

R1-050941



3GPP TSG-RAN1 Meeting #42

London, UK, 29thAug.-2nd Sept, 2005

Agenda Item: 10.2

Source: Nortel

**Title: Proposal for Methods to Mitigate Inter-cell
Interference**

Document for: Discussion

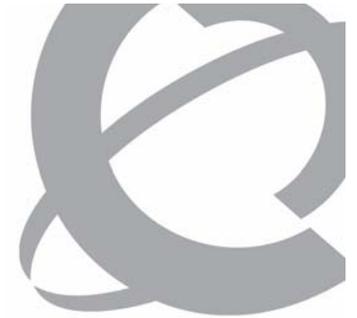


>THIS IS **THE WAY**

Methods to Mitigate Inter-cell Interference

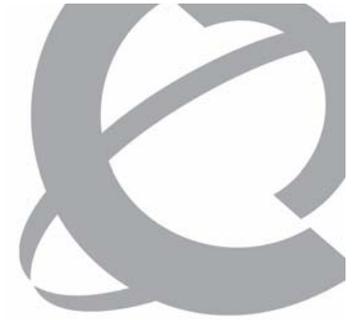
Aug.24, 2005

>THIS IS **NØRTEL**



Introduction and Background

- > For OFDM system in the frequency reuse-one deployment, the inter-cell interference is the limiting factor for coverage and cell-edge bit-rates
- > A number of techniques may be considered to mitigate inter-cell interference
 - Fractional frequency re-use network
 - Each cell occupies partially the total bandwidth
 - Reduces system capacity dramatically
 - OFCDM
 - Frequency domain spreading with CDM
 - Spreading gain
 - Performance degradation due to orthogonality loss
 - Macro diversity
 - For example: fast cell selection, soft handoff



Summary of the Proposed Solution

- > Proposal is based on the definition of two interference zones on a cell level
 - A low inter-cell interference (LICI) zone
 - The LICI zone is defined in the time domain (granularity corresponds to a symbol pair)
 - The LICI zone is applied on the complete set of sub-carriers in the cell
 - The LICI zone is characterized by the use of a fractional frequency reuse
 - A normal inter-cell interference zone
 - As for LICI zone the normal zone is defined in the time domain
 - The normal zone is applied on the complete set of sub-carriers in the cell
 - The normal interference zone is characterized by the frequency reuse 1
- > On a cell level, the mapping of the low interference zones and normal interference zone is dynamic in time (TDM dimension)
 - A zone corresponds e.g. to one symbol (for the symbol 1 in the TTI) or a symbol pair
 - One TTI can contain a Low interference/normal interference or a mix of both zones
 - Symbol 1 (Pilot+control) by default corresponds to the LICI zone
- > Proposal relies on a synchronization between cells within the cyclic prefix
 - TTI (7 symbols) are aligned between cells
- > No need to perform frequency planning as such
- > No need to co-ordinate dynamic mapping of zones between cells
- > LICI concept combined with channelisation schemes (sub-band or frequency based) allows for
 - Users with resource in LICI or normal zone exclusively depending on geographical location
 - User with resource in both zones, with different distribution between the zones
- > Fractional frequency re-use with pilot pattern shift



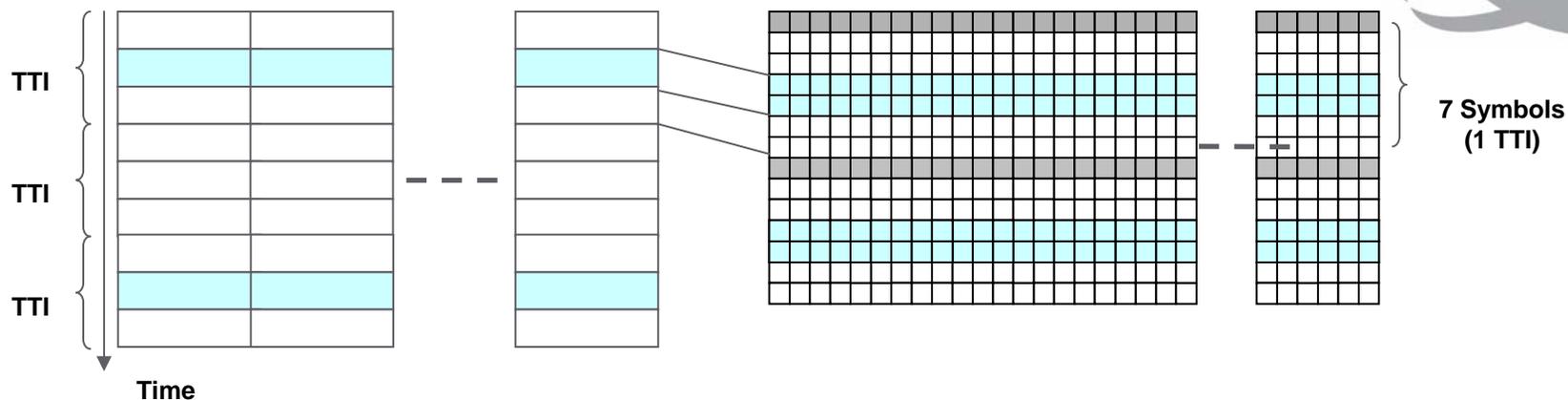
Low Inter-cell Interference Zone

- > LICI zone can be used to improve the coverage
 - Scenario-1: fractional frequency reuse without planning
 - Scenario-2: inter-cell interference avoidance
 - Scenario-3: inter-cell interference reduction
 - Full power transmission from serving Node-B and reduced power transmission from neighboring Node-Bs

- > Flexible LICI zone and normal zone partition/allocation
 - The whole channel resource can be shared by the normal transmission and high protected transmission
 - The partition between the normal zone and the low inter-cell interference zone can be changed on-demand

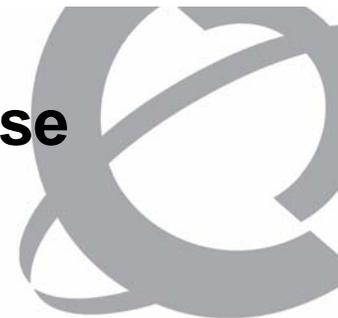
Normal Zone and LICI Zone Partition

TDM Based



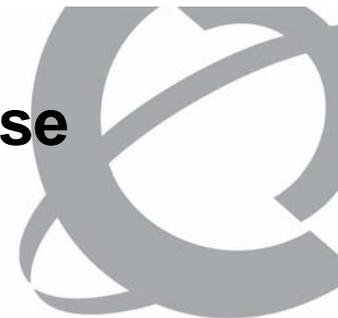
- > **The entire TTI is partitioned into sub-slots**
 - Symbol 1 is assigned to the LICI zone
 - The remaining symbols are grouped into sub-slots (symbol pairs) and can be assigned to normal zone or LICI zone
- > **The sub-band allocation for normal transmission and high performance transmission can be changed based on**
 - percentage of the cell edge UEs
 - ratio of the normal traffic and the high performance traffic

Operation Scenario of Fractional Frequency Reuse in LICl Zone



- > Fractional frequency reuse without network planning
 - To improve coverage and the data rate at the cell edge.
- > According to the numerology specified in 3GPP TR 25.814 vo.1.1, one TTI consists of seven OFDM symbols
 - The first symbol can be used to carry pilot channel and control channel
 - The active UE only needs to monitor the control information transmitted by the first symbol in each TTI
 - The control channel can be decoded with the assist of the pilot channel carried in the same OFDM symbol
 - Enable UE battery saving
 - The rest six symbols are used as traffic channel
 - Scattered pilot can be embedded
 - Fractional frequency reuse scheme can be applied to first symbol in all TTI and the 4th and 5th symbols in some TTI (LICl zone)

Operation Scenario of Fractional Frequency Reuse in LICI Zone (Cont)

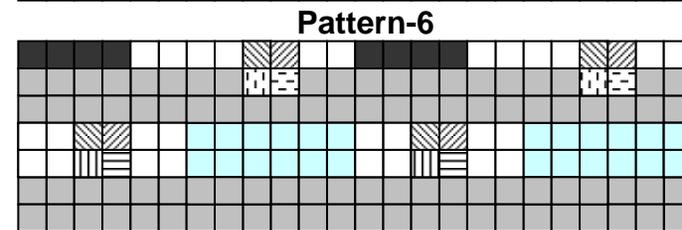
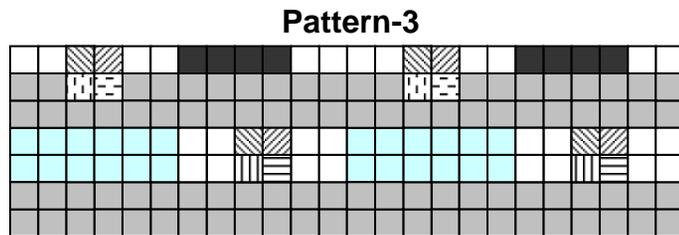
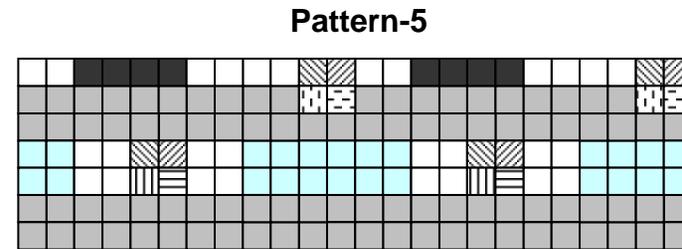
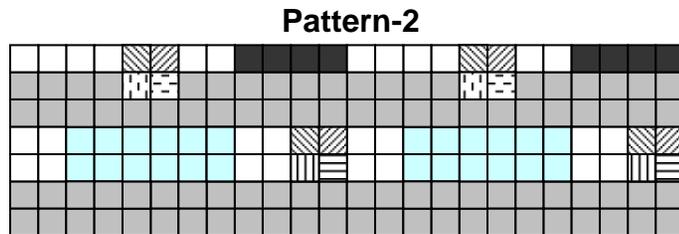
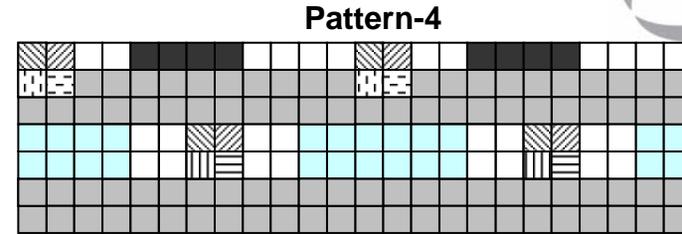
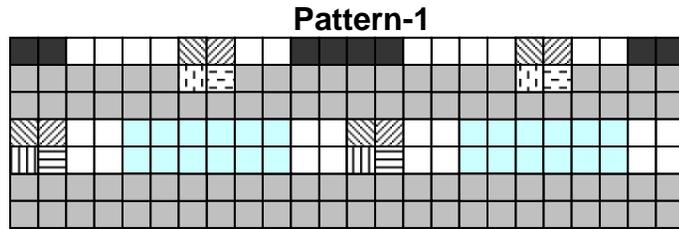
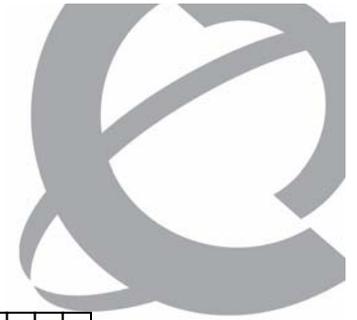


- > Fractional frequency reuse of the control channel and pilot channel in first symbol
 - Enhanced performance for control channel
 - Improve channel estimation performance obtained from the pilot data from the first symbols.
 - Can be used for channel estimation in both normal zone and low inter-cell interference zone.

- > Fractional frequency reuse can be realized together with pilot pattern shift
 - Each cell select a pattern based on its cell ID
 - The pattern selected by each cell may be changed cyclically.

Pilot Pattern Shift Pattern

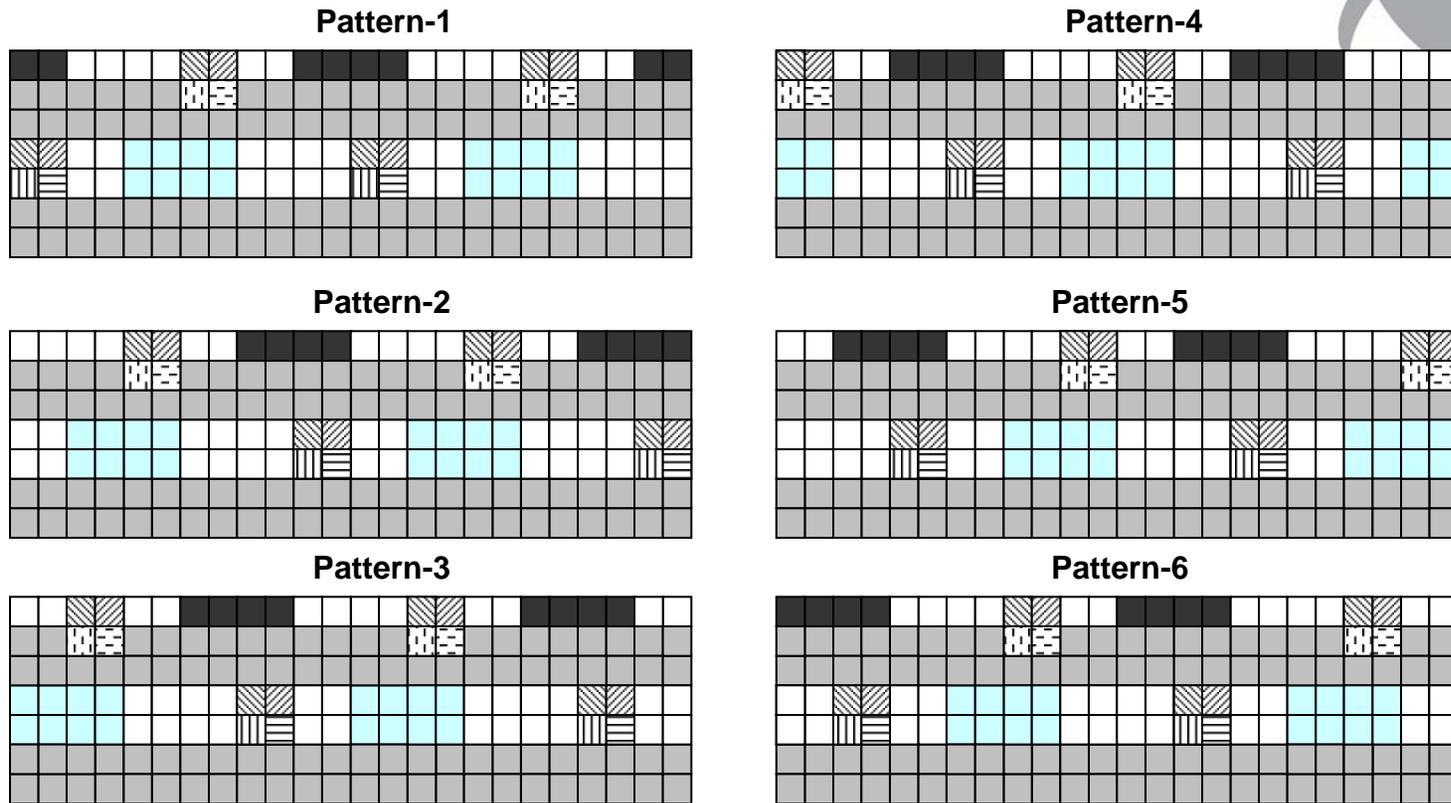
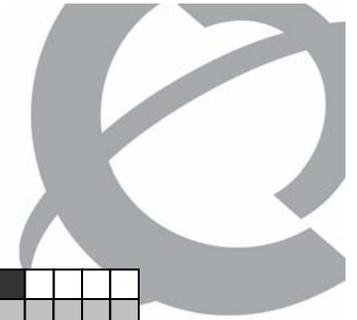
(Frequency Reuse=2/3)



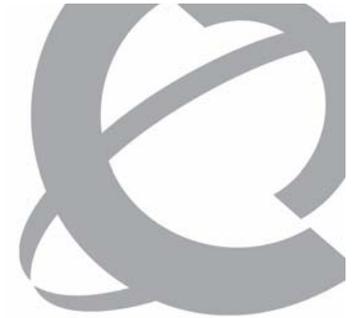
- | | | | | | |
|--|-------------------------------|--|-------------------------------|--|------------------|
| | Scattered Pilot for Antenna 1 | | Scattered Pilot for Antenna 3 | | Control Channel |
| | Scattered Pilot for Antenna 2 | | Scattered Pilot for Antenna 4 | | Normal Zone Data |
| | Punctured Pilot for Antenna 3 | | Punctured Pilot for Antenna 4 | | LICI Zone Data |
| | Null | | | | |

Pilot Pattern Shift Pattern

(Frequency Reuse=21/2)



- | | | | | | |
|---|-------------------------------|---|-------------------------------|---|------------------|
|  | Scattered Pilot for Antenna 1 |  | Scattered Pilot for Antenna 3 |  | Control Channel |
|  | Scattered Pilot for Antenna 2 |  | Scattered Pilot for Antenna 4 |  | Normal Zone Data |
|  | Punctured Pilot for Antenna 3 |  | Punctured Pilot for Antenna 4 |  | LICI Zone Data |
|  | Null | | | | |



Summary and Conclusions

- > The introduction of LICI zone can provide sub-channels with low inter-cell interference to cell edge users and the highly performance data transmission.
- > The fractional frequency reuse with different reuse ratios can be realized together with pilot pattern selection.
- > The proposed LICI zone with fractional frequency reuse does not require network planning