

Agenda Item : 11.4
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Document for : Discussion

Comments on Proposals to Restrict the OFDM Study Item to FDD Only.

1 Background and Introduction

At RAN #16 June 2002, a study item for WG1 named “Analysis of OFDM for UTRAN Evolution” [1] was approved. The version of the study item description that was approved did not restrict analysis of OFDM to either FDD or TDD modes.

Since that time RAN WG1 have been attempting to further clarify the content and scope of the study item. Some input papers on this topic eg: [2] have proposed a restriction of applicability of the OFDM study item to FDD only and others, although not explicitly stating a restriction, have failed to give any consideration to TDD. Some comments voiced on the RAN WG1 email reflector have also proposed to limit the scope of the SI to FDD.

We try to clarify within this document some of the arguments against such a restriction of the OFDM study item to FDD only and propose a way forward on this issue.

2 Discussion

It is noted that the result of the study item (TR-25.892) is scheduled for submission to RAN plenary #19 for information and for final approval at RAN #20. It is felt that the OFDM study item is potentially extremely large (probably far bigger than can be thoroughly studied within the given time frame), since it is not only a specification of a new modulation format; rather it has ramifications over the entire system design, affecting system fundamentals such as frequency domain reuse, multiple access type, RF deployment and co-existence scenarios, receiver complexity issues, physical channel definition, transport channel processing, power control procedures, macro diversity etc...etc...etc...

Bearing this in mind it would seem that careful focus of the study item is required in order to produce meaningful results in the given timeframe. The results should therefore maintain a high degree of generality as it is not the goal of the study item to define the detail of the OFDM system, only its potential and applicability to UTRAN.

3 Drawbacks of an FDD-Only Restriction

It is felt that restriction of the SI to FDD only is not acceptable from the following three standpoints:-

- Such a restriction was not imposed in the original SI description as was approved by RAN [1]. This would imply by deference that the intention of RAN was to include both modes in the study.
- In the event that the outcome of an “OFDM-for-FDD” study is positive for OFDM, we are then in the situation that in order to assess the benefits (if any) for TDD, a new SI or an extension to the old one is most-likely required. This would impart a significant and unacceptable delay in terms of the formal standardisation of OFDM for TDD with respect to FDD.
- The SI is intended to investigate whether or not OFDM is capable of bringing benefits to UTRAN (as per the SI title). If OFDM brings a complexity or performance gain to FDD that may have been similarly achieved via the use of the existing TDD mode, then the new (OFDM) mode must be introduced only following due consideration of whether it brings an *overall* benefit/incremental gain to UTRAN (UTRAN here being the set of existing FDD and TDD modes).

4 Suggested Way Forward

It has already been agreed that the primary focus of the SI is on downlink only. As such the reference OFDM design will utilise an OFDM component on the DL carrier coupled with a WCDMA UL. For FDD it is likely therefore that a target spectrum allocation would be the typical 2x5MHz deployment, with the DL carrier using only OFDM or at least an element thereof, whilst the UL carrier closely (or exactly) resembles the current WCDMA FDD uplink.

However, for TDD, there is of-course the added dimension provided by the time-slotted nature of the system. As such, it should be possible to utilise WCDMA DL, OFDM DL and WCDMA UL technologies within the same radio frame, the technologies being made orthogonal in the time-domain within the same carrier.

Thus, there already exists some element of compatibility between OFDM for FDD and OFDM for TDD since DL-only introduction of OFDM is feasible for both; it's just that for the TDD carrier there is some additional flexibility in that appropriate/optimised fractions of the 1x5MHz resource may be assigned to WCDMA UL/DL and to OFDM [as for R99/4/5 TDD allows for the amount of deployed resource for uplink to be more accurately tailored to service requirements].

In light of the above, it is proposed that a single reference OFDM system is analysed and compared to the performance and complexities of both FDD and TDD modes.

That is to say that when deriving the reference OFDM system, features should not be added that would restrict the use of this reference system to only one of the duplex modes.

Using such a reference system it should be possible to single-out and extract those fundamental areas of the system in which it is believed gain may be achieved. As an example; for a simple hypothesis that OFDM can bring significantly reduced Eb/No requirements under certain channel conditions, the reference system should provide isolated results that demonstrate this gain when compared to existing results for the current releases of both FDD and TDD. The gain in this case could then be identified as being applicable to neither/either or both modes since the reference OFDM system is itself generic and equally applicable to FDD and TDD.

It is clear that when performing capacity analyses, compensation must be made for any differences (between FDD and TDD) in the fraction of the resource used for non-OFDM purposes. For example, the spectral efficiency of a 100% OFDM DL and 100% WCDMA UL using 2x5MHz (FDD) could be compared to a 67% OFDM DL and 33% WCDMA UL using 1x5MHz (TDD) etc... However, the *baseline* OFDM system behind these calculations/simulations is the same for each mode.

5 Summary and Conclusions

The issue regarding the proposed restriction of the recent OFDM study item to FDD only has been discussed.

It is proposed that the SI is not restricted to FDD only, but that a generic OFDM reference system is derived from which results may be extracted that are equally applicable to both modes.

Benefits of this approach are:-

- The study item will be properly able to conclude whether OFDM brings anything to UTRAN (UTRAN being the set of both FDD and TDD modes)
- Very little additional effort is required since alternative reference systems need not be derived for FDD and TDD.
- TDD is not delayed with respect to FDD in the event that the outcome for OFDM for both modes is positive.

6 References

- [1] RP-02-0442 "Proposed Study Item: Analysis of OFDM for UTRAN Evolution", Nortel Networks and Wavecom, 3GPP RAN #16, Marco Island, USA, 4th-7th June 2002.
- [2] R1-02-0932, "Assumptions and Objectives for 'Analysis of OFDM for UTRAN Enhancement' Study Item", Nortel Networks, RAN WG1 #27, Oulu, Finland, 2nd-5th July 2002.
- [3] R1-02-1023, "Revised Study Item Description for Analysis of OFDM for UTRAN Enhancement", Nortel Networks, RAN WG1 #28, Seattle, USA, 19th-22nd August 2002.
- [4] R1-02-1024, "Revised Draft TR on Feasibility Study for Analysis of OFDM for UTRAN Enhancement", Nortel Networks, RAN WG1 #28, Seattle, USA, 19th-22nd August 2002.
- [5] R1-02-1114, "Views on the OFDM Study Item Scope", Telia AB, RAN WG1 #28, Seattle, USA, 19th-22nd August 2002.