

Narrowband IoT – Perspectives

A couple months ago, someone in management made a comment related to the Nb IoT feature, its development being too slow and Nokia now being behind their customer. I asked why that happened and got a couple of comments related to people not taking responsibility. It sounded interesting as I knew a few people who worked on Nb-IoT and had not heard the same comments from the people in the teams.

This got me curious, and I started asking around more people and got a lot of different perspectives on the same development. Some of them are the opposite of each other!

Nb-IoT is an important feature in LTE and the late delivery has caused problems in the market. However, when we can't use critical thinking and true analysis of what happens, then we're doomed to repeat the same mistakes again and again.

Right now, LTE takes actions based on opinions of people without a shared understanding on what the actual problem is. Continuing that way of problem solving is likely to create a random set of actions and our success will be determined by luck.

I'd like to share the perspectives I've got from the organization. Note that this is not a root cause analysis but simply showing that we all think we know the cause... but really... we don't!

Perspective from a Product Owner PHY

Not 100% sure what went wrong, but these are my thoughts:

1. Nokia decided to start with NB-IoT at a very early stage of the standardization, to be a frontrunner, actually at that time we really had been the first discussing and starting implementing NB-IoT. Huawei had different solution and E/// was not yet on the NB-IoF trip, so more or less it was our invention, as far I understood to have a counter proposal against Huawei non-LTE thing.
2. Starting implementation for example in PHY and MAC layer on such an early stage of proposals in 3GPP has big risks, it means you can be sure that the concept will be changed 3, 4, 5x times while you are implementing, so you actually spend your development resources not one time to implement the same thing but several, well that is possible in agile way of working but it very costly in terms of efforts as well.
So we had to redo and redo and redo implementation, even for the "non 3GPP compliant" LTE3071, as also our partner Intel wanted to update several things and get close to the actual standardization discussion, while we have been already on the way to make first integration steps. Also UE side availability for integration is probably easier as well now, Intel did start with us as well to implement and needed also their time to make it happen. So in summary from my point of view it was started too early by management push, with the expectation to be faster, but the result was the opposite, a start maybe 3-4 months later might have been faster and more efficient.
3. Then integration phase took quite long, about 6 months, or so, I don't know the detailed reasons, this might be necessary to do a deep dive on this question with the development teams and integration guys especially. A technical reason I saw in the mail threads and

discussion is that NB-IoT feature requirements were not good matching to the available MAC scheduler so far. Let me explain too technical topics here:

- a. Inband NB-IoT means you use only one PRB out of 50 to host a complete cell, this is very few resource, so what happened is that all the normal procedures that we have in LTE designed for 50 times more bandwidth failed when first trying this out in one PRB. So these problems have been not seen beforehand, when doing the design as far as I understand, but all came up in integration. So timers need to be extended for example, as normal procedure could not be finished in the “normal LTE time”, but due to low bandwidth, took much longer to complete, etc.
 - b. NB-IoT means what is typically done in parallel in LTE, with different channels, must all be serialized in time, due to this small resource, this algorithm and serialization was very complicated for the MAC scheduler to be implemented, so a very different approach, which even ended up in own implementation, that now as the feature needs to be provided in World Market, needs to merged back.
4. The NB-IoT feature itself see above, has quite many impacts, and is a big one for the U and C-plane. Now there had been three different parts of approaches here:
- a. LTE3033- this was the kind of demo to go for prestandard (non 3GPP) solution. It was more or less the minimum you need to implement to get anything on NB-IoT to test.
 - b. LTE3071 was seen as the complete World Market solution (3GPP standard) update. But here we had some differences between R&D and Product Management. As this needed to be finished in one release, it was pushed in and development descoped as much as possible to make it happen. Then in a second round some month(s) later, after discussion with some customers, it came up that this “descoped” version of the feature was not good enough for one of our customers, so then several add-on features where needed to close this gap. And these are now pointing to very late dates, when we compare to what competitors claim they can already deliver...

Good things about the development:

- F2F Workshop at the beginning (a year ago) was really good investment to get the things started, and planning in principle structure in good shape and teams ramped up early.
- The guy that did a specification did really a good job in filling the necessary parts in short time, when there wasn't anything available from standardization, also he clarified the upcoming issues in excellent way. Still I see the problem more that we started at way to early with implementation and therefore there was need to fill these gaps and rework several times.
- Planning of the L3 call parts, deliveries, sequence etc. was excellently done from FOT Leader, so we did know how to reach the goal in detail and this was available early and came true exactly like planned from the structure, but not the timing and just it took maybe quite long to get there.
- Nowadays there is different guidance from pushing feature split into one FB incl. entity testing did also guide to not make plans beyond next month (even if known and overall integration plan could be made visible for all early. This lead to situation that overall proceeding/direction got a bit lost, more discussions and late in program, and adds overall additional delays. LTE3033 NB-IoT in contrast was a good example how to do planning of content upfront, which is possible for these kind of features.

- Interworking between the teams was on very good level. Though we weren't all in the same place, I felt still included all the time and up to date where we are.

Perspective from a Team Member focused on C-Plane

NB-IoT is for sure a failure, but in my opinion is not bigger than any other feature failure implemented by our company.

Let me tell you the story of NB-IoT seen my eyes in short three acts.

First act - LTE3033, FL16A

Storyline: There is no 3GPP specification for NB-IoT (work just started).

A fast track manager asked for a limited functionality (demo-like) narrow band internet of things (NB-IoT) feature to be developed on our trunk. It should have regular trunk feature quality (LTE DoD and other blah blah).

The development started with a big workshop in Wroclaw which included TPM, 3GPP delegates and a CFAM leader. In this workshop, we discussed how the feature should work and how we can achieve it. We together created some draft implementation plan. This included a timeline, which was obviously a bad move because some people, who mostly were not participating in the workshop, took that as a list of deadlines which would later be called milestones - after some time the dates had been engraved into stone. The initial plan was (as usual in R&D) didn't include any buffers, etc. As a R&D we felt that we all agreed that feature teams will design and implement the feature.

Unfortunately we didn't take into account that presence of only one SFS participant is not enough for the whole CFAM process machine. Thus, when the CFAM process started, a lot of people, who had not participated in the workshop, were added. They did not know the agreements and did not have the mindset and wish to work differently than other features specified before.

We joined the weekly CFAM meetings to try to steer it in the right direction. Soon we discovered that it is impossible. Some SFS colleagues did not seem open for R&D input. We decided to not waste our effort on CFAM (except for one guy, who we sacrificed, the EFS person).

Soon realized that SFS is specifying things which were more complicated than what was needed for demo/trial version. Our SFS colleagues did not want to discuss it with us and we ended up deciding to leave CFAM document as it is and not care.

We wrote our own feature documentation called 'concept paper' with things worth mentioning (e.g. why some decisions were made, based on which assumptions etc). After FL16A P6 (end of development) SFS colleagues aligned CFAM chapters 1-3 with chapter 5 (this one was written by EFS, based on our concept paper). Because of rough estimations and deadlines it was really challenging to stick to the initial, draft estimations (called by management milestones) but finally with some minor delay - we had something working. Great success achieved.

The thing which has been done wrongly on our local level was ET - done by 'some guys on 2nd floor'

- not by the teams. This was identified as a problem and was changed in the second act ;-)

Second act - LTE3071, FL17

Storyline: 3GPP specification is almost done, most things are clear (only few gray gaps left).

LTE3033 continued with a completely new CFAM process for LTE3071 (at least with mostly the same people as before). The scope was defined as '3GPP compliant LTE3033'.

The development teams came with a proposition to cooperate with SFS colleagues and produce CFAM chapters parallel to implementation. We wanted to go the same speed to ensure that the direction will be the same. Unfortunately after long discussions with SFS experts, CFAM process inventor, SFS head and other very important and smart guys (and an enormous quantity of our life energy) we got nothing. The SFS experts said they cannot focus on a small portion of requirements because they need to have a big picture overview and cannot work iteratively.

I don't know if we have negotiated anything (maybe some minor things), but very quickly we found that the LTE3071 CFAM process looks exactly the same as CFAM for all other features. The magical thing with the CFAM document is that it is opened and closed the same time - something like open-close-principle. Officially (for processes, tools, managers) CFAM for LTE3071 is already closed, but for SFS/EFS it is possible to introduce any changes they want.

LTE3071 CFAM is a full blown commercial feature in good, old Nokia style (we will implement for you everything - does not matter if you need it or not). We tried asking TPM (Antti Kuurne) where they really need it all, but unfortunately he didn't have time for these questions. At the end of FL17 new TPM is assigned to the feature (Helene Lambert, former ALu TPM), but I don't think this had any impact to FL17.

From the beginning we told to everyone that the only thing which is possible to implement in FL17 is 3GPP compliance, nothing more. But unfortunately the scope described on hundreds of CFAM specification pages (I think something between 600 and 800) was describing a lot of other stuff.

We asked our SFS colleagues to drop configuration parameters (NIDD, former PDDb) because we knew that in FL17 there will be PDDb harmonization, single O&M feature and stuff, which smells broken eNB for months. Of course they 'could not' do that because process says that CFAM must be closed before NIDD can be changed. We were also not helping because we had an argument with SFS colleagues about object modelling, which caused required parameters to be available on our trunk 1.5 month from end of release.

We had ET included into items in backlog, but unfortunately we couldn't test because we were not able to configure the feature (no parameters available). When the parameters became available, we have realized that we still cannot test because of BTS O&M and feature 'single OAM'. 'During the entire release no entity testing of LTE3071 was possible.

From the beginning of release we have asked about priorities (scenarios and sub-features within LTE3071), but unfortunately the answer was always 'all parts are equally important and must fit into FL17'. We have been saying that they will not fit FL17 but nobody wants to listen such news. It was very frustrating combined with town hall meetings with Vesa, who was saying 'I know that it is difficult, but I believe that we can do it'. Yes, sure.

One last fun fact: Even though everyone knew that the time is short, we were still requested to estimate new NB-IoT features in hours which waster a lot of R&D time. Why was it requested?

Probably because some excel documents had empty fields.

Third act. - LTE3071 and other NB-IoT features in FL17SP

(SP in this context is jokingly referred to as a Polish abbreviation for 'fuckup')

Storyline: 3GPP specification is done, LTE3071 'surprisingly' does not fit to FL17. We don't know how complete LTE3071 is as not a single entity test is passing. I guess it means that the feature is 0% complete?

It seemed to surprise management that LTE3071 didn't fit in FL17. Now they seem to believe that it will fit in FL17SP despite there are a lot of NB-IoT features added (improvements for the basic version).

Of course, new features means new LTE feature numbers. With new numbers, what is the thing we'll need to do? Yes, you are right we need a new CFAM process, one per feature, probably just to decrease the synchronization effort, but I don't know this for sure.

At the beginning we have made a workshop because this has been successful in the past. The same location, more or less the same people (TPM is different, one additional SFS colleague from China, IPHY Manila physically present), more wide audience from R&D. The target of the workshop was to prioritize features/sub-features, give effort estimations and create a roadmap.

Some of that work was done and the goals were partially achieved. Vesa and Tero are telling that the features will fit into FL17SP, despite our input that it can't. As a mitigation action additional R&D teams will need to join NB-IoT 'area'. We all know the best way to fix a delayed project is to add extra people there (or maybe I messed something up?).

On a workshop there was a guy who is EFS or product owner of one of the U-Plane components. He was acting very strange - he was saying sentences like 'Vesa will not accept this' or 'we need to agree this with Vesa'.

Current situation is that ET is still not possible. We are now struggling with cell setup because we have a week for important milestone, which obviously cannot be moved to future. The reason is still the same: BTSOM/IPHY. Maybe we will be able to run some tests till end of week. Keep fingers crossed.

Additional Reflections

We are going the right direction at the bottom of the organization (development unit). It is slow process because years of 'old style waterfall development' killed a lot of good practices in developers and efficiently blocks any ideas to change. There is no switch to 'turn off waterfall' and 'turn on agile' in human heads, it will take time. Right now, self organization is limited to only developers, product owners who try to do that, and they are supported by some line managers. The head of DevWro1 usually supports good initiatives. From my perspective, everything above development units is a 'rock solid waterfall'.

I don't know what the problems in SOAM and IPHY are, but from my perspective, they are not providing a good quality software. By doing so, they block development in C and U plane. When C-Plane promotes some trunk revision it means that a lot of regression testing was done and all main functionalities were tested. However, when O&M promotes to trunk, it doesn't seem to mean

anything. Even basic functionalities may not work properly. Where are their tests? For IPHY, I know there aren't a lot of test, so it doesn't surprise me that it does not work time to time.

For example, we were waiting for the NIDD parameters and finally got them. But now we still can't turn on NB-IoT. Mostly because of various problems in BTSOM (commissioning does not worked, after it was fixed - delta does not worked, after that O&M binaries was crashing when NB-IoT was enabled, after crash was fixed no radio modules were detected, after that there were 'not enough hw for lcr' error). Fixing NB-IoT isn't the highest priority for BTSOM as they have their own high priority features.

From my perspective, there is no clear eNB level priority queue consistent for all components. Because of that C/U-Plane implements one high priority feature which will not work because M-Plane does not implement a few lines of code (low priority). The same is true the other way around: for OAM the main goal is to implement parameter harmonization, but finally it will not work because for C-Plane this is lower priority.

The effect of not being able to prioritize is that we will now have 2 features missing instead of one or none.

Epilogue

If Tero/Vesa says that the feature will fit - it just needs to fit.

CFAM process/SDA team are the greatest blockers for any changes in the organization. They should work closely with R&D, not in setups like now.

There are no clear targets. Our organization supports the situation because we have a lot of matrices (programs, releases, SDA, R&D is divided into components, etc).

Of course NB-IoT is not hermetically closed in a bottle - other features/priorities/targets affects NB-IoT (e.g. BTSOM and his priority: single O&M affects, etc).

Higher layers are sticking hands too low: SFS into code design, management into development scheduling details, etc.

Perspective from R&D Management

What happened in NB IoT:

- In the beginning NB IoT was agreed to be Fast track Program with dedicated resources.
 - **Consequence:** Not followed all normal processes and reviews. The team started to optimize R&D work rather than customer value/output.
- In 5/16: SDA/R&D or ProdM did not understand the size/Scope of work for IoT.
 - **Consequence:** Only small team were allocated for the work.
- At 5/16 SDA/R&D or ProdM did not understand the scope of work.
 - Too big feature in the beginning.
 - For some reason: It was unclear for R&D team is it only a basic feature or does it cover everything e.g. error cases?
 - SDA and ProdM had a clear opinion that it included.

- R&D was too busy for actual implementing and “current tasks” at May and R&D did not put a real focus for CFAM work during May/16 when SDA were doing those.
 - **Conclusion:** If R&D can’t participate CFAM work we should not approve CFAMs
 - **Conclusion:** R&D needs to allocate e.g. 20% of time for future evaluations even that we are busy with current implementation tasks
 - **Conclusion:** After CFAM is done if the work is done between DU’s or multisite we should make critical path analyses for big features to understand customer e2e feature and LE for feature output
 - LE’s needs to be updated bi weekly e.g. after FB’s.
- In 6/16: Program and R&D team started to descope the work for allocated people and with Intel capabilities for NB IoT.
 - The team did not ask resourcing help outside Wro1 as they wanted to keep feature at one site but at the same time they did not have resources to do what was a business need.
 - Consequence: no sellable feature on time or the feature did not fulfil customer needs.
- In 6-8/16 summer vacations.
 - No all normal meetings.
 - 30% people are away.
- In 7/16 War room mode lead by Tero started when Tero/Vesa came back from vacation.
- In 8/16: R&D did not understand EE’s for each sub components and R&D has not done specs for their work.
 - UL/DL data (R&D focus was only for basic topics).
 - Error handling (this part was unclear for R&D in 9-10/16).
 - 3GPP spec (final agreement of CR’s to be done was agreed 10/16).
 - ...
- In 8/16: still we did not understand dependencies for different Feature team deliverables.
 - **Consequence:** no understanding when customer feature is ready and what is a scope of R&D work
- In 8-9/16: We were still discussing what R&D should do NB, Standalone or QuardBand IoT and in which order.
- In 9/16: FOT did not have a clear understanding what is a scope of work for priority 1 NB IoT.
 - Error cases (and which) to be included for customer delivery.
 - No priority order for different sub features (paging, ...).
- In 10/16.
 - BL did not have clear understanding which features should be done and in which order if we can’t do everything?
 - Priority order was agreed 1st time for key features inside NB IoT.
 - IoT WS (SDA/R&D/ProdM) was agreed.
 - After that we have got better understanding what is a scope of work and teams are more sync.
- In 11/16
 - IoT planning WS (SDA/R&D/ProdM) was done.
 - The scope was agreed between SDA/R&D/ProdM in detail level.

- **Conclusion:** This should have been done in 9/16 that we would have understood to scope of work two months earlier.
 - It **does not** mean that We would have won two month calendar time or accelerate two month of customer deliverables.
 - **Conclusion:** for all big features we should keep, as minimum, a Video WS and continue those weekly until key items are agreed (it seems to take 3-6 weeks for big topics).
- At 12/16
 - Management changed priority orders for IoT features based on updated business needs.
 - No Changes for priority topics but for “stretched topics” + new targets were added.
 - Management gave extra commitment with understanding that we don’t have bottom up plans.

Perspective from Program

NB-IoT functionality has been introduced as part of IoT technology for 3GPP Rel13. Nokia ambition is be a leader in this technology and do massively offer for customers around the world.

NB-IoT streams overview

Two different streams have been defined to develop the functionalities:

1. Dedicated stream for LTE3033 (FL16A) with the target to make a showcases for customer during 2H2016
 - August 2015:

There was decided to create dedicated stream to prepare solution and make a trials with customers during 2H2016.
 - November 2015:

Dedicated stream with clear interface has been created to execute the plan and fulfilled expectation.

First team allocated to work on the functionality.
 - August 2016:

Showcases started for 20+ customers
 - December 2016:

Last showcased done based on FL16A SW release.
 - Outcome of the stream:
 - Expected demo system ready in August 2016 with mitigated impact on scope and functionalities.
 - Performed shows/demos for 20+ customers during 2H2016
2. Commercial full-blown NB-IoT feature (FL17SP)
 - June 2016:

Work on new feature version has been started.
 - August 2016:

Replanning the feature with the risk on FL17SP->FL17A

- During next months
Continuous planning, clarification and mitigation the delay of the whole feature(s)
- Outcome of the stream:
 - Feature is under development still.
 - Deliveries of the functionalities according to the final plan, but far away from the business expectation.
 - Very hard possibilities of mitigation the scope and timeline due to lack of room of improvements.

NB-IoT Dedicated stream for LTE3033 (FL16A)

Good achievements:

- Dedicated team for provide the solution:
 - Program, product manager for execution (leader of decision team)
 - LPO and RAMs for looking after the R&D (part of decision team)
 - System design team with specification experts to create solution (part of decision team)
 - Development team, testers and system testers for verification solution on different levels
 - Dedicated 3GPP experts to support coming changes and influent on 3GPP solution
 - Communication channel to align with UE partner – Intel
- Collocated team in one location as good as possible
- Simplified decision path to keep the work ongoing and avoid blockers
- Short communication path to announce all changes and decisions which impact on the solution/timeline
- Fully focused team on the solution during whole program live (not only between certain milestone)
- Initial workshop to align target, timeline, mode of work, responsibility and the most important initial technical solution
- Thanks to the setup of very flexible team it was possible to reliable response to official changes comes from 3GPP – major risk
- Working on the functionality in time not on dedicated release
- End2end visibility and responsibility for whole team (success or failure of everyone)
- Fast and reliable analyzes done for new concept/solution to make a correct decision for further development
- Disconnection from commercial program processes and execution
- On last stage final merge of enablers to commercial program

Areas of improvements:

- Acting in the new mode of work from very beginning of the program
- Faster escalation of items slowing down and blockers to decision team
- Less changes in the solution and strategy
- Better communication to the whole team about changes and decisions

NB-IoT Commercial full-blown feature LTE3017 (FL17SP) + add-ons FL17A/SP

Good achievements:

- Started with the same mode of work from the very beginning – fastest way
- The same people allocated with very well known subject which allows to start analyzes from the very beginning with full speed
- Good prediction about the complexity, effort and lead time for particular features
- The same interfaces to all teams internal and external (including partner – Intel)

Place for improvements:

- Changed management way to standard program management instead dedicated one.
- Too many uncertainties about the priorities inside and outside NB-IoT area
- Continually coming changes from 3GPP has changed the target solution – impact on design and schedule
- Dedicated team changed to shared one (continues resource conflict between NB-IoT and LTE-M)
- Too big scope/effort to develop this functionality in expected time (parallel with 4 others big high important features)
- Lost focus on the NB-IoT development by pushing another feature in this same area
- Lack of possibility timeline mitigation due to complexity and scope of the functionality

Perspective from a Product Management

My feeling is that when 3GPP June version was coming, we started to see in the implementation how much there is work and a constant slippage of schedules started. Every month we found out one more month of delay after June. Still I don't know if that's because we did not have enough people from implementation/specs following tightly 3GPP progress before June or if changes in June were so massive that it was not a matter of lack of visibility. Competition somehow anyway seems to have managed much faster than us. But what they did better I don't know honestly.

Towards customers I have used a reason that we have too many architecture impacting changes ongoing simultaneously:

- Aircscale support
- New user plane architecture (BB pooling)
- New O&M architecture for SRAN
- Cat-M
- Company integration (not architecture impacting but lots of new people suddenly)

Perspective from a Systems Design

Our steps:

In Oct, 2015, the NB-IoT concept is just raised in 3GPP area. Nokia is working on NB-LTE option with Ericsson and Intel against Huawei's Clean-Slate.

In Dec, 2015, 3GPP agree the converge solution on NB-IoT for IoT area. And 3GPP WI start the detail 3GPP specification from Dec-2015 to Jun-2016.

From Dec, 2015 to Jun, 2016, Nokia start a pre-standard NB-IoT solution to allow the early trial and lab test for customers, together with Intel.

From Jun, 2016 to end of 2016, Nokia try to plan the commercial NB-IoT roadmap.

- In Jun, 2016 - Sep, 2016, the LTE3071 CFAM is started and planned in FL17 (later move to FL17SP) for basic inband NB-IoT.
- In Sep, 2016 - Dec, 2016, more CFAM work of NB-IoT features are planned in FL17SP (later move to FL17A) for additional functionalities. But we are late comparing with other competitors.

What goes wrong and can be improved (from my viewpoint):

1. Priority:

I don't think we get the correct priority for NB-IoT project firstly. There are too many higher priority features in the queue of this release (AirScale, BBU pooling, LTE-M, PCMD, etc.). We need to work on all of them in parallel.

But the priority of NB-IoT features and priority of features inside NB-IoT changes back and forth after escalation from customers even recently. Our R&D capacity is limited be capable on high priority features only, but

2. Late planning:

NB-IoT features come much later (~6 month) than normal feature because 3GPP comes late. Typically SDA work for features in 6-12 month leading time to have better analysis and simulations. But NB-IoT is a very complex feature and we did it in a hurry. The NB-IoT LTE3071 is started in 2016-May, but target for FL17 firstly (then delay to FL17SP and FL17A). This was considered as risk from beginning, but seems no effective recovery action.

3. Capacity:

What I heard is R&D capacity can't fit all requested features in FL17. It's very difficult to be accelerated. We are balancing resources between features (descope or dropping some features to free the resources).

4. Scope:

There are too much scope changes back and forth. It should be ~15 CRL in LTE3071 (some of changes even without CRL in early phase). PLM would like to have more due to the pressure from customer, while R&D would like to descope due to the capacity. We cost too much effort on descope discussion by reduce the functionalities. Each churn bring extra efforts for changes and waste previous efforts.

No technical experts in R&D can cover the whole picture. It makes R&D difficult to make quick decision and high level analysis (almost all decisions requires involvement from SDA or even PLM to descope). Our current effort estimation and planning are done in very detailed approach targeted for the efforts in hours and planning for months (following Agile process), but it's difficult to make commitment and planning for releases

5. Competence:

I feel the R&D are quite young (30% with < 1-2 year working experience). It brings risk for NB-IoT implementation. SDA IoT team in Beijing is also new setup, although some of us have lots experience in RRM algorithms, but some people has no experience of handling complex features, although they are trying to do this well.

6. Early preparation:

Typically, we start 3GPP features after standards have been locked down at least half years and there are some research team (from T&I) has some algorithms or proposals submitted, which we can used for product reference. There are also some fast track for basic product modelling for demo possible to find limitation and bottleneck of our products. For NB-IoT, all of them are not exist. We started the NB-IoT feature even 3GPP is not locked down. It put more risks in product implementation. Although all companies face similar situation, but I believe Huawei and Ericsson are better than us because they have more submissions in 3GPP NB-IoT than us. It means we are more like a follower than leader in standard, which will cost extra effort for us during implementation. Additionally, Huawei has started the Clean-Slate (a variant of NB-IoT) for 2 years. Lots algorithm and experience can be re-used although they need to re-do the brand new NB-IoT.

7. Eco-system:

We are not working on chipset. We selected Intel as chipset partnership, but unfortunately Intel is also not strong enough (their roadmap and NB-IoT experience seems not good from my viewpoint).

Huawei has their own chipset (Hisilicon), while Ericsson selects Intel firstly, but try to work together with Hisilicon later. Looks they have better ecosystem collaboration / support than us.

Perspective from a Team Member focused on U-Plane PS

Rather than going with solid text, I'd like to just share some pros and cons and a short summary. Most of these are taken out of our retrospectives.

Let start with some bad things to end with positive attitude:

What went wrong:

- Feature teams was just as a name. We had cross team testing so testers from our team tested some other not related feature and vice-versa (we asked for switch with no results from higher management)
- Huge amount of statements were just gentlemen agreement. As it turned out we are not gentlemen...
- Poor quality of SDA with plenty of words that shall not be used in specification like "carefully"/"shall work", lot of time was consumed as contingent to deliver proposals rather than getting them.
- Sometimes approach of testers is "Hello I've run Test it didn't pass Have a nice day"
- As technical guys we shall use strict and understandable language to easily pass information. This one is still missing as even now I have lot of complaints from team that this is not progressing anywhere good.
- Some time ago "Quality" was one of our main keys to success as a company. During this feature seems we were proven otherwise. It's not key to make something good it just have to pass tests and there is no place for quality later on. We were told that in after delivery we

will be able to rework it based on gained knowledge but now we just try to do so on daily basis with higher efforts as we cannot trust in given word.

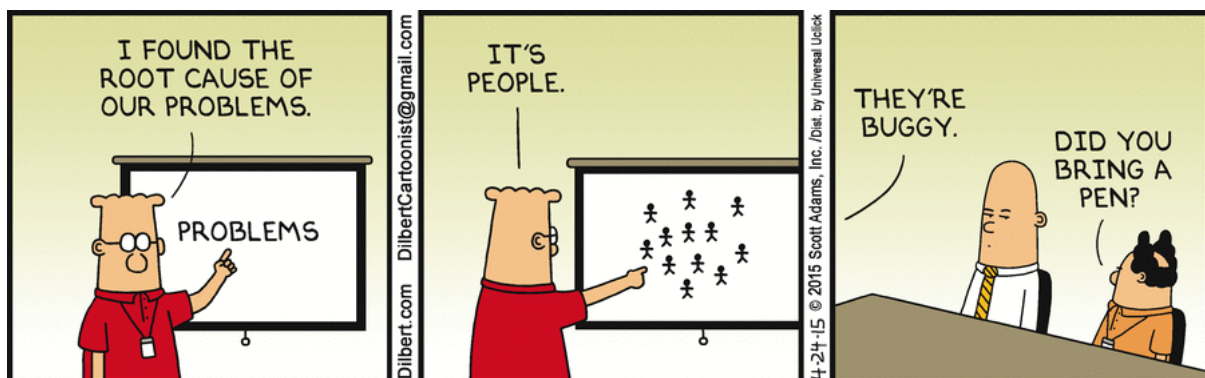
- Attempts to push dates even with making mess with process just to say that some milestones were done while this brings still no progress to whole feature
- Misalignment of our SFS/feasibility study doc/Intel-Nokia spec/ life. (Yeah we had 4 docs for same thing)
- We had strongly limited time for development of implementation ideas, as sometimes we couldn't trust SFS but only 3GPP.
- Requests of delivering something in unreasonably short time. Seems EE from teams are used just to fulfil the process of asking for them.
- Requests for whole feature planning till the end in highly dynamic changes of 3gpp specification
- Approach that meeting can solve everything, often rather than attempt to fix peoples lack of soft-skills (usually it's easier just to approach someone and have a talk)

Good things:

- As a team we were given our own sandbox to deliver it and get to know how it works from scratch
- Finally scrum process touched higher layers of waterfall so EFS and SFS.
- We were able (sometimes even forced due to lack of trust into SFS) to create design and spec. (this one is together with 3rd from list above)
- Close cooperation with multiple components gave broader view about how all of this works
- Parallel work with creating of specification rather than implementing just written word
- Finally R&D not just D

In general this seems to be a step towards integrating Specification with Development. It is great approach as then overall output is better due to complementary knowledge and competence of team.

As often it sums up in one Dilbert...



Perspective from Systems Design

It is a good chance for me to summary some minds for NB-IoT features.

In general, I think that NB-IoT make a good example for fast delivery.

1. More and more customers are interested in NB-IoT. Different customers has different requirements. Those requirements are prioritizes in program manage team and implement the higher priority function at the early phase.
2. Each team can cooperate very closely to reach our target.
3. Each team are working very hard for this fast delivery.

NB-IoT is a totally new technology for IoT evolution. More and more customers plan to do some trial or deploy NB-IoT on their site in early phase. But the specification was started from Sep 2015 and was done on June 2016. The specification has not been mature by now, there are still some corrections, some CRs in each RAN meeting. All those things introduce more late changes in our design.

On the other hand, NB-IoT is too complex and it change from the physical layer to NAS layer, from UE, eNB to Core Networks. Almost everything were changed compared with the legacy LTE. An end to end solution is also needed to be consider in our design including the interwork with UE and Core Network.

Regarding the Process, the NB-IoT is a big feature than before, it is hard to implement all the functions in one release. So a long term planning shall be more suitable for such functions.

That said, some additional observations from my side:

1. The schedule for NB-IoT is still late and difficult to be accelerated even some additional resources added by potentially dropping features.
2. When I met some R&D people and team. I feel the R&D are quite young (30% with < 1-2 year working experience). It brings risk for NB-IoT implementation.
3. Less technical experts in R&D can cover the whole picture. It makes R&D difficult to make decision and high level analysis (almost all decisions requires involvement from SDA or even PLM)
4. The effort estimation and planning are done in very detailed approach targeted for the efforts in hours and planning for months (following Agile process), but it's difficult to make commitment and planning for releases (e.g. what can be delivered in FL17SP or FL17A)
5. The discussion efficiency is low due to too much detailed discussions with open issues.
6. There are many mismatch between SDA and R&D on detailed feature design, although we have started introduction and CFAM work for a while. More discussion seems help to clear mismatches on very detailed level.
7. The high level outcomes are still limited (no decisions on the way forward, full plan for standalone is not ready due to timeout and complexity on RF radio, the plan for paging is not even estimated)

Perspective from Product Owner IoT

I assume that problems with delivery are connected to commercial NB-IoT implementation (3GPP compliant version). It was requested to be part of FL17 and today the same content is planned for FL17A and FL17A_SP. My feedback will focus on this part.

What went wrong?

We (Nokia as organization) didn't realize that NB-IoT isn't just another feature (it's new telecom technology, independent in many cases from LTE). Yet, it was managed as standard feature (with medium priority) in the program (FL17). It was not communicated that for NB-IoT there is no complete 3GPP, SDA design approved and that implementation/estimation/plans are done in parallel. This caused a lot of problems and still does. Other sites, business units, managers were surprised NB-IoT requires extra/nonstandard actions.

Another thing is connected to distributed responsibility. It's hard to determine who is responsible for NB-IoT delivery (feature team, LPO, RAM, sPM, L4 manager, ...). And who is responsible for integration of the feature (feature teams, FOT, POT, Workshop team ...) I know we work in such organizational environment for long time and it seems to work but it also makes NB-IoT deliveries being delayed. As at last what is the role of line manager here? Over last months I work in NB-IoT I've seen LMs who tried to help in NB-IoT but they lose their energy to explain where/why they can help.

We prepare poor quality plans (NB-IoT plan is now 55 pages for power point presentation). It's hard to understand what is our goal and plan itself if full of "draft version", "guess estimations". They are done fast and minimal engineers involvement. Why we don't trust our engineers that they can analyses technology and plan their work?

When pressure for NB-IoT raised we started to work in not standard mode. Planning was done on 'on-site workshop' and integration is done in 'task force' that works over the weekends and in overtime. If we need to stop our agile mode of work to fulfil market demands, maybe we are not agile? Moreover we try to accelerate deliveries by adding more teams/sites rather than development competences (no trainings, SDA done in separate site then development)

What went right?

As for today it seems that higher management already realized how complex IoT project is and there is more attention given for problems that we have. We have dedicated sPM which is good move (is should be nominated long time ago).

Lastly we have shown that our teams are able to work with multiple changes and under pressure. This is optimistic having in mind how much work there still is.

微信扫描以下二维码，免费加入【5G 俱乐部】，还赠送整套：5G 前沿、NB-IoT、4G+ (VoLTE) 资料。

