

Requirements for next generation access

Telstra

Purpose

This contribution captures requirements for next generation access that are of importance to Telstra

– We welcome discussion and feedback from fellow 3GPP members

Areas of interest include:

- Architectural considerations for mobility anchor function
- Integration and feedback between RAN and backhaul
- Security threats on the RAN and from the RAN
- Customer experience aspects of integration with non-3GPP access
- Advanced SON capabilities suitable for NG access
- Efficiency of control plane as it affects interference and signalling burden
- Additional deployment scenarios for fixed broadband use cases
- Extending network slicing into the RAN
- RAN support for differentiated device handling
- Enhanced interworking within and between RATs
- Long range self-install coverage for IoT
- Inclusion of wireless backhaul architectures and technologies in RAN

Mobility anchor function

Requirement

- The draft TR includes consideration for mobility (7.2.3); as part of this we propose to include a study on new ways to handle mobility management
- We acknowledge that SA2 has on-going discussions on mobility management (China Mobile, Qualcomm, CATT, ZTE, NEC, Ericsson, NTT etc)

Motivation

- To meet 5G requirements (eg eMBB and URLLC), the number of base stations is expected to significantly increase and content is expected to be brought closer to the RAN. With today's architecture, this will lead to excessive handover activity involving the SGw (managing GTP tunnels), which may become a bottleneck
- The study shall consider new architectures for mobility management including a potentially extreme outcome of removing the anchor point (for some scenarios) by using SDN
- Although this is primarily an SA2 consideration, we expect the 5G RAN to have more functions with greater CN inter-dependence, so the impacts on RAN should be considered directly

RAN to have tighter integration with backhaul / fronthaul

Requirement

- Tighter integration between the RAN and backhaul and fronthaul links is required. This integration shall support use cases including providing performance feedback, resource reservation, triggering dynamic change of transport paths, reporting of predicted degradation, performing user-based traffic steering, deselection of cells with degraded (wireless) transport in carrier-aggregation etc.
- The solution may also leverage SDN technology and data analytics techniques

Motivation

- The role of backhaul in delivering QoE will become much greater for 5G due to diverse and demanding requirements (eMBB and URLLC). Fronthaul is becoming a key requirement for C-RAN. Wireless backhaul is expected to become a major transport method
- In today's architecture, backhaul and fronthaul are handled as independent transport services with their own methods of handling QoS. New technologies such as NFV / SDN and analytics need to be exploited, which will allow for deeper integration between RAN and backhaul / fronthaul

Security threats on the RAN and from the RAN

Requirement

- We propose the TR include a study of security threats that apply directly to the RAN: attacks on the RAN and indeed from the RAN should be considered
- We acknowledge the work currently occurring in SA3, and will co-sign an upcoming contribution to SA3 (Ericsson), however we feel that RAN security threats deserve additional attention and should be considered directly in RAN to ensure impacts are identified early

Motivation

- The security environment for 5G will be more challenging than previous generations, considering that:
 - We'll have many more small cells with weaker physical security and a broad range of backhaul technologies
 - UEs will have increased compute power and the potential for more sophisticated attacks (eg a 'botnet' DDoS attack directly on the RAN via C/U-plane)
 - BBUs will likely to start to move towards COTS hardware platforms, so may become more exposed
 - We'll be integrating non-3GPP access technologies
 - The consequences of attacks will be greater, particularly for URLLC use cases

Reduce customer confusion when integrating with non-3GPP access

Requirements

- We acknowledge that Intel has proposed and added a new section “Requirements on integration with non-3GPP systems” to the TR skeleton document
- Ensuring that this is done in a way that minimises customer confusion is critical; a sub-section called “non-technical barriers” should be included in the study
- The final solution shall directly address issues of confusion around the use of multiple access technologies which may each have very different pricing constructs
- Note that we prefer integration at the RAN at PDCP

Motivation

- Customers desire a seamless experience between 3GPP and non-3GPP access networks; integration at the RAN is the best method to achieve this
- However, customers are accustomed to thinking that Wi-Fi is cheap / free whereas the mobile network is more reliable and are accepting of paying a premium
- Integration with non-3GPP access at CN level exists today in 3GPP but with many challenges. We are not aware of significant global adoption to date

Auto deployment, configuration, optimisation and healing for 5G networks ...1

Requirement

- Develop an adequate SON requirement set which will enable
 - fast and accurate deployment of radio nodes with (i) minimum planning (ii) automatic configuration of parameters (iii) self optimisation of parameters for cells (which will include increased no of antennas, several small cells, IoT nodes etc) (iv) zero touch plug and play
 - almost zero drive tests and auto healing
 - cover transport and core in an integrated end-to-end organisation
 - Provide increased frequency of observability of KPIs and accurate geo-location of poor performance
 - Auto management of the tracking area and paging algorithms

Auto deployment, configuration, optimisation and healing for 5G networks ...2

Motivation – general

- Current SON standards are limited in scope and capability and will not be sufficient to handle extensive 5G deployment.
 - With the use of mm-wave small cell technologies, unlicensed spectrum and radio techniques such as massive MIMO and massive IoT, the 5G RAN needs to be supported with an advanced SON (eSON) which will truly result in plug and play auto configuration, minimise cell identity conflicts / confusions and provide self healing capability
 - This capability should extend to transport and core aspects as capacity and performance management will become critical for these also in the face of massive deployments

Auto deployment, configuration, optimisation and healing for 5G networks ...3

Motivation – tracking area management

- Maintenance of tracking areas, tracking area lists, and any service areas relating back to the tracking area, will become more complex with large deployments of small cells and with 5G distributed network deployment architectures which involve new MME/SGW/PGW slices deployed closer to the edge where the tracking or services areas need to be rearranged. This can be simplified with automation and alignment in a centralised management system
- Support for new market verticals, IoT, and low powered devices will present inefficient use of paging resources if the tracking area and tracking area list is common for every subscriber and resource intensive to manually manage multiple lists. This can be improved with targeted paging techniques based on device, application and coverage area, by an automated and centrally managed system
- We acknowledge that tracking area architecture is an SA consideration, however the opportunity for advanced integrated SON capabilities to enhance management has a direct linkage with tracking area architecture

Minimisation of overheads and frequency of signalling

Requirement

- Include a requirement or design goal that control plane overheads be minimised by:
 - Suitable design of control signals (including reference signals) be release proof; and
 - Minimise switching between various UE states (idle, active etc)

Motivation

- System capacity needs to be maximised by minimising the resources required by control signals. System capacity is impacted both by interference caused by control signalling and the overhead imposed at a transactional level on network elements

Additional deployment scenarios for fixed broadband applications

Requirement

- Two additional deployment scenarios are proposed for consideration, which relate to fixed broadband applications
 - 5G as a direct alternative to fixed broadband
 - 5G as a failover service that automatically provides service when the primary fixed broadband service fails and / or cannot be provisioned in a timely manner

Motivation

- In underserved areas, extreme rural areas and hard to reach places for fibre, 5G can provide last mile access, which provides an important broadband connectivity alternative to communities
- 5G as a failover service will help integrated operators deliver broadband services with significantly improved uptimes and reduced provisioning times

Network slicing of an eNode-B to support industry verticals or tenants

Requirement

- It is proposed the TR include a study on how the eNode-B can be logically divided to target specific requirements of different industry verticals, without having to introduce dedicated antennas, frequency bands or sub-dividing spectrum into dedicated blocks
- This work will extend the SA2 study on dedicated core networks, as well as providing an alternative for the RAN to offer multi-tenancy capabilities similar to the core

Motivation

- Multi-tenancy of a mobile network is supported today, but not in an end-to-end sense. It is supported in core network infrastructures, allowing multiple tenants to ‘see’ a network in which they are the only users of the system, and provides separation at each technology layer to support isolation of information (for security reasons), performance, and management. Multi-tenancy in the RAN today requires the provision of dedicated infrastructure and air-interface resources, which is inefficient
- Multi-tenancy will improve the economics of deploying RAN sites and better serve the specific needs of use cases including mMTC and URLLC where specific RAN parameters can be optimised per market vertical

RAN support for differentiated device handling

Requirement

- The RAN should be able to differentiate the triggering of RAN features, RAN feature functionality and appropriate parameters based on a device identifier that has been provided to the RAN

Motivation

- The IMEI SV was included in S1AP (from Rel 12.2.0) and has allowed for device ID awareness in the eNodeB
- This has primarily been driven by the fact that various devices models can behave differently (including non-compliance) with the RAN including aspects of optimisation (timers, RAN parameter settings) from one another but remains a proprietary capability within the RAN implementation itself
- Moving towards a standardised implementation of differentiated device handling in the RAN will greatly improve the operator's ability to introduce and manage RAN feature capability. The capability will also allow the operator to improve RAN efficiency by being able to deliver different RAN parameter sets to specific device IDs to best exploit their behaviour and / or capabilities

Enhanced interworking within and between RATs

Requirement

- Ensure that the RAN can support a large minimum set of relationships with new and existing RATs out to ~2030 timeframes
- Provide greater flexibility for the management of inter RAT interaction in handover and capacity management techniques
- This requirement can be relaxed for 3G and older RATs (tight interworking with LTE is the primary concern)

Motivation

- Due to the increasing number of RATs, carriers and spectrum, it will be necessary to continue to provide operators with as much flexibility to make the most efficient use of their spectrum and carrier assets in carrying traffic
- Different applications and users can utilise the carriers and RATs in different ways both in technical and commercial constructs; the ability to direct and steer traffic appropriately is important
- The study should also look at capabilities to differentiate interworking using prioritisation, load-based, barring, mobility/speed-based, application based, etc. capabilities and indicators

Long range self-install coverage for IoT

Requirement

- Ensure that eNodeB equipment can be installed and operated by untrained people (similar to Wi-Fi access point) in rural locations, but can achieve a long range for IoT applications
- This implies that the 5G waveform should be designed so that equipment can operate at safe transmission power levels yet still achieve ~10km range, and that the self-install eNode-B should tolerate high latencies

Motivation

- In many rural agricultural areas, the population is low but there is need for IoT coverage to support connected sensor and actuator devices
- A single outdoor eNodeB may provide coverage to devices used by only a single customer, e.g. a farm owner, making traditional site deployment uneconomic. Enabling the customer to deploy the eNodeB themselves is a proven approach, but the equipment needs to transmit at levels where this would be safe
- Additionally, the rural site may have satellite backhaul, so the self-install eNodeB would need to tolerate long latencies

Include wireless backhaul architectures and technologies in RAN

Requirement

- Include consideration for architectures and technologies for wireless backhaul systems which can significantly improve their key performance metrics, e.g. link throughputs (includes difficult NLOS multipath environments), achievable area densities, deployment ease through ‘plug & play” capabilities, capex and opex costs etc. It is envisaged that the study would include the following considerations
 - Backhaul deployment use cases (includes frequency bands)
 - PHY and MAC (includes multi-antenna technologies)
 - Adaptive techniques for operation in environments characterised by NLOS multipath channels as well as interfering (close-by) wireless backhaul links – consideration of modulation methods, CSI requirements & acquisition, multi-antenna technologies, transmit pre-filtering (includes beamforming), self-configuring, self organising technologies (SON capabilities) etc.
 - Separate consideration may need to be given to (in-band) self backhauling technologies, and (out-of-band) backhauling technologies

Motivation

- It is becoming increasingly clear that wireless backhaul will be a critical technology for the low cost provision of dense small cell deployments, e.g. for 5G in urban environments - it is essential that wireless backhaul technologies be available in the 5G timeframe which can meet the very demanding performance & cost requirements required of them.