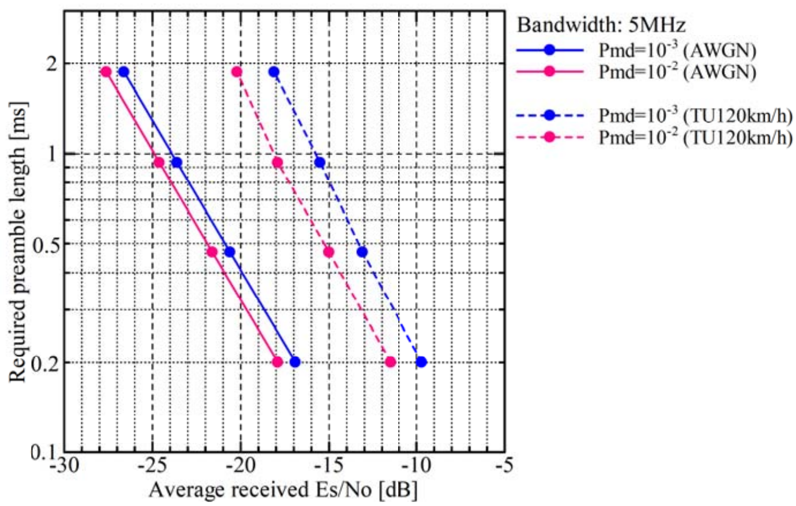

Figure 5 Preamble length to Es/No of false alarm probability = 10^{-3} (5MHz)

According to [6] , approximately -13 dB and -18 dB of the average received Es/No were derived from the system level evaluation for the ISD 500m and 1732m, respectively, when using open-loop TPC and 5MHz transmission bandwidth. Table 2 shows preamble length required for -13dB and -18dB of Es/No under AWGN and TU120km/h.

Table 2 Required preamble length to the average received Es/No (5MHz bandwidth)

Average received Es/No	AWGN		TU-120 km/h	
	Pmd = 10^{-2}	Pmd = 10^{-3}	Pmd = 10^{-2}	Pmd = 10^{-3}
-13 dB (ISD=500m)	1-repetition (67 usec)	2-repetition (133 usec)	5-repetition (333 usec)	7-repetition (467 usec)
-18 dB (ISD=1732m)	3-repetition (200 usec)	4-repetition (267 usec)	14-repetition (933 usec)	28-repetition (1867 usec)

In this evaluation, only one preamble is transmitted. If multiple preambles are transmitted and multiple preambles are also received at the same time, additional preamble length would be required due to multiple access interference (MAI).

2.3. Random access procedure

For non-synchronized random access procedure, we introduced the four methods in the Denver meeting [10] . We extended the discussion to following five methods. In the figure "preamble" could be randomly chosen signature sequence

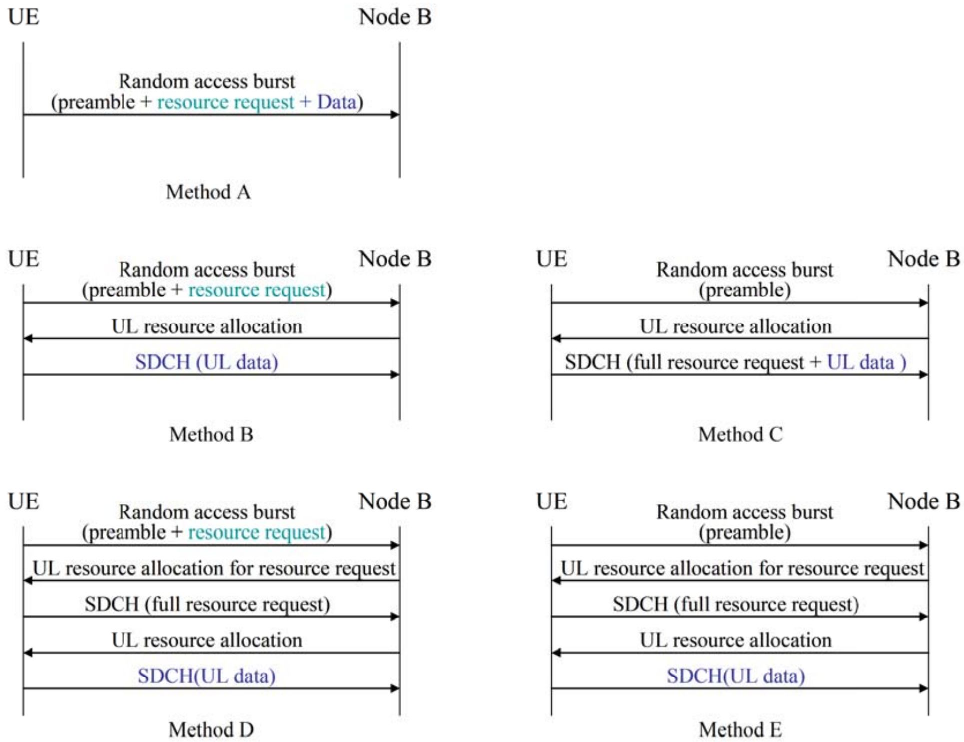

Figure 6 Initial resource allocation sequence

- Method A

The random access burst contains preamble, resource request and data. The delay for data transmission could be shortest.

- Method B

The random access burst contains preamble and resource request. The resource request could tell the amount of UE buffer and/or transmitter status. We assume only one or a few bits for this. The allocated amount of UL resource could be based on this resource request. The actual data is transmitted after one round trip time (RTT).

- Method C

The random access burst contains preamble only. The allocated amount of UL resource could be based without UE buffer and/or transmitter status. Therefore, the uplink resource allocation is not so accurate and could be waste of time-frequency resource in the uplink. The actual data is transmitted after one RTT.

- Method D

The random access burst contain preamble and resource request. The allocated amount of UL resource in the first SDCH would be relatively small because only a few information bits are obtained at Node B. The next SDCH contains UL data. The actual data is transmitted after two RTT.

- Method E

The random access burst contain preamble and resource request. The allocated amount of UL resource in the first SDCH is small because only resource request is transmitted. The next SDCH contains UL data. The actual data is transmitted after two RTT. Although the delay of SDCH transmission, the benefit of this scheme would be a appropriate amount of time-frequency resource to the second SDCH is based on more detailed information of resource request in the first SDCH. Therefore, accurate resource allocation is possible.

Method A requires different design of random access burst from the others. From the discussion of the previous sections, it would be difficult to include a large number of control information bits in a random access burst. Method B, C, D and E are almost similar on the design of random access burst.

We prefer method B/D than method C/E, because to include a few bits of the control information is beneficial in order to shorten the delay. The difference of B/D and C/E is whether to have a few bits on UE resource status (buffer and/or transmission status). On the actual resource status signaling method, there are two approaches. One is short message part is included as shown in Figure 7(a). The other is preamble pattern itself is chosen from the large number of preamble set shown in Figure 7(b). The choice of preamble pattern itself indicates the signaling.

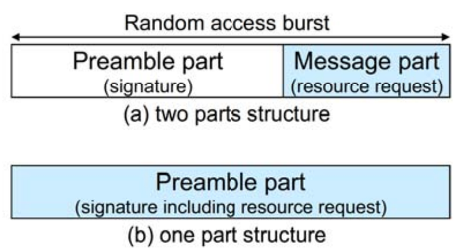

Figure 7 Inclusion of short message in random access burst

We don't see so much difference between B and D. The difference between B and D is the amount of uplink resource allocation in the first SDCH. Depending on cell level traffic situation, the scheduler could control the amount of allocation in the first SDCH. In method B, not only cell level traffic situation, but also the scheduler can control the amount of uplink resource based on the resource request from each UE. If UL resource allocation is relatively large, method B is applied. If UL resource allocation is relatively small, method D is applied. We think this handling of procedure looks useful approach because this enables trade off between delay and efficiency.

As a conclusion, we propose to take method B/D. The difference of B and D can be considered as the difference of the scheduler operation.

3. Conclusion

In this contribution, we evaluated the preamble performance. Based on the evaluation results, we discussed the inclusion of message part on RACH. Our current view is that it would be difficult to include a large massage part in RACH due to the limitations imposed by the link budget and preamble performance. However, we think that the inclusion of a few number of control information bits on random access burst is still beneficial from process delay point of view. A small size of message part may be included depending on target Es/No.

References

[1] TR 25.814 V1.0.2, "Physical layer aspects for evolved UTRA"

[2] TR25.913 V2.0.0, "Requirements for Evolved UTRA and UTRAN"

[3] R1-051445, Ericsson, "E-UTRA Random Access"

[4] R1-051391, NTT DoCoMo, "Random Access Transmission for Scalable Multiple Bandwidths in Evolved UTRA Uplink"

[5] R1-060025, Motorola, "RACH Design for EUTRA"

[6] R1-060047, NTT DoCoMo, NEC, Sharp, "Random Access Transmission in E-UTRA Uplink"

[7] R1-060181, Qualcomm, "Characteristics of UL Access Channel"

[8] R1-060152, Nortel, "Consideration on UL RACH scheme for LTE"

[9] R1-060226, Huawei, "EUTRA RACH preambles"

[10] R1-060699, Panasonic, "Inclusion of additional data on RACH"

[11] R1-060061, "LTE L1 related questions to RAN1"

[12] TR25.104 V6.11.0, "Base Station (BS) radio transmission and reception (FDD) (Release 6)"

[13] D. C. Chu, "Ployphase codes with good periodic correlation properties," IEEE Trans. Information Theory, vol.18, pp531-532, July 1972.

EXHIBIT 5

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Subject: Panasonic LTE Contributions for RAN1#45
From: Katsuhiko HIRAMATSU <[log in to unmask]>
Reply-To: Katsuhiko HIRAMATSU <[log in to unmask]>
Date: Tue, 2 May 2006 14:56:03 +0900
Content-Type: multipart/mixed
Parts/Attachments: text/plain (22 lines) , R1-061114.zip (22 lines) , R1-061115.zip (22 lines)

```
Dear Yoshi and all,

Please find the attached Panasonic contributions on
LTE.

R1-061114 Random access design for E-UTRA uplink
          11.1.2
R1-060115 System level simulation result no SC-FDMA
          11.6.2


Yoshi, if it is acceptable for you, I'd like to
revise
the title on R1-061114?

  ----Original title----
  Random access preamble design for E-UTRA uplink

  ---- New title ----
  Random access design for E-UTRA uplink

Best regards,
Katsuhiko Hiramatsu
```

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EXHIBIT 6

TSG-RAN WG1 Meeting#45 **R1-061114**
Shanghai, China, May 8 - 12, 2006

Source: **Panasonic**
Title: **Random access design for E-UTRA uplink**
Agenda Item: **11.1.2**
Document for: **Discussion and Decision**

---

1. Introduction

In this document, we discuss the random access structure as follows. This document only discusses non-synchronized random access structure.

- The preamble sequence
- The minimum preamble length
- The minimum bandwidth
- The sequence composition in preamble
- The control information over the preamble part
- The necessity of message part

2. Random access structure design

2.1. Preamble sequence

Random access is a contention based transmission. Therefore, multiple random access bursts from multiple UEs could be transmitted simultaneously. It is also good, if multiple random accesses are detected simultaneously at E-NodeB. To reduce the collisions among the random access, a common approach is UE randomly chooses one out of plural different preambles/signatures. To distinguish random accesses from different UEs at NodeB, a sequence with good auto-correlation and good cross-correlation property is required. For these reasons, we compare the miss detection probability vs. the average Ep/No among the different type of sequences (i.e. W-CDMA preamble sequences, different CAZAC sequences and cyclic-shifted CAZAC sequences).

Performance of different preamble sequences

The simulation parameters are shown in Table 1. Preamble performance evaluation criteria used are false alarm and miss detection probability to the average Ep/No. The definition is as follows:

- **False alarm** (**Pfa**): the probability of a particular code being detected when nothing, or different code is transmitted
- **Miss detection** (**Pmd**): the probability of a particular code not being detected when the code is transmitted

Table 1 Simulation parameters

Parameter	Value
Transmission Bandwidth	1.25MHz (Allocated bandwidth: 1.024MHz)
Preamble length	Approximately 400 usec
Guard time	Approximately 100 usec
Signature Pattern	- W-CDMA (truncated) - CAZAC sequence (Zadoff-Chu CAZAC[20])
Length of CAZAC sequence (N)	- W-CDMA (400 symbols: 16 signature * 25 repetition) - CAZAC (401 symbols) - Cyclic-shifted CAZAC (401symbols, shift duration: 50usec)
Number of multiplexed preambles	1, 2, 4, 8, 12, 16
Antenna configuration	1 Tx antenna, 2 Rx antennas (power profiles are combined)
Detector	Matched filtering in time domain. See Appendix.
Number of detector	16
Channel model	6-path Typical Urban 120km/h

Figure 1 shows the miss detection probability (Pmd) against the average Ep/No of each preamble sequence to achieve the false alarm Pfa = 10^{-3} under TU 120km/h. The miss detection probability against the Ep/No is always satisfied in Pfa = 10^{-3}. The result reflects that the false alarm probability is fluctuated due to mutual interference between preambles when plural preambles are transmitted.

From the evaluation, both CAZAC sequence and cyclic-shifted CAZAC sequence show better detection performance compared with the truncated WCDMA preamble sequence. Eight cyclic-shifted CAZAC sequences mixed have similar performance with only one CAZAC sequence. Moreover, the performance in 8 cyclic-shifted a CAZAC sequences and 4 cyclic-shifted other CAZAC sequences mixed have similar to 4 different CAZAC sequences mixed. Therefore, cyclic-shifted CAZAC sequence has superior performance among compared sequences. This aspect is also discussed in [14] .

As the results, we propose to choose cyclic-shifted Zadoff-Chu CAZAC as preamble sequence mainly. In addition, to have more signatures, we also propose to use different Zadoff-Chu CAZAC sequence.

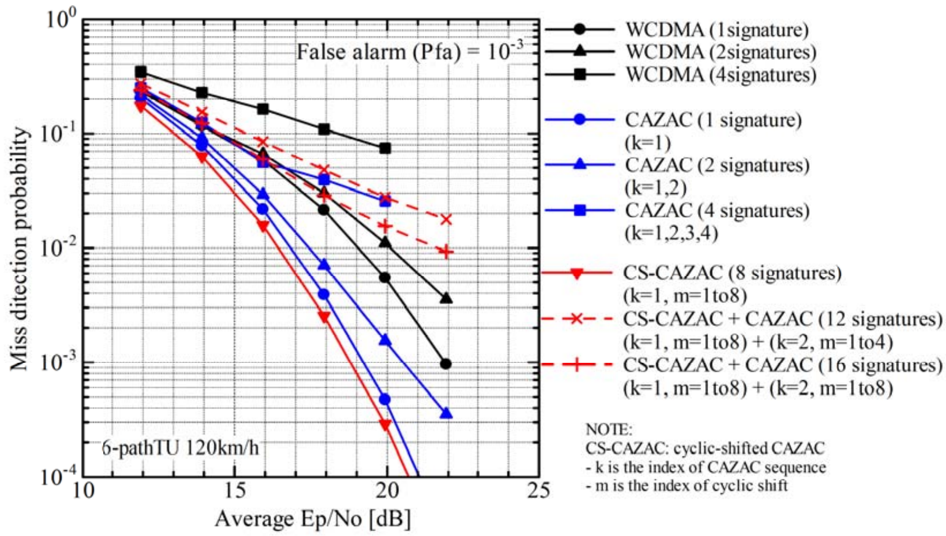

Figure 1 Miss detection probability (Pmd) to the average Ep/No (TU 120km/h)

2.2. Preamble length

Approximately 300 usec preamble length is required for ISD=500m and approximately 900 usec is required for ISD=1732m to achieve Pmd = 10^{-3} on CDF = 5% under TU 120km/h from the preamble detection performance in [13] . In the document, power control scheme assumed is relatively simple one. If more sophisticated one is assumed, the averaged received SINR at CDF = 5% would be further improved. In addition, more sophisticated preamble detectors in [15] [16] improves the preamble detection performance. These two aspects would allow reducing the required preamble length. Therefore, we propose to have two preamble lengths, around 400 usec and around 800 usec.

2.3. Minimum bandwidth

We propose the minimum bandwidth (BW) of random access burst is 1.25MHz. More than 1MHz BW would be required in order to obtain 1 usec time resolution for the uplink time alignment [19] . If only rough resolution is obtained in random access procedure, timing alignment control after random access procedure would get complicated.

In addition, sufficient number of symbols of the CAZAC sequence is required to eliminate mutual interference among preamble signatures. Therefore, we propose 1.25MHz as the minimum bandwidth.

2.4. Sequence composition in preamble

In the previous sections, we discussed the preamble sequence, the preamble length and the minimum bandwidth. Next topic is how to fulfill the possible preamble field using preamble sequence. Two approaches have been proposed. One is composed of multiple short CAZAC sequences [15] [16] . The other is one long CAZAC sequence [19] . For the decision among two, following aspects should be considered.

- Mutual interference among preambles
- Reuse factor of CAZAC sequence
- The possibility to transmit control information
- Decoder complexity

Mutual interference among preambles

Multiple short CAZAC sequence approach suffers more mutual interference among preambles. In addition, as we saw the evaluation in section 2.1, cyclic-shifted CAZAC sequence has superior performance. But cyclic-shifted CAZAC sequence requires relatively long sequence. Therefore, long CAZAC sequence is better than multiple short CAZAC sequence on this aspect.

Reuse factor of CAZAC sequence

The longer CAZAC sequence has a benefit to have bigger reuse factor of sequence management with less inter-cell interference when cell planning aspect is considered [19] . Therefore, long CAZAC sequence is better than multiple short CAZAC sequence on this aspect.

The possibility to transmit control information

To have a few number of control information bits on random access burst allows of an more efficient uplink and downlink resource utilization after random access attempt. In the case control information is mapped on the preamble part, control information including random ID is mapped to different signatures one by one. This means the more control bits are contained, if the larger number of signatures is used in one cell. Therefore, the required length of CAZAC sequence increases when more number of control bits is used. In addition, the length of CAZAC sequence further increases when bigger reuse factor are used. The number of different CAZAC sequences used by one cell is shown in Table 2. The number in ( ) shows the case four cyclic-shifted sequence are generated for each CAZAC sequence.

Table 2 the number of CAZAC sequences used in one cell

Number of control information bits (including random ID)	3 cell reuse	4 cell reuse	7 cell reuse
5 bits	96 (24)	128 (32)	224 (56)
6 bits	192 (48)	256 (64)	448 (112)
7 bits	384 (96)	512 (128)	896 (224)
8 bits	768 (192)	1024 (256)	1792 (448)
9 bits	1536 (284)	2048 (512)	3584 (896)

Discussion

From above discussion, long CAZAC sequence is preferred option. From the previous sections, we proposed 400 usec as the minimum preamble length and 1.125MHz (90% of 1.25MHz) as the minimum preamble bandwidth. Therefore, the maximum number of symbols contained in the preamble part is around 450 symbols.

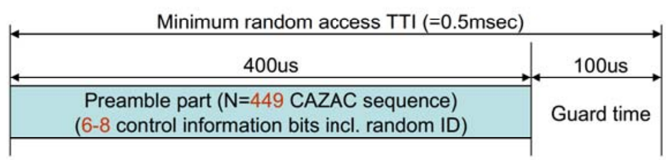

Figure 2 proposed the non-synchronized random access structure

We propose the N=449 (prime number) cyclic-shifted CAZAC sequences with also use different CAZAC sequences for the preambles. For supporting larger cell size, repeating this sequence twice (i.e. 800 usec) can be used.

According to this design, up to 8 control information bits including random ID can be transmitted on the preamble part with 7 cell reuse. A fewer usage of code sequence alleviate the decoder complexity. With also taking into account complexity aspect, we propose the number of control information bits contained in the preamble is around 6 bits.

2.5. Control information over the preamble part

We propose the followings control information is transmitted in non-synchronized random access preamble part.

- Random ID: To avoid collisions and to distinguish random access attempt from different UEs.
- Access type and buffer status: To allocate appropriate first uplink resource corresponding to the access reasons. One example is to distinguish among initial access/TA-update, handover, recovery of the synchronization in LTE_ACTIVE with bigger buffer size and recovery of the synchronization in LTE_ACTIVE with smaller buffer size
- UE Tx power head room or Downlink CQI: To perform link adaptation and/or power control for allocated uplink/downlink resource.

Example of possible mapping usage of 6 bits is shown in table 3. Similar way of mapping is also proposed in [15] .

Table 3 Example of propose control information mapping to signatures

Tx power head room	Cause/Access type	Signature ID (=Random ID) (case of 64 signatures)
Large Tx power head room	Initial access/TA-update	1-3
	Handover	no allocation
	LTE_ACTIVE(small buffer size)	4-6
	LTE_ACTIVE(large buffer size)	7-9
Middle Tx power head room	Initial access/TA-update	10-13
	Handover	no allocation
	LTE_ACTIVE(small buffer size)	14-17
	LTE_ACTIVE(large buffer size)	18-21
Small Tx power head room	Initial access/TA-update	22-26
	Handover	no allocation
	LTE_ACTIVE(small buffer size)	27-31
	LTE_ACTIVE(large buffer size)	32-36
No Tx power head room	Initial access/TA-update	37-45
	Handover	46-54
	LTE_ACTIVE(small buffer size)	44-64
	LTE_ACTIVE(large buffer size)	no allocation

2.6. Necessity of message part

If more than 6-8 control bits are required to be transmitted on random access burst, the message part has to be associated with the preamble part. However, in that case, the preamble part and message part should support the following properties.

- Channel estimation for coherent detection by the preamble part
- Message part should have similar BLER with miss detection probability of the preamble part.
- Message part should have similar collision avoidance performance with that of preamble part.

In order to achieve the above requirements, the longer associated message part might be required [17] . This consumes more uplink radio resources. Therefore, the trade-off between the merit of associating message part and the demerit of radio resource expense should be carefully considered.

3. Conclusion

We propose the following random access burst.

- Zadoff-Chu CAZAC sequence for the preamble sequence
- Both of cyclic-shifted CAZAC and different CAZAC sequence is used.
- Preamble lengths is around 400 usec and around 800 usec
- 1.25MHz is the minimum bandwidth
- One large CAZAC sequence for example N=449 is used to compose preamble sequence.
- The following control information is mapped on the CAZAC preamble signatures.
  - UE Tx power head room or downlink CQI
  - Access type and buffer status
  - Random ID

References

[1] TR25.814 V1.2.2, "Physical layer aspects for evolved UTRA"
[2] TR25.913 V2.0.0, "Requirements for Evolved UTRA and UTRAN"
[3] TR25.104 V6.11.0, "Base Station (BS) radio transmission and reception (FDD) (Release 6)"
[4] R1-051058, Texas Instruments, "RACH Preamble Design"
[5] R1-060047, NTT DoCoMo, NEC, Sharp, "Random Access Transmission in E-UTRA Uplink"
[6] R1-060152, Nortel, "Consideration on UL RACH scheme for LTE"
[7] R1-060161, Panasonic, "Inclusion of additional data on RACH"
[8] R1-060181, Qualcomm, "Characteristics of UL Access Channel"
[9] R1-060226, Huawei, "EUTRA RACH preambles"
[10] R1-060376, Texas Instruments, "RACH preamble design for E-UTRA"
[11] R1-060387, Motorola, "RACH Design for EUTRA"
[12] R1-060541, Huawei, "Some Considerations for Random Access Frame Design"
[13] R1-060792, Panasonic, "Random access burst evaluation in E-UTRA uplink"
[14] R1-060797, Huawei, "RACH design for E-UTRA"
[15] R1-060786, NTT DoCoMo, "Random Access Channel Structure for E-UTRA uplink"
[16] R1-060908, Nortel Networks, "On the performance of LTE RACH"
[17] R1-060909, Nortel Networks, "Consideration on the issues of LTE RACH"
[18] R1-060992, NTT DoCoMo, "Investigations on Random Access Channel Structure for E-UTRA Uplink"
[19] R1-060998, Ericsson, "E-UTRA Random Access Preamble Design"
[20] D. C. Chu, "Ployphase codes with good periodic correlation properties," IEEE Trans. Information Theory, vol.18, pp531-532, July 1972.

Appendix: Preamble detection algorithm

Two receiver antenna diversity reception is used. The 16 different power delay profiles are measured by the 16 matched filters corresponding to preamble sequences in each branch and then combined. Figure A illustrates the preamble detection method. The window size of the peak detection of the delay profile is set to 100usec for WCDMA preamble and CAZAC preamble. The window size for Cyclic-shifted CAZAC preamble is 50 usec to evaluate the detection performance up to 8 cyclic-shifted CAZAC sequences. Noise level is measured from the delay profile but the samples larger than Threshold A are not used for noise level calculation. Threshold B is the preamble detection threshold from the calculated noise level plus an offset value. The offset value is adjusted to achieve 0.1% false alarm probability. The maximum peak power is compared to Threshold B.

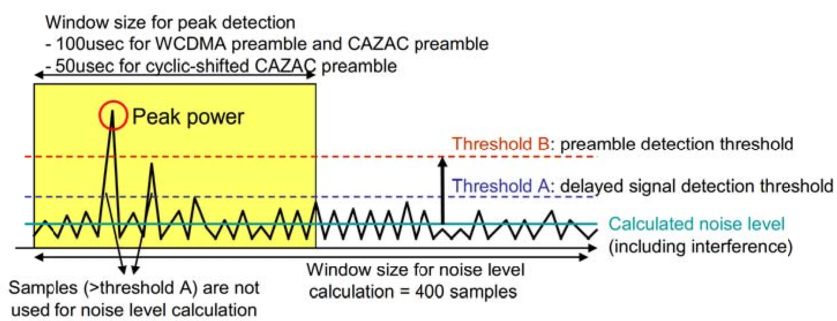

Figure A Output signal of matched filter and preamble detection algorithm

ZTE/HTC
Exhibit 1015-0058

EXHIBIT 7

www.3gpp.org - /ftp/tsg_ran/WG1_RL1/TSGR1_45/Docs/

[To Parent Directory]

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5/2/2006	4:18 PM	232973	R1-061106.zip
4/13/2006	5:01 PM	9258	R1-061107.zip
5/2/2006	7:03 AM	136220	R1-061108.zip
4/25/2006	4:39 PM	14452	R1-061109.zip
5/2/2006	6:23 AM	1262233	R1-061110.zip
5/12/2006	3:14 PM	431339	R1-061111.zip
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EXHIBIT 8

TSG-RAN WG1 Meeting#45 **R1-061114**
Shanghai, China, May 8 - 12, 2006

Source:	**Panasonic**
Title:	**Random access design for E-UTRA uplink**
Agenda Item:	**11.1.2**
Document for:	**Discussion and Decision**

1. Introduction

In this document, we discuss the random access structure as follows. This document only discusses non-synchronized random access structure.

- The preamble sequence
- The minimum preamble length
- The minimum bandwidth
- The sequence composition in preamble
- The control information over the preamble part
- The necessity of message part

2. Random access structure design

2.1. Preamble sequence

Random access is a contention based transmission. Therefore, multiple random access bursts from multiple UEs could be transmitted simultaneously. It is also good, if multiple random accesses are detected simultaneously at E-NodeB. To reduce the collisions among the random access, a common approach is UE randomly chooses one out of plural different preambles/signatures. To distinguish random accesses from different UEs at NodeB, a sequence with good auto-correlation and good cross-correlation property is required. For these reasons, we compare the miss detection probability vs. the average Ep/No among the different type of sequences (i.e. W-CDMA preamble sequences, different CAZAC sequences and cyclic-shifted CAZAC sequences).

Performance of different preamble sequences

The simulation parameters are shown in Table 1. Preamble performance evaluation criteria used are false alarm and miss detection probability to the average Ep/No. The definition is as follows:

- **False alarm (Pfa)**: the probability of a particular code being detected when nothing, or different code is transmitted
- **Miss detection (Pmd)**: the probability of a particular code not being detected when the code is transmitted

Table 1 Simulation parameters

Parameter	Value
Transmission Bandwidth	1.25MHz (Allocated bandwidth: 1.024MHz)
Preamble length	Approximately 400 usec
Guard time	Approximately 100 usec
Signature Pattern	- W-CDMA (truncated) - CAZAC sequence (Zadoff-Chu CAZAC[20])
Length of CAZAC sequence (N)	- W-CDMA (400 symbols: 16 signature * 25 repetition) - CAZAC (401 symbols) - Cyclic-shifted CAZAC (401symbols, shift duration: 50usec)
Number of multiplexed preambles	1, 2, 4, 8, 12, 16
Antenna configuration	1 Tx antenna, 2 Rx antennas (power profiles are combined)
Detector	Matched filtering in time domain. See Appendix.
Number of detector	16
Channel model	6-path Typical Urban 120km/h

Figure 1 shows the miss detection probability (Pmd) against the average Ep/No of each preamble sequence to achieve the false alarm Pfa = 10^{-3} under TU 120km/h. The miss detection probability against the Ep/No is always satisfied in Pfa = 10^{-3}. The result reflects that the false alarm probability is fluctuated due to mutual interference between preambles when plural preambles are transmitted.

From the evaluation, both CAZAC sequence and cyclic-shifted CAZAC sequence show better detection performance compared with the truncated WCDMA preamble sequence. Eight cyclic-shifted CAZAC sequences mixed have similar performance with only one CAZAC sequence. Moreover, the performance in 8 cyclic-shifted a CAZAC sequences and 4 cyclic-shifted other CAZAC sequences mixed have similar to 4 different CAZAC sequences mixed. Therefore, cyclic-shifted CAZAC sequence has superior performance among compared sequences. This aspect is also discussed in [14] .

As the results, we propose to choose cyclic-shifted Zadoff-Chu CAZAC as preamble sequence mainly. In addition, to have more signatures, we also propose to use different Zadoff-Chu CAZAC sequence.

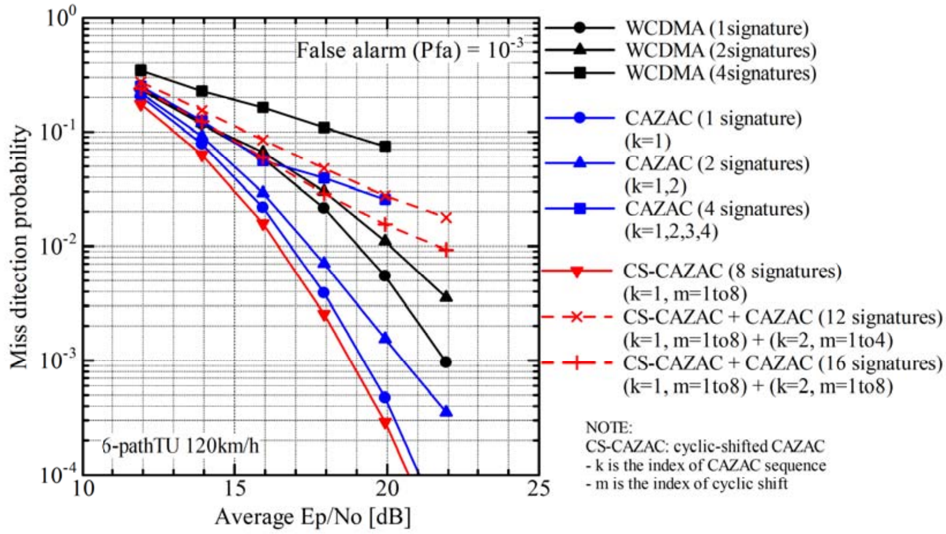

Figure 1 Miss detection probability (Pmd) to the average Ep/No (TU 120km/h)

2.2. Preamble length

Approximately 300 usec preamble length is required for ISD=500m and approximately 900 usec is required for ISD=1732m to achieve Pmd = 10^{-3} on CDF = 5% under TU 120km/h from the preamble detection performance in [13] . In the document, power control scheme assumed is relatively simple one. If more sophisticated one is assumed, the averaged received SINR at CDF = 5% would be further improved. In addition, more sophisticated preamble detectors in [15] [16] improves the preamble detection performance. These two aspects would allow reducing the required preamble length. Therefore, we propose to have two preamble lengths, around 400 usec and around 800 usec.

2.3. Minimum bandwidth

We propose the minimum bandwidth (BW) of random access burst is 1.25MHz. More than 1MHz BW would be required in order to obtain 1 usec time resolution for the uplink time alignment [19] . If only rough resolution is obtained in random access procedure, timing alignment control after random access procedure would get complicated.

In addition, sufficient number of symbols of the CAZAC sequence is required to eliminate mutual interference among preamble signatures. Therefore, we propose 1.25MHz as the minimum bandwidth.

2.4. Sequence composition in preamble

In the previous sections, we discussed the preamble sequence, the preamble length and the minimum bandwidth. Next topic is how to fulfill the possible preamble field using preamble sequence. Two approaches have been proposed. One is composed of multiple short CAZAC sequences [15] [16] . The other is one long CAZAC sequence [19] . For the decision among two, following aspects should be considered.

- Mutual interference among preambles
- Reuse factor of CAZAC sequence
- The possibility to transmit control information
- Decoder complexity

Mutual interference among preambles

Multiple short CAZAC sequence approach suffers more mutual interference among preambles. In addition, as we saw the evaluation in section 2.1, cyclic-shifted CAZAC sequence has superior performance. But cyclic-shifted CAZAC sequence requires relatively long sequence. Therefore, long CAZAC sequence is better than multiple short CAZAC sequence on this aspect.

Reuse factor of CAZAC sequence

The longer CAZAC sequence has a benefit to have bigger reuse factor of sequence management with less inter-cell interference when cell planning aspect is considered [19] . Therefore, long CAZAC sequence is better than multiple short CAZAC sequence on this aspect.

The possibility to transmit control information

To have a few number of control information bits on random access burst allows of an more efficient uplink and downlink resource utilization after random access attempt. In the case control information is mapped on the preamble part, control information including random ID is mapped to different signatures one by one. This means the more control bits are contained, if the larger number of signatures is used in one cell. Therefore, the required length of CAZAC sequence increases when more number of control bits is used. In addition, the length of CAZAC sequence further increases when bigger reuse factor are used. The number of different CAZAC sequences used by one cell is shown in Table 2. The number in ( ) shows the case four cyclic-shifted sequence are generated for each CAZAC sequence.

Table 2 the number of CAZAC sequences used in one cell

Number of control information bits (including random ID)	3 cell reuse	4 cell reuse	7 cell reuse
5 bits	96 (24)	128 (32)	224 (56)
6 bits	192 (48)	256 (64)	448 (112)
7 bits	384 (96)	512 (128)	896 (224)
8 bits	768 (192)	1024 (256)	1792 (448)
9 bits	1536 (284)	2048 (512)	3584 (896)

Discussion

From above discussion, long CAZAC sequence is preferred option. From the previous sections, we proposed 400 usec as the minimum preamble length and 1.125MHz (90% of 1.25MHz) as the minimum preamble bandwidth. Therefore, the maximum number of symbols contained in the preamble part is around 450 symbols.

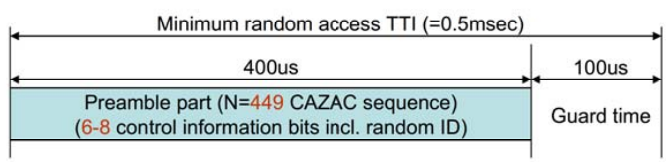

Figure 2 proposed the non-synchronized random access structure

We propose the N=449 (prime number) cyclic-shifted CAZAC sequences with also use different CAZAC sequences for the preambles. For supporting larger cell size, repeating this sequence twice (i.e. 800 usec) can be used.

According to this design, up to 8 control information bits including random ID can be transmitted on the preamble part with 7 cell reuse. A fewer usage of code sequence alleviate the decoder complexity. With also taking into account complexity aspect, we propose the number of control information bits contained in the preamble is around 6 bits.

2.5. Control information over the preamble part

We propose the followings control information is transmitted in non-synchronized random access preamble part.

- Random ID: To avoid collisions and to distinguish random access attempt from different UEs.
- Access type and buffer status: To allocate appropriate first uplink resource corresponding to the access reasons. One example is to distinguish among initial access/TA-update, handover, recovery of the synchronization in LTE_ACTIVE with bigger buffer size and recovery of the synchronization in LTE_ACTIVE with smaller buffer size
- UE Tx power head room or Downlink CQI: To perform link adaptation and/or power control for allocated uplink/downlink resource.

Example of possible mapping usage of 6 bits is shown in table 3. Similar way of mapping is also proposed in [15] .

Table 3 Example of propose control information mapping to signatures

Tx power head room	Cause/Access type	Signature ID (=Random ID) (case of 64 signatures)
Large Tx power head room	Initial access/TA-update	1-3
	Handover	no allocation
	LTE_ACTIVE(small buffer size)	4-6
	LTE_ACTIVE(large buffer size)	7-9
Middle Tx power head room	Initial access/TA-update	10-13
	Handover	no allocation
	LTE_ACTIVE(small buffer size)	14-17
	LTE_ACTIVE(large buffer size)	18-21
Small Tx power head room	Initial access/TA-update	22-26
	Handover	no allocation
	LTE_ACTIVE(small buffer size)	27-31
	LTE_ACTIVE(large buffer size)	32-36
No Tx power head room	Initial access/TA-update	37-45
	Handover	46-54
	LTE_ACTIVE(small buffer size)	44-64
	LTE_ACTIVE(large buffer size)	no allocation

2.6. Necessity of message part

If more than 6-8 control bits are required to be transmitted on random access burst, the message part has to be associated with the preamble part. However, in that case, the preamble part and message part should support the following properties.

- Channel estimation for coherent detection by the preamble part
- Message part should have similar BLER with miss detection probability of the preamble part.
- Message part should have similar collision avoidance performance with that of preamble part.

In order to achieve the above requirements, the longer associated message part might be required [17] . This consumes more uplink radio resources. Therefore, the trade-off between the merit of associating message part and the demerit of radio resource expense should be carefully considered.

3. Conclusion

We propose the following random access burst.

- Zadoff-Chu CAZAC sequence for the preamble sequence
- Both of cyclic-shifted CAZAC and different CAZAC sequence is used.
- Preamble lengths is around 400 usec and around 800 usec
- 1.25MHz is the minimum bandwidth
- One large CAZAC sequence for example N=449 is used to compose preamble sequence.
- The following control information is mapped on the CAZAC preamble signatures.
  - UE Tx power head room or downlink CQI
  - Access type and buffer status
  - Random ID

References

[1] TR25.814 V1.2.2, "Physical layer aspects for evolved UTRA"
[2] TR25.913 V2.0.0, "Requirements for Evolved UTRA and UTRAN"
[3] TR25.104 V6.11.0, "Base Station (BS) radio transmission and reception (FDD) (Release 6)"
[4] R1-051058, Texas Instruments, "RACH Preamble Design"
[5] R1-060047, NTT DoCoMo, NEC, Sharp, "Random Access Transmission in E-UTRA Uplink"
[6] R1-060152, Nortel, "Consideration on UL RACH scheme for LTE"
[7] R1-060161, Panasonic, "Inclusion of additional data on RACH"
[8] R1-060181, Qualcomm, "Characteristics of UL Access Channel"
[9] R1-060226, Huawei, "EUTRA RACH preambles"
[10] R1-060376, Texas Instruments, "RACH preamble design for E-UTRA"
[11] R1-060387, Motorola, "RACH Design for EUTRA"
[12] R1-060541, Huawei, "Some Considerations for Random Access Frame Design"
[13] R1-060792, Panasonic, "Random access burst evaluation in E-UTRA uplink"
[14] R1-060797, Huawei, "RACH design for E-UTRA"
[15] R1-060786, NTT DoCoMo, "Random Access Channel Structure for E-UTRA uplink"
[16] R1-060908, Nortel Networks, "On the performance of LTE RACH"
[17] R1-060909, Nortel Networks, "Consideration on the issues of LTE RACH"
[18] R1-060992, NTT DoCoMo, "Investigations on Random Access Channel Structure for E-UTRA Uplink"
[19] R1-060998, Ericsson, "E-UTRA Random Access Preamble Design"
[20] D. C. Chu, "Ploypháse codes with good periodic correlation properties," IEEE Trans. Information Theory, vol.18, pp531-532, July 1972.

Appendix: Preamble detection algorithm

Two receiver antenna diversity reception is used. The 16 different power delay profiles are measured by the 16 matched filters corresponding to preamble sequences in each branch and then combined. Figure A illustrates the preamble detection method. The window size of the peak detection of the delay profile is set to 100usec for WCDMA preamble and CAZAC preamble. The window size for Cyclic-shifted CAZAC preamble is 50 usec to evaluate the detection performance up to 8 cyclic-shifted CAZAC sequences. Noise level is measured from the delay profile but the samples larger than Threshold A are not used for noise level calculation. Threshold B is the preamble detection threshold from the calculated noise level plus an offset value. The offset value is adjusted to achieve 0.1% false alarm probability. The maximum peak power is compared to Threshold B.

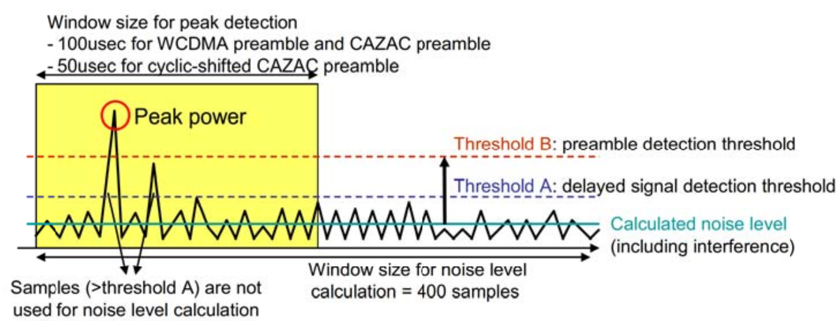

Figure A Output signal of matched filter and preamble detection algorithm