Comba

Tech Brief

HOW DO WE BRING THE GSM LEGACY TO OUR FUTURE?

GSM may not be the newest technology out of 3GPP but its impact on society and everyday life is still high in many regions of the world. Despite having the fifth generation, 5G NR, here now, GSM/2G, refuses to die quickly. From a technology point of view, many want to see it gone as it is not spectrum efficient and also requires software and hardware to be maintained and up to modern-day cyber security standards. Nevertheless, it is not unreasonable to see how GSM/2G could still be with us in our networks for another 10-15 years driven by legislation around emergency calls & mandatory eCalls for cars, adding to this the vast amount of Point Of Sales (POS) terminals and Machine to Machine (M2M) used for utility meter readings and other applications.

While some may think about OpenRAN as greenfield 5G NR or even 6G, as some vendors propose, the reality for OpenRAN to be viable on a larger scale today or tomorrow will need to fulfill the site needs of the operators. Today the dominant operator strategy is the geographical separation of vendors. This is likely to continue. The domain strategy has never been adopted on large scale due to the inefficiencies on site. This means, for almost all operators, a mix of GSM/LTE/NR are still needed on site.

How does this impact modern radio design?

For starters, gradual spectrum refarming on legacy bands without site visits has put a strong requirement for the radios to:

1. Support concurrent multi-standard radio as the default configuration
2. Manage mixed sets of TX/RX configurations within the same radio
3. Be able to change carrier configurations remotely

OpenRAN has settled for option 7-2x for LTE and NR to offload the DU from the "heavy lifting" of what is called the low-phy. This consumes large amounts of computational complexity as is in the OpenRAN concept carried out by the RU as opposed to the traditional way where the low-phy was in the DU baseband (aka BBU). There are some good reasons for this as the COTS hardware used for DU in OpenRAN is not very strong for heavy and highly repetitive computational load.

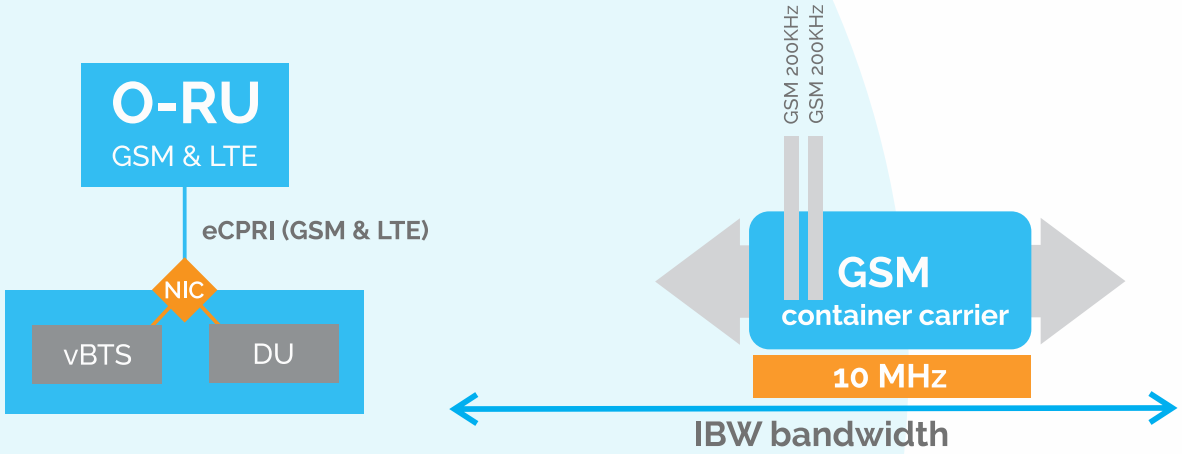
GSM, on the other hand, requires by today's means a very small amount of processing as the bandwidth is 200KHz vs typical 10 to 100MHz for LTE and NR, ie one to two magnitudes less bandwidth. Add to this that, while many operators still have GSM in their network, the investment in GSM stopped about 10 years back in many networks which means that most GSM solutions today have not been modernized and there is no real financial incentive to do so either. Hence there is a need to reuse many of the legacy solutions both from an investment perspective but also from a feature richness/completeness perspective to be able to swap legacy sites.

Given these constraints the natural way forward for GSM on OpenRAN is to standardize the fronthaul using eCPRI and control, user, synchronization, and management planes but change the user plane split to be option 8, essentially the legacy way of packing I/Q samples but not in CPRI blocks but rather in eCPRI frames. The GSM baseband SW can easily fit into COTS HW and by this architecture a DU could serve GSM and LTE and NR using the same OpenRAN fronthaul.

Getting into the details

Comba has been working with DU providers in the OpenRAN industry to implement a practical way of enabling MSR GSM/LTE/NR on the radios.

The GSM model consists of a profile based on the following basic operation:

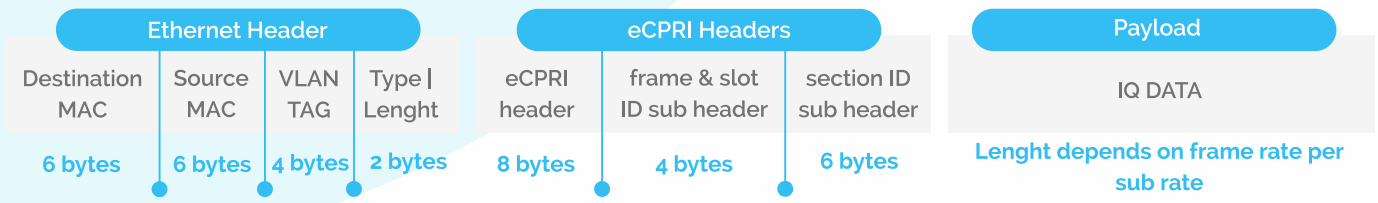


1) Multiple carriers inside a 10MHz wide container carrier
2) eCPRI split-8 based, time domain IQ samples
3) Sampling frequency 15.36MHz
4) 1ms subframe structure
5) Share the same port as LTE/NR
6) Share the same MAC address as LTE/NR
7) Segregation can be done by VLAN ID for the CU plane data.
8) No GSM-specific control plane is used
9) M-plane used to configure carrier though the yang model
10) Synchronisation through PTPile based on the following basic operation:

Starting with the basics

The basic idea is to create a container carrier in which the individual GSM carriers are placed. This 10MHz container carrier can be placed anywhere in the IBW space.

This container carrier is then sampled at a rate of 15.36MHz and the IQ samples are packed up in the IQ payload in the eCPRI frame.



It is up to the vBTS to mark the downlink IQ sample stream in user plane frames based on the eAxC ID and segregate it from the LTE symbols by different VLAN ID. Then both LTE and GSM user plane packets can be sent to the O-RU over the same physical interface.

In the uplink direction, the O-RU will send the continuous uplink IQ sample stream of the GSM container carrier, segregated by VLAN ID to vBTS for baseband processing.

For this GSM implementation, unlike split 7-2, there is no CP removal and insertion by O-RU, or PRACH identification. No CONTROL Plane functions are hence needed and thus simplifying the implementation. Management and Synchronization planes are used as normal in OpenRAN and the radio needs to have phase sync through precision time protocol (aka PTP) or GNSS.

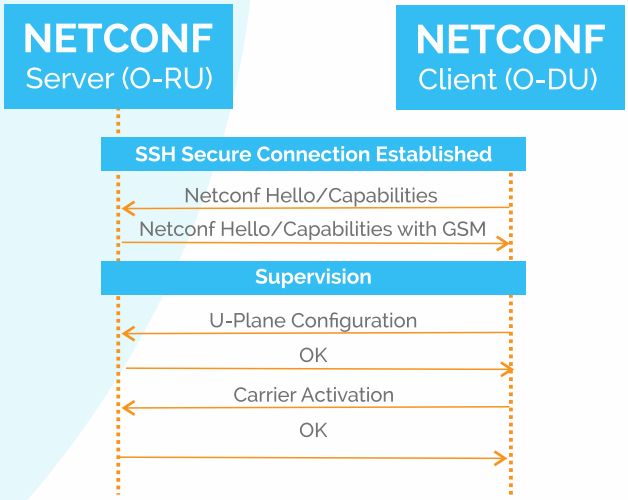
Management-Plane (M Plane)

To keep the M-plane modification minimal and not deviated from the O-RAN specification, our solution only adds what is necessary to the GSM CUS plane to make it operational.

In the current M-plane protocol, the O-RU reports the supported technologies such as LTE, and NR in the yang module: o-ran:module-cap. For the O-RU to advertise its support of GSM, an additional leaf of GSM as supported technology is added. This will allow a vBTS to determine if the O-RU can carry GSM.

Once vBTS has recognized that the **O-RU supports GSM**, then it can proceed to configure the GSM container carrier U-plane. The vBTS will request a carrier of GSM type in the carrier type field in **<tx-array-carriers>** and **<rx-array-carriers>**.

For other features of the M-plane, e.g. call home supervision management and performance counters, management is the same as for LTE.



Advanced GSM features

This model of managing GSM in an O-RU still maintains the basic layout of a BTS with roughly the same separation between "DU/vBTS" and RU.

Frequency hopping is created by vBTS as the O-RU has no concept of individual GSM carriers all the vBTS needs to do is to place the individual GSM carriers in the right part of the container carrier at the right time.

VAMOS, separating the users in the I/Q plane is also with the vBTS in this model and thus any constraints such as terminal support can be managed by the SW in the vBTS.

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