3GPP TSG-RAN1 Ad-hoc on LTE
Sophia-Antipolis, France, 20th-21st June, 2005

R1-050641

Agenda Item: 4.1

Source: Nortel

Title: Proposal for the Downlink Preamble Design for E-UTRA

Document for: Discussion

© NORTEL, 2005, All Rights Reserved

>THIS IS **THE WAY**

Proposal for the Downlink Preamble Design for E-UTRA

Nortel

Jun 20, 2005

>THIS IS NORTEL

Contents

> Introduction and background

> Design principle

> Preamble Structure

- Time domain structure
- Frequency domain structure
- Antenna Mapping and Sequence Mapping

> Initial Acquisition and Synchronization

> Summary and conclusion

© NORTEL, 2005, All Rights Reserved

Design Principle

> The introduction of the preamble enable:

- Fast initial system access
- Easy synchronization
  - Timing
  - Frequency
- Fast on-going cell search to support fast cell selection
  - Low complexity
- Support channel estimation
  - Initial MIMO channel estimation
  - CIR measurement
- Support MIMO
  - No impact on non-MIMO terminal
  - Transmit antenna configuration detection (desirable)
- Preamble sequence selection
  - Low PAPR
  - Common sequences and cell specific sequences
- Scalability
  - Uniform performance for 1.25, 5 bandwidth
  - Same or improved performance for 10, 15 and 20 MHz bandwidth

© NORTEL, 2005, All Rights Reserved

Preamble Structure

> Preamble is inserted periodically in time
  - For example at the beginning of each frame, every several TTIS or every several frames.

> Time domain repetition structure enables fast frame (or coarse) synchronization

> Frequency domain non-overlapping sequence mapping scheme
  - No inter-antenna interference
  - Enable MIMO channel estimation

> Preamble carries primary common synchronization channel and secondary cell specific synchronization channel.
  - To enable the fast system access and cell search
    - Primary common SYNC channel (PSC) to carry common PN codes known by all cells
    - Secondary cell specific SYNC channel (SSC) to transmit cell specific PN codes assigned to each cell

> Preamble consists of 2n head symbols
  - n is a configurable parameter depends on channel bandwidth, for example:
    - n=0.5 (or 1) for 10, 15 & 20 MHz Bandwidth
    - n=1 for 5 MHz Bandwidth
    - n=2 for 2.5 MHz Bandwidth
    - n=4 for 1.25 MHz Bandwidth

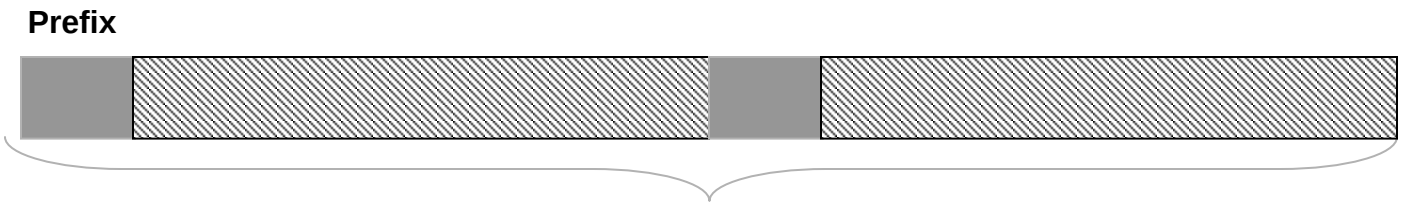
© NORTEL, 2005, All Rights Reserved

Preamble Structure (Time Domain Structure)

> A preamble consists of 2n identical head symbols

- Support frame synchronization
  - Identify frame boundary based on the auto-correlation peak
- Support FFT size identification
- Support frequency synchronization

5 MHz bandwidth (n=1)



© NORTEL, 2005, All Rights Reserved

Preamble Structure (Frequency Domain Structure)

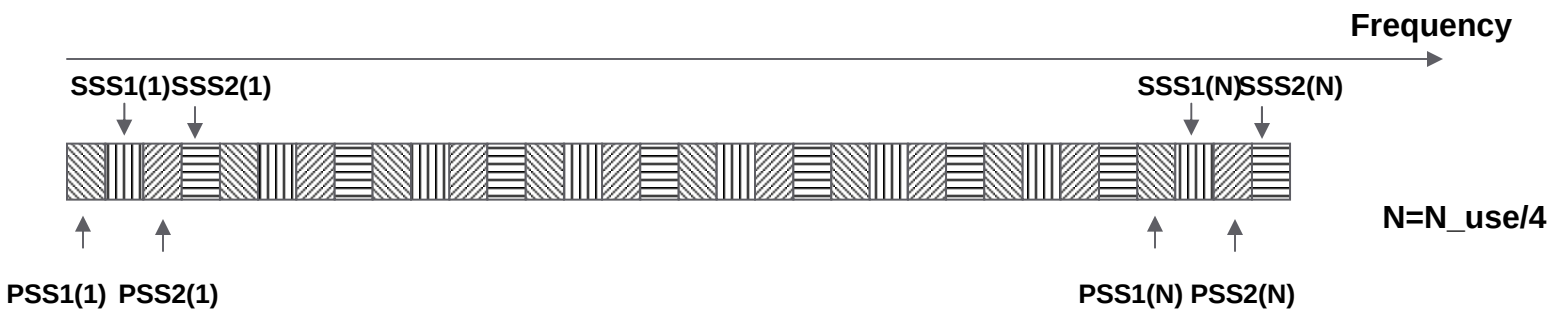
> The whole useful sub-carriers per OFDM symbol are shared by primary common SYNC channel (PSC) and secondary cell specific synchronization channel (SSC)

- PSC
  - Provide the candidate timing synchronization positions for cell identification
  - Multiple cross-correlation peaks corresponding to different BTS
- SSC
  - Cell identification based on the cross correlation peak
  - MIMO channel estimation
  - CIR estimation
  - Support timing synchronization conformation and tracking

© NORTEL, 2005, All Rights Reserved

Preamble Structure (Antenna Mapping and Sequence Mapping)

> Support up to four transmit antennas
  - Orthogonality is maintained between different antennas in the frequency domain
> Sub-carriers assigned to PSC are modulated by two primary SYNC sequences (PSS)
  - PSS-1: unique sequence applied by all cells
  - PSS-2: unique sequence or multiple sequences carrying antenna configuration information
> Sub-carriers assigned to SSC are modulated by two secondary SYNC sequences (SSS)
  - SSS-1 and SSS-2: cell specific sequences determined by cell Id
> The length of PSS and SSS (N) is equal to the quarter of the useful sub-carrier number



For 1 Transmit Antenna	Antenna 1	Antenna 1	Antenna 1	Antenna 1
For 2 Transmit Antenna	Antenna 1	Antenna 2	Antenna 1	Antenna 2
For 4 Transmit Antenna	Antenna 1	Antenna 2	Antenna 3	Antenna 4

© NORTEL, 2005, All Rights Reserved

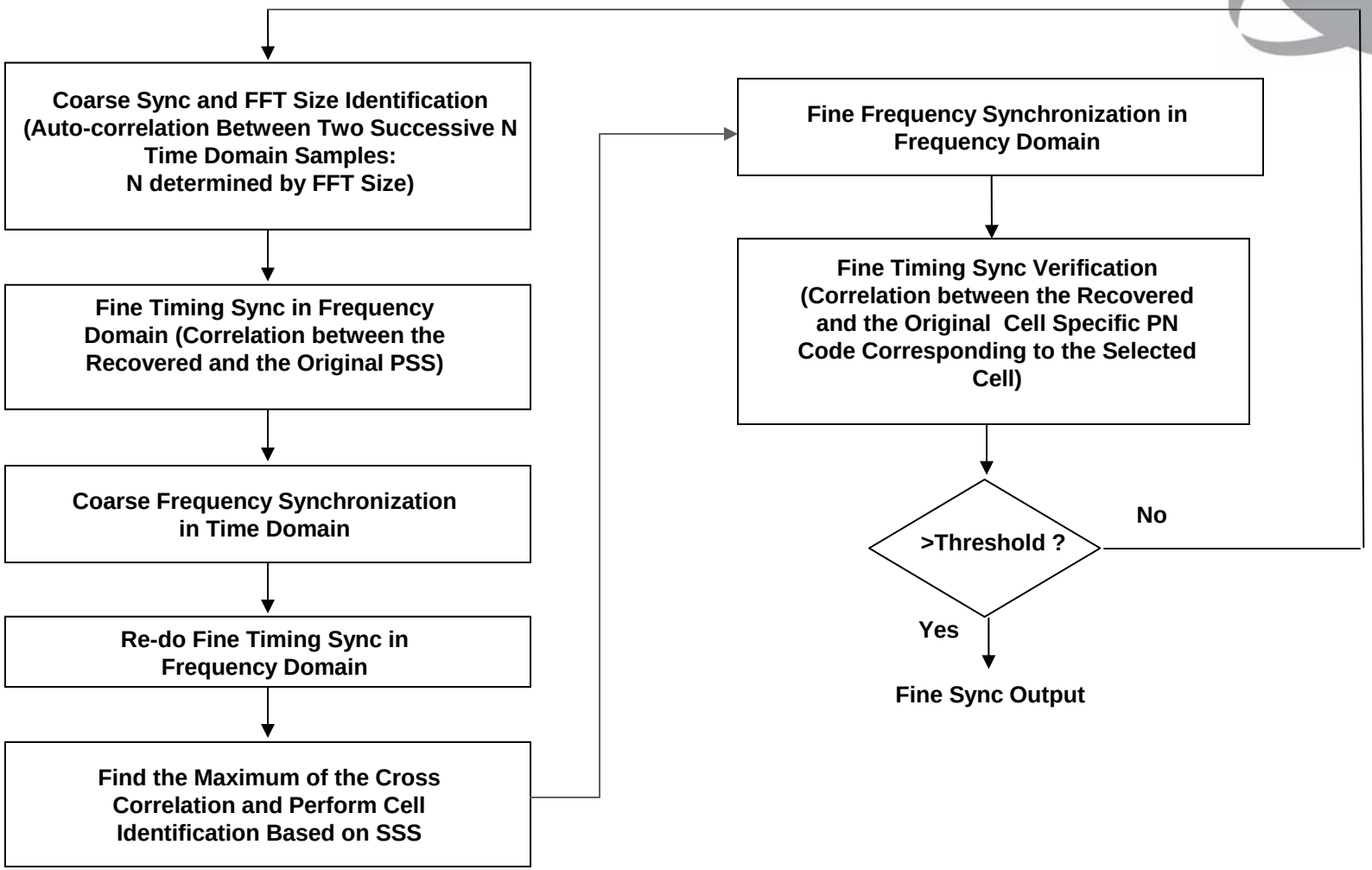
Initial Acquisition and Synchronization

> UE can perform initial acquisition and synchronization based on the head symbols in the preamble.
  - FFT size identification
  - Frame acquisition (coarse timing synchronization)
  - Timing acquisition
  - Frequency acquisition
  - Cell identification and selection
  - Fine frequency synchronization
  - Fine timing verification

> A number of algorithms can be applied by UE, next slide gives an example of the processing procedure for initial acquisition and synchronization.

© NORTEL, 2005, All Rights Reserved

Initial Acquisition and Synchronization Procedure



© NORTEL, 2005, All Rights Reserved

Summary

> DL preamble structure is proposed

- Structure relies on Primary common SYNC channel and secondary cell specific SYNC channel as for WCDMA
- Structure supports MIMO and different channel bandwidth

© NORTEL, 2005, All Rights Reserved