

3GPP 5G Adhoc: Any Decisions on RAN Internal Functional Split?

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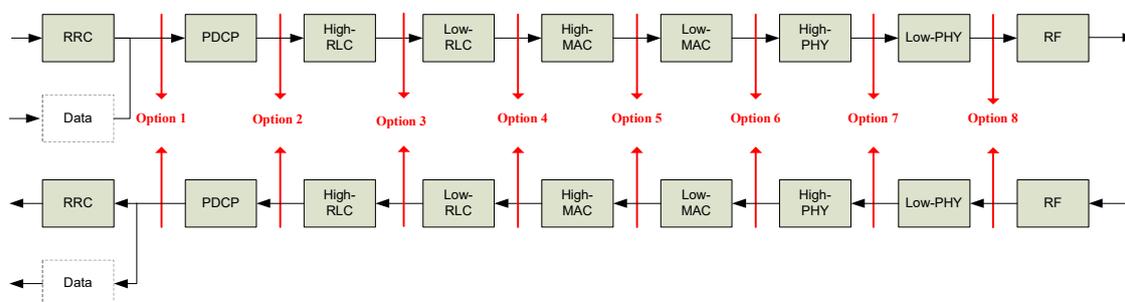
As you might know, the RAN working groups met last week in cold Spokane, US, for their first big adhoc meeting on 5G. This time I would like to report on RAN3 discussion, since there are major decisions to be taken concerning the 5G RAN architecture that will have a major impact on all future mobile communication networks.

What are the decisions to be made?

Basically, concerning RAN internal interfaces three major areas of discussion are:

1. Decision regarding the split between the Central Unit (CU) and the Distributed Unit (DU)
2. Decision regarding the front-haul split towards the Remote Radio Head
3. Decision regarding a RAN internal split of a User Plane and Control Plane

This figure [1] nicely illustrates the general options under study:



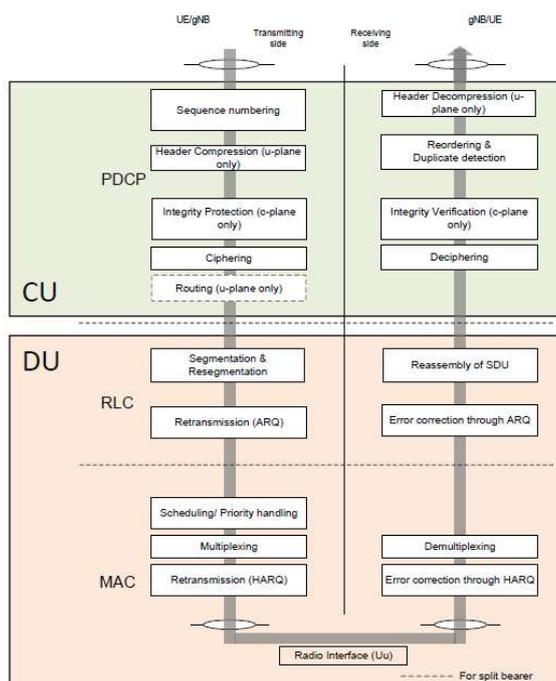
For all the options it needs to be decided if an interfaces shall be standardized in 3GPP or not. If so the next question is, whether the standard should just define the functional architecture (stage 2) or all messages, bits and bytes of the interfaces (stage 3). Bear in mind that in every generation we standardized interfaces in RAN3, which in practice still did not allow for multi-vendor interoperability.

While it is difficult to explain all the details in a few lines, I still would like to highlight some points, reflecting the discussion that took place last week. The general attitude is that most infrastructure vendors are opposing to standardize any RAN internal interfaces in detail. The operators on the other hand insist to standardize at least one front-haul and one mid-haul interface in detail. This shall enable a multi-vendor infrastructure market. While the arguments could not be resolved last week, it is also noteworthy that even within the operator as well as within the vendor community there are diverging views on the options to be selected. For the CU/DU split Option 2 and 3 are the candidates and for the front-haul interface option 6, 7 and 8 are mostly considered. Last week I got the impression that the vendors are willing to compromise in having a functional stage 2 description. This would provide the companies at least a common basis for the future, but still does not satisfy the purpose of operators.

In case of the front-haul split, interfaces like CPRI and OBSAI were standardized outside of 3GPP, which worked reasonable well. Nevertheless vendor specific adaptations had to be done and there are multiple options as well. Considering that there is not a clear view from the operators on the split yet and the lack of expertise in RAN3 on a physical layer internal interface, I doubt that we will see quick progress on a front-haul interface specification.

Lots of time was spent on discussing the benefits and drawbacks of option 2 and 3 for the mid-haul interface. Since this has some impact on the ordering of the user plane layer 2 functions, there was also a joint meeting with RAN2. Eventually, both options are feasible with reasonable impact. Let's have a look at the details, based on a nice summary slide set provided by DoCoMo, the RAN3 5G rapporteur, in [2].

Layer 2 structure split into CU and DU (Option 2)

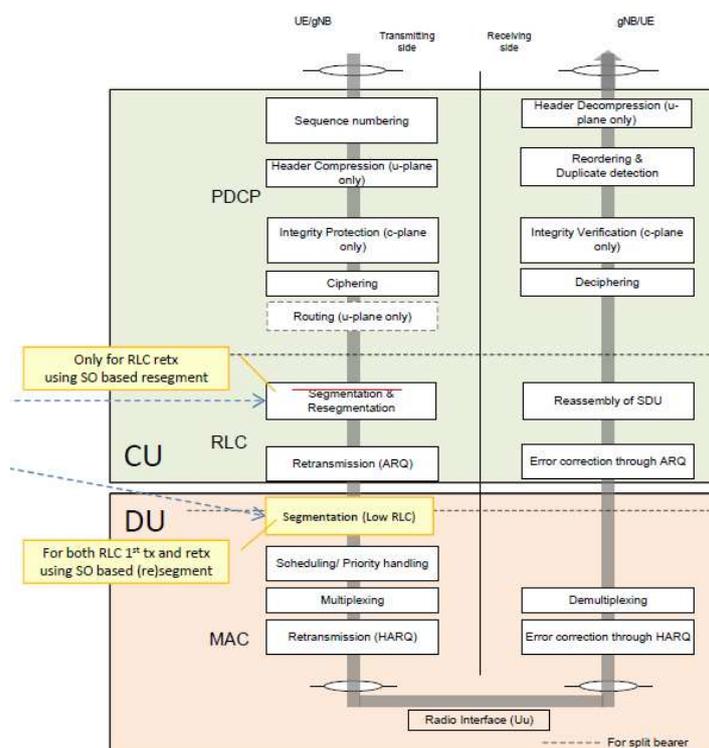


I expect an LTE-like PDCP layer to be used connecting to LTE, 5G, WiFi etc. Option 2 is attractive due to the commonality with the functional split in case of LTE Dual Connectivity. We might see first 5G deployments based on Dual Connectivity with LTE providing the Master eNB. This split could speed up the standardization and implementation process, but should the choice be made due to a better compatibility with a previous release?

Option 3 in the figure below provides other benefits, mostly since ARQ is handled in the central unit. Having HARQ in the DU and ARQ in the CU could be a nice approach. The first to handle fast retransmissions together with link adaptation, the second level of ARQ to handle mobility errors or potential errors on the transport (e.g. in case of wireless relay). It will also increase the number of functions that are centralized and thus leverages packet pre-processing and pooling gains.

Having the luxury of an independent view, I would like to state a slight preference for option 3. Nevertheless, having seen rounds of the same discussion going on every meeting, I would rather state my stronger preference for a quick decision, no matter if this is option 2 or option 3. Well, I know it is going to be a big decision, so let's be patient and give the stakeholders a bit more time and appreciate the work done so far. If no decisions can be made by the next meeting, it is likely that operators bring the issue forward to RAN plenary for decision making. The RAN plenary will anyway have to agree on all the 5G work items and would also assign the task of standardizing of such an interface to RAN3.

Layer 2 structure split into CU and DU (Option 3)



I somehow realized that key functional decisions like this are done differently over different network generations. Actually we appear to be going back and forth from generation to generation. Not sure why, maybe it is the same as our lives. Multiple ways can be taken and lead to a certain outcome, each having its pro and cons. Unfortunately, once a certain approach is taken, its drawbacks become more apparent. In LTE we decided to remove the central Radio Network Controller of 3G. This simplified the architecture, we got rid of the soft handover with all the burden on the backhaul and made significant progress in terms of adaptability to the varying nature of the radio interface, since functions were located much closer to the air interface.

In 5G this decision will be reversed to a certain extent, since we are likely to have a central controller in most of the deployments. The ambitious research people would like to move all functions, even the baseband processing, into the cloud. By 2020 we got an ideal backhaul anyway, don't we?

Whatever approach 3GPP takes, my hope is that we are able to make the decisions that are required. Most importantly, let's make not too many compromise decisions that keep multiple options in the standard. I hope we learned our lessons. Sure, there might be beneficial scenarios for each option and with NFV/SDN we got the flexibility - right. Nevertheless, flexibility might be a dangerous beast. Complexity, testing effort and inter-operability problems might grow exponentially. For me, this is one of the biggest risk for the success of 5G. We got such a huge community of people and companies involved in 5G research, standardization and commercialization. Everyone wants to get its share and compromises become more challenging using the consensus approach of 3GPP.

Nevertheless, we did surprising well with LTE, so let's be hopeful to continue our success in 5G.

I hope this helps you in understanding 5G. If you appreciate this work, please forward this post.

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References:

- [1] 3GPP RAN3 Technical Report TR38.803v1.1.0, Section 11, Figure 11.1.1-1
http://www.3gpp.org/ftp//Specs/archive/38_series/38.801/38801-100.zip
- [2] 3GPP TSG RAN2 Tdoc R2-1700637 "Summary of RAN3 status on CU-DU split Option 2 and Option 3, and questions/issues for RAN2" RAN3 NR Rapporteur (NTT DoCoMo, Inc.)
http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_AHs/2017_01_NR/Docs/R2-1700637.zip