**NEW RADIO SITES**

**Technical Specifications**

**Background**

MIC2 intends to have a tender for deploying 100 new Radio sites in different areas on Lebanese territory. The new sites will be implemented in Beirut and across various governorates where existing sites currently support 2G and 3G with Huawei equipment and LTE with either Huawei or Nokia equipment.

The desired new sites will have LTE Advanced based on the latest available technology in the market, having full scalability, relying on Carrier Aggregation, 4x4 MIMO, delivering the best throughput and quality of service and using the most effective capacity maximization techniques. The desired new sites should effectively carry VoLTE communications with the best quality of service across the network.

**NEW RADIO SITES**

**Technical Requirements**

**Introduction**

This section provides an explicit list of the main Radio technical requirements in relation to the needed new sites.

The addressed vendor needs to provide a detailed technical solution for each requirement, along with its detailed technical specifications.

**Killing Factors**

1. Vendor shall provide 100 sites with SRAN solution having the following configuration:

LTE 800 Band (1 carrier of 15 MHZ bandwidth)

LTE 1800 Band (2 carriers of 20 MHZ and 15 MHZ bandwidth respectively)

LTE 2100 Band (1 carrier of 15 MHZ bandwidth)

1. The System should comply with the latest 3GPP specifications and the vendor shall provide 5G, VoLTE, 4.5G X references in Europe and America continents or X global penetration and the solution shall be 5G HW ready with the possibility to re-use L2100 for NR2100
2. Vendor should guarantee interoperability with existing Huawei 2G and 3G sites on all existing bands, interoperability with existing Huawei and NOKIA 4G sites on all existing bands and interoperability proven with MIC2 existing RAN, MW, Core, PCRF suppliers
3. All Base stations should include Multi-band, Multi-technologies RRUs.
4. Reshuffle of all type of licenses should be done once needed between RAN elements dynamically, (remove/add between sites the licenses for RRU, cells, RRC, Baseband unit, PRB, throughput…)

**General Requirements**

The vendor will provide and include in his offer a turnkey solution whereby the vendor will provide the RAN, along with the services part.

1. Upwards/Downwards Compatibility
2. Vendor shall provide radios for all technologies considering that 60 sites will have 4 sectors and the remaining 40 sites will have 3 sectors
3. The latest commercially proven eRAN SW shall be deployed on all new sites
4. Vendor shall provide outdoor cabinets that support latest SRAN solution
5. Vendor shall provide outdoor cabinets having the following requirements:

Waterproofing

Security

Cooling and ventilation

Cable management

Power and backup

Size and capacity

Material and construction

Ease of installation and maintenance

Compliance and standards

1. The provided solution should have built-in serge protection
2. Each site should be ready to support up to 6 sectors (with all bands and technologies listed in System General Requirements, requirement # 2) without the need of additional boards on the baseband unit
3. Carrier aggregation between the 800 MHz, 2x1800 MHz, and 2100MHZ bands should be available on all sites from a SW, HW, features and licenses point of view
4. Carrier aggregation between the 800 MHz,2x1800 MHz, and 2100MHZ bands should be available on an intra-site, intra-band, inter-band, inter-site basis and UL carrier aggregation
5. Vendor solution should support from CAT2 to CAT16 devices
6. The vendor should connect all technologies for each sector to one antenna
7. The vendor should explain his multi-mode and multi-frequency solution
8. Flash and ultra Flash CSFB
9. CoMP features need to be provided including uplink CoMP and inter-site CoMP and should be compatible with other vendors networks
10. X2 based functionality should be supported and compatible with other vendor's network
11. The provided solution should guarantee a fast telecom implementation process
12. Vendor needs to ensure complete and effective integration with the existing network elements, among which the existing 2G, 3G and LTE radio network including a seamless mobility management
13. Vendor should include all basic and advanced features to activate VoLTE/ViLTE and eSRVCC
14. Documentation for all hardware and software offered in the response
15. LTE-A solution should support DL 3CC CA, UL 2CC
16. LTE-A solution should support DL 5CC CA, UL 2CC on 5 sites
17. The vendor solution should support licensed activated access capability
18. Vendor should provide a testing lab including all functionality in the RFP scope, including but not limited to full configured site, antennas, rectifier, etc...
19. Vendor needs to provide a detailed documentation of his proposed SW basic features and optional features

**Equipment HW Specs & Requirements:**

1. **Main Hardware & System Specs**
2. The Basedband and radio units should support carrier aggregation (CA) as per the latest 3GPP release
3. SingleRAN site solution shall be adopted for all hardware requirement mentioned in the RFP
4. On a single baseband card. Both SIMO, 4x4MIMO and massive MIMO modes should be supported
5. Vendor shall provide the latest release and details about scalability and future upgrades
6. Base station should support environment temperature from -40°C to 55°C.
7. All Equipment should be operating with a nominal -48V DC
8. All Equipment should be operating with a relative humidity of 5 to 95%
9. Installed outdoor cabinets should have enough space and power to host the MW IDU and power rectifiers, inside them (9RU space, -48V DC power source and other requirements if any. In addition, to the provided cabinets for the radio sites, an extra 10 empty outdoor cabinets should be included in the offer
10. Typical optimum power consumption and heat dissipation for any network element
11. The vendor should describe the redundancy principle for each Base station configuration type
12. Base station should support SCTP (Stream Control Transmission Protocol) multi-homing to provide fault recovery by failover between redundant network paths of all interfaces
13. The Base station should support dynamically adjustable output power to reduce power consumption
14. The RRU should support the natural cooling mechanism instead of fan
15. Adaptive Power Consumption: RF power amplifier working state can be automatically adjusted according to the traffic load, so that the total Base station power consumption can be saved
16. RF Channel Intelligent Shutdown: when no traffic is carried by a cell that is configured with the MIMO mode, only a part of the transmit channels needs to be switched on with the PAs of other transmit channels shut down. In this way, the power consumption of the base station in empty load mode is decreased. When there is traffic, the transmit PA is switched on automatically to have the cell run normally again.
17. Low Power Consumption Mode: in some cases, a Base station can be forced to run in low power consumption mode. The low power consumption mode can help expand the life span of a Base station. The function can be triggered by a command sent by operator via OSS or by a power alarm in case the power supply fails.
18. Power Consumption Monitoring: Base station should periodically monitor the power of each monitoring point and report the power consumption within a period. The EMS receives and collects all data about power consumption. Through the EMS, the operator can observe the change in the power consumption and analyze the power consumption according to a statistics report generated by the OSS
19. PSU Intelligent Sleep Mode: certain PSUs can be powered on or off according to the power consumption of the Base station, thus reducing the power consumption
20. Base station should support transmission topologies such as Tree topology, Star topology and Chain topology to meet different requirements
21. Header Compression: the Base station should support IP header compression and multiplexing to save the IP transport resource and provide higher transport efficiency of the IP transmission
22. Base station should support transport admission control function, which is designed to prevent any congestion in order to admit users for certain traffic classes
23. Base station should support different QoS profiles to provide QoS guarantees by classifying and managing different traffic types in the network. The QoS Class Indicator (QCI) and DiffServ Code Point (DSCP) relationship can be configured by operator
24. Base station should support transmission overbooking with the enhanced admission control mechanism and QoS mechanism (traffic shaping and congestion control) to guarantee the transmission quality.
25. Base station should support transport resource overload control to rapidly enhance the transmission stability when overload happens unexpectedly.
26. Base station should support different transport paths based on QoS grade to improve the network reliability.
27. SCTP Congestion Control: if a network has heavy traffic, SCTP congestion control can be used to prevent SCTP association exceptions caused by SCTP signaling congestion. SCTP congestion control is triggered when the SCTP resources, including the central processing unit (CPU) and buffer resources, are insufficient
28. Base station should provide reliability of OM channel with an alternative OM channel if OM main channel happen to fail
29. Base station should support IP Route Backup to provide reliability of IP route with an alternative IP route if the IP main route happens to fail
30. Base station should support Ethernet Link Aggregation (802.3ad) to bind several Ethernet links to one logical link.
31. Base station should support Internet Protocol Security (IPsec) Tunnel backup which provides prime and backup IPsec tunnels from one Base station to two security gateways (Se-GW) to improve the reliability of Base station transportation paths protected by IPsec tunnels
32. Base station should support E2E transport connectivity monitoring: Bidirectional Forwarding Detection is required, for instance to check connectivity between Base station and intermediate transport Network Elements.
33. Base station should support IEEE1588V2 clock synchronization over IPv4 and IPv6 network to provide frequency and time synchronization
34. Base station should support GPS clock synchronization
35. Base station should support the synchronization with Ethernet (ITU-T G.8261)
36. Base station should support the synchronization with the clock over IP to provide frequency synchronization
37. Base station should support the synchronization with the BITS.
38. Base station should support the synchronization with E1/T1 interface
39. Base station should support the synchronization with 1PPS
40. Base station should support work in multiple clock synchronization modes. The system clock source can be chosen in a convenient and flexible manner. When one clock source fails, the system clock can be manually or automatically switched to another available one
41. The Base station should support uplink power control, it is essential in controlling the uplink transmit power of UE by the base station, it should also control the interference with the neighboring cells to improve the system throughput
42. The Base station should support scalable bandwidth configuration of 1.4M/3M/5M/10M15M/20M on the 1800 MHz band, 800 MHz band and 2100 MHZ band
43. Adaptive antenna solution recommended design
44. The base station filters should support all the 800,1800,900 and 2100 MHz frequency bands
45. All proposed HW should be based on the most recent and effective commercially proven HW released by the vendor, taking into account the scalability and future upgrades. Vendor shall specify in details the provided HW release and the status of this HW in the vendor roadmap
46. The HW should be capable to support at least for LTE, 2 carriers on the 1800MHz band, each carrier of 20MHz bandwidth, 1 carrier on the 800 band of 15MHZ bandwidth, and 1 carrier on the 2100 band of 15MHZ
47. The hardware to be installed should have the latest HW release available on the installation date
48. Base station should support LTE-A.
49. Base station should support VoLTE/ViLTE and SRVCC/eSRVCC. All basics and advanced licenses/features should be provided.
50. RRU power/fiber cables to support 150 meter lengths
51. Baseband/control unit should be modularly assembled to meet different requirements of network capacity and faulty board replacement
52. The Base station should support Remote Electrical Tilt Control (RET) and comply with the AISG2.0 and AISG1.1 specification.
53. Base station’s hardware capability should support more than 10K active users (RRC\_connected)
54. The Base station should support Control channel Interference Rejection Combining (IRC) to protect physical uplink control channel (PUCCH) and Physical Random Access Channel (PRACH) from inter-cell interference.
55. Power consumption of different Base station portfolio should be provided under variable loading conditions (full and typical loads). (we should consider Power efficiency of Remote Radio unit)
56. RRU should support daisy chain topology, for daisy chain at least 3 RRUs can be cascaded and the distance should reach 20KM as the minimum requirement
57. **Interfaces and main ports**
58. At least 64 X2 interfaces should be supported per Base station.
59. Up to 16 S1-flex interfaces should be supported per Base station.
60. **System and Equipment capability**
61. Base station should support LBS features providing methods to identify UE's geographical location by radio signal measurement. The following positioning methods should be supported:

a. Cell ID based – basic accuracy (depending on radio network density)

b. Enhanced Cell ID based

c. OTDOA (Observed Time Difference Of Arrival) – Medium accuracy

d. A-GPS – High accuracy

1. LTE Cell throughput capacity should be 200Mbps for DL and 100 Mbps for UL.
2. The vendor should indicate his system’s readiness for a user throughput of DL: 500 Mbps, UL: 100 Mbps in DL 2x2 MIMO mode with CA, UL 2X2 MIMO mode (as soon as the terminals are available). 1000Mbps for DL 4x4MIMO
3. DL 2x2 MIMO: the vendor should support DL 2x2 SU-MIMO, DL 2x2 MU-MIMO, 2-Antenna transmit Diversity and Adaptive MIMO schemes between UE and Base station to improve system downlink performance. The Base station should adaptively select one of the ten 3gpp MIMO modes based on the UE rate and channel quality, including transmit diversity, open-loop spatial multiplexing, closed-loop spatial multiplexing, closed-loop rank-1 pre-coding.
4. UL 2x2 MU-MIMO: the vendor should support UL 2x2 MU-MIMO, 2-Antenna Receive Diversity. The Base station should adaptively select between UL 2x2 MU-MIMO and UL 2-Antenna Receive Diversity.
5. UL 2x4 MU-MIMO: the vendor should support UL 2x4 MU-MIMO, 4-Antenna Receive Diversity. The Base station should adaptively select between UL 2x4 MU-MIMO and UL 4-Antenna Receive Diversity.
6. DL 4x4 MIMO: downlink 4x4 MIMO with fixed/adaptive open-loop & closed-loop modes should be supported
7. RRU should support 4T4R per module
8. RRU should save energy consumption
9. RRU should be capable of TX power sharing between different bands, to expand coverage of one band for far edge users
10. All RF modules should support an Instantaneous Bandwidth (IBW) of at least 40MHz on 1800MHz.
11. RF modules should support the whole bandwidth of LTE Band 20 (800MHz, 30MHz).
12. RF modules should support the whole bandwidth of LTE Band 3 (1800MHz, 75MHz).
13. RF modules should support the whole bandwidth of LTE Band 1 (2100MHz, 60MHz).
14. RF modules should support the whole bandwidth of LTE Band 8 (900MHz, 35MHz).
15. The vendor should provide the dimensions of all equipment/modules
16. Each Base station should handle 700 RRC connection with capability of pooling/License sharing between Base stations.
17. Each carrier should be licensed for 100W power and hardware should support 4x100W
18. The vendor shall provide High-Capacity Solution with Penta Beam antennas for 10 sectors to be allocated dynamically on different sites

**Equipment Services & Features**

1. **System capacity**
2. In case of unusual increase in traffic, license limitations should be exceptionally withdrawn temporarily in order to handle the sudden increase of network capacity. This capability should be addressed in great detail by the vendor.
3. A single baseband board should support at least 3600 active users (RRC\_connected) at bandwidth 5M/10M/15M/20M, and any cell should support at least 1200 active users (RRC\_connected) at bandwidth 5M/10M/15M/20M without any limitation on cell level
4. Vendor should provide licensing schemes and allocation method per element.
5. Licenses should meet capacity requirements covered in this RFP.
6. MIC2 should have the flexibility to reallocate licenses between RAN elements whenever needed through OSS, including RRC active users, throughput, and output power.
7. RRU sharing licenses/feature between sectors should be included in the offer
8. License allocation should be hardware independent (no binding between licenses and cards).License transfer should be permissible to MIC2 whenever needed.
9. **Services**
10. The vendor is responsible for the installation and the related cabling requirements of the new antennas. This statement is valid disregarding if the vendor is providing the antenna or if the antenna is provided by another party and also disregarding the warehouse owner and location of where the antenna is stored
11. The Vendor shall be responsible for the antenna line testing.
12. The Vendor shall be responsible for delivering the purchased equipment to the warehouse specified by MIC2.
13. The Vendor shall be responsible for delivering the equipment to site from the warehouse.
14. In the case of antenna damage during the transportation and the process of the installation, the vendor should replace the damaged antenna at their own expense by a new one with the same specifications
15. Proposal should include the type and quantity of the tools to be used for the hardware installation, commissioning, Drive test and benchmarking.
16. **System features**
17. The blind handover should be supported in case inter-RAT measurements are omitted or unavailable. For example, if an E-UTRAN cell is co-sited with a UTRAN cell, and having the same coverage range, it should be possible to configure the UTRAN cell as the E-UTRAN cell's blind handover target cell.
18. Inter-RAT Load Sharing to UTRAN/GERAN: this feature achieves better utilization of network resources of LTE, UMTS, and GSM network based on UE capability. In addition, it reduces the probability of system overload and increases access success rates.
19. X2 and S1 handover should be supported.
20. Data forwarding process should be supported in PS handover.
21. Distance-based inter-frequency and inter-RAT Handovers (optional).
22. eNodeB should support CS fall back to UMTS/GSM. In order to increase the success rate of CS fallback to UMTS/GSM, the eNodeB should support CS fallback to UMTS/GSM based on UMTS/GSM cell load information.
23. eNodeB should support RIM (RAN Information Management) procedure according to 3GPP with SIB CS fall back to UMTS/GSM to provide a decreased delay on CS access. This penalty time should not exceed 0.6 seconds for originated and terminated calls when compared to native 3G/2G calls.
24. eNodeB should support blind CS fallback function for cell center users and cell-edge users to reduce the CSFB delay.
25. The vendor should offer their detailed possible features that could reduce the possibility of Location Area Updates during and after fallback, whether they should be implemented on LTE or UMTS/GSM networks.
26. eSRVCC solution should be supported for the LTE’s voice service to UTRAN/GERAN.
27. eNodeB should support CSFB/eSRVCC from E-UTRAN only to the highest-priority UTRAN carrier.
28. In case of CS+PS sessions, CSFB & eSRVCC should be performed on the voice bearer in conjunction with the handover of the data bearers into a multi-RAB/combined-service configuration on 3G. The interruption time for both voice and data should be stated clearly by the vendor along with signaling flows & illustrations.
29. High-Mobility-Triggered Idle Mode: a high-mobility UE can be switched from the always-online state to idle mode if the signaling increase due to frequent UE handovers is greater than the signaling reduction gained by staying in the always-online state.
30. UE Level Oscillating Handover Minimization: oscillating handovers may occur for individual users due to specific radio conditions. Instead of changing cell offset for the cell and impacting all users, this feature should change cell individual offset for each user experiencing oscillating handovers and hence UEs experiencing good conditions will not be affected.
31. Mobility Robust Optimization (MRO): typical mobility control parameters should be dynamically optimized on both cell-level and UE-level in order to minimize too early handovers, too late handovers, and Ping-Pong handovers.
32. Service-Based Inter-frequency Handover (optional): service-based Inter-frequency Handover should be supported to improve efficiency and capacity of whole system.
33. Service based inter-RAT handover to UTRAN (optional): this feature should enable VOIP service steering to UMTS during service setup phase.
34. Automated RACH root sequence allocation to reduce false preamble detection which should improve UE accessibility.
35. MRO aimed at avoiding Ping-Pong handover, handover too early, handover too late, corner phenomenon, and needle phenomenon, typical mobility control parameters optimization, which includes cell individual offset, need to be considered to improve the user’s experience.
36. Support intra-LTE MLB (Mobility Load Balancing, MLB), by which the eNodeB’s traffic load, Physical Resource Block (PRB) usage per QCI, Hardware load and RRC user number should be considered.
37. Support inter-RAT MLB, by which the eNodeB’s traffic load, PRB usage per QCI, Hardware load should be considered.
38. TA to be automatically planned and optimized/maintained in the entire lifecycle of the base station.
39. Antenna fault and VSWR detection should be supported
40. The eNodeB should support Adaptive ICIC (Inter-Cell Interference Coordination). In intra-frequency networking, this feature can adaptively adjust algorithms based on load changes, which reduces inter-cell interference and improves cell edge user throughput. The adaptive function is automatically disabled or enabled based on the network load and interference to determine whether to perform inter-cell interference coordination.
41. Downlink Dynamic ICIC: the DL dynamic ICIC should dynamically adjust the system frequency band for cell-edge users according to DL ICIC messages.
42. Uplink Dynamic ICIC: the UL dynamic ICIC should dynamically adjust the system frequency band for cell-edge users according to the cell load.
43. The eNodeB should support intra-band CA to allocate up to a 40 MHz downlink bandwidth for two downlink carriers.
44. The eNodeB should support inter-band CA to allocate up to a 50MHz downlink bandwidth for two downlink carriers.
45. The eNodeB should support common DRX for UEs using two aggregated downlink carriers to save the power of such UEs.
46. The eNodeB should support CA. One single UE can reach a peak data rate of 500Mbps in downlink and 100Mbps in the uplink.
47. The eNodeB should support differentiated scheduling to CA UEs and non-CA UEs, thereby CA UEs can achieve better service quality than non-CA UEs.
48. The eNodeB should support to activate or deactivate the secondary serving cell (SCell) of a CA UE according to data traffic of the primary serving cell (PCell) of the UE.
49. The eNodeB load balancing function between aggregated bands in co-coverage areas should be supported.
50. Enhanced PDCCH Link Adaptation: enhanced PDCCH adaptation introduces a dedicated link adaptation capability for PDCCH. In absence of this feature, the PDCCH link adaptation is handled as a fixed offset from the PDSCH link adaptation.
51. Multi-Target (neighbor cells) RRC Connection Re-Establishment: the features improves the basic functionality for RRC connection re-establishment, with support for RRC connection re-establishment during ongoing handover and for RRC connection re-establishment in any cell were the original source cell is included in the neighbor list of the cell were the UE is doing the RRC connection re-establishment.
52. RLC in Unacknowledged Mode: this feature is useful for services that can tolerate a higher packet loss rate but require lower latency.
53. Multiple Radio Bearers per User: up to 8 simultaneous data bearers established with different QoS.
54. PUCCH Flexible Configuration: with this feature, the PUCCH can occupy Resource Blocks that were originally available to the PUSCH. Likewise, the PUSCH can occupy RBs that were originally available to the PUCCH.
55. Jumbo Frames: this feature enables the configuration of the S1-U MTU to greater than 1500 bytes as a means to manage excess packet fragmentation and reassembly.
56. LBS feature should be implemented mainly in E-SMLC and UE while the eNodeB will be acting as a transparent entity for messages and information measurement forwarding. LPPa (LTE Positioning Protocol Annex) should be supported for the transfer of positioning related information. Typical LBS procedures are:

a. MME receives LBS request for a target UE location, or MME starts LBS service by itself.

b. MME sends LBS request to E-SMLC.

c. E-SMLC sends auxiliary data to UE, checks related measurement information from UE/eNodeB. E-SMLC calculates out location information of target UE and forward it to MME.

1. GTP-U Supervision: this feature allows complete standard compliance for the GTP-U protocol at eNodeB according to 3GPP TS 29.281 Rel-10.
2. In order to have complete interworking and interoperability with exisitng LTE/WCMDA/GSM Vendors, selected vendor should provide all required LTE features and requirements to achieve LTE/WCDMA/GSM interworking requirements with all features required in this RFP
3. DRX (Discontinuous Reception) should be supported. This feature can reduce the power consumption of UEs and enhances the usage of system control channel.
4. Efficient DRX: DRX is mandated by 3GPP for Idle Mode but this feature introduces the possibility to use DRX also in Connected Mode for UEs that have this capability. The time periods where the UE receiver is turned off should be configured by the network.
5. Dynamic downlink power allocation should be supported, this feature should allow an eNodeB to dynamically set the transmit power at downlink channels to reduce power consumption while maintaining the quality of radio links. It should provide flexible power allocation for downlink channels based on the user’s channel quality and maintains acceptable quality of the downlink connections.
6. Parallel Soft Interference Cancellation Technology: eNodeB should be able to use Parallel Soft Interference Cancellation (PSIC) to mitigate two types of interference: interference between MU-MIMO UEs and interference among symbols of one UE.
7. Vendor shall include in his offer, all basic and advanced features among which the effective CSFB features, all mobility management features, radio resource management features, interference cancellation & management features as well as the complete VoLTE/eSRVCC features.
8. Vendor shall also provide all new features that can help solving any problem faced in the network within the first five years free of charge
9. UL Interference Rejection Combining (IRC in 2-way and 4-way receive modes) to effectively overcome the inter-cell interference. This method can be used with receiving diversity and can be used for MIMO decoding in any scenario.

**Equipment & System Design**

1. **System Design**
2. The vendor should provide the traffic model calculation, network dimensioning, board capacity and utilization to cater for the purchased sites
3. The vendor should consider any future upgrades and expansions
4. **Network Planning**
5. The vendor should provide product roadmaps up to 3 future years, highlighting the main features of each evolution step.
6. Vendor will be responsible for delivering the Radio Network Design for the complete solution
7. Vendor will be responsible of the Sites/Clusters Optimization for the complete duration of the project.
8. Vendor should ensure an inter-vendor border optimization and guarantee the network KPI's along the border between sites from different vendors. In addition the vendor should offer his optimization services to include any area within the MIC2 network affected by overshooting of his own sites.
9. The vendor should show his Active/Smart Antennas roadmap and offer these solutions.
10. A summary of the sites needed over the coming few years.

**Supervisory Management System & Software Support**

1. **General EMS requirements**
2. The system should reliably apply latest ML/AI techniques to enhance end user experience in different aspects (FCAPS).
3. Out of the Box support for LTE and 5G.
4. Utilization of private cloud technology
5. AI-Based Load Simulators

Uses virtualized network environments and cloud simulation

AI dynamically adjusts load generation based on real network conditions

Scales up easily for large network testing (cloud-based)

AI models learn and replicate real-world user behavior dynamically

Lower costs as it runs on software-based infrastructure

1. Subscriber and equipment trace.
2. Cell Outage Compensation, which provides automatic detection of cell outage, and automatic adjustment of surrounding cells’ RRM/RF parameters to compensate outage cells. (SON Feature)
3. Automatic generation of all planning data including RF parameters, radio network specific data and RRM control parameters with minimum manual intervention according to real deployment environment before deployment.
4. Automatic adjustment of the planning data, e.g. PCI/PSC, neighbor relation, TA (Tracking Area)... according to concrete detection of radio environment after initial deployment with default values (SON Feature).
5. Iterative planning and adjustment, i.e. updating planning data including RF parameters, radio network specific data and RRM control parameters when a new site is added into or when a current site is removed from the existing network (SON Feature).
6. Inter-RAT Automatic neighbor relation (ANR)
7. Support PCI conflict detection.
8. Full system documentation including full feature list for LTE and 5G.
9. Full System licensed capacity
10. License cost should be one time
11. Latest SW version to be provided
12. Unlimited LCT license
13. Automatic schedule for common administration tasks (backup, health check, logs, performance reports dumps, inventory, logical and physical configuration, etc...). Log data and PM data should be kept for 1 year
14. The managed network shall be represented graphically, as a Network Map window, and it shall display:

a. NEs

b. Boards and their status graphically

1. Automatic generation of comprehensive and detailed Reports for defined and customized network KPIs in standard formats e.g. Excel, csv, PDF, etc...
2. **FM**
3. The offered EMS system shall support the following:

a. Should be able to acknowledge alarms and by choice, delete these alarms. If alarm persisted, it should come back again.

b. The users shall be able to enable or disable the Auto-acknowledgement feature

c. Must support alarm history and event history and please to provide the system handling capacity in terms of size and time of saving such data. Up to 3 years

d. Alarms should not be transferred to Alarm History file unless the EMS users acknowledge them.

e. The EMS shall be able to export the alarms to an external system.

1. Predictive Fault Detection & Self-Healing utilizing ML/AI techniques for Anomaly Detection, Future fault and maintenance prediction.
2. Thresholding feature, when a certain event exceeds a certain KPI limit an alarm will be generated.
3. Alarm correlation and root cause analysis utilizing AI techniques like Anomaly Detection, Future prediction of faults
4. Ability to define actionable commands thru rules supported by AI techniques
5. EMS should provide support for monitoring services and all related tasks
6. AI/ML – Driven Fault Management

* Predictive Fault Detection & Self-Healing
  + AI-powered root cause analysis (RCA) for anomaly detection.
  + ML-based alarm correlation to reduce noise & false positives.
  + Self-Healing Automation (AI-based auto-restart, reconfigure, reroute)
* Proactive Incident Management
* AI-based ticketing system with priority classification.
* Automated Fault Escalation using intelligent workflows.
* Real-time Fault Prediction with historical ML analysis
* Intelligent Network Recovery
  + AI-driven clock synchronization to prevent timing drifts.
  + 5G Slicing fault isolation to prevent cascading failures

1. **PM**

* Real-time Performance Management and Reporting.
* Graphical and tabular representation of KPIs
* Full statistical analysis and reporting of all performance raw data. Single or multiple nodes. Storage for 1 year
* Definition of customized KPIs storage for 1 year
* Mass activation of counters
* AI-Based Performance Management
  + AI-Powered KPI Monitoring & Analytics
    - Real-time 5G KPI dashboards with anomaly detection.
    - Traffic Pattern Prediction for proactive scaling.
    - User Experience (QoE) Analytics using ML models.
* AI-Driven Resource Optimization
  + Dynamic Bandwidth Allocation using reinforcement learning.
  + Energy-Efficient Network Management for power saving.
  + Load Balancing using AI across DU, CU, Core, Transport
* Predictive Maintenance
  + AI-based hardware failure prediction for proactive replacement.
  + Real-time data correlation to prevent performance degradation.

1. **CM**
2. Users shall be able to perform the following during NE creation/modification Process

A. Mass configuration for Nes thru MML and GUI.

B. Export/Import utility.

C. Comparison with optimum parameters value.

D. Synchronization between EMS and Nes.

1. AI powered SON to provide but not limited to
   * Automated RAN parameter tuning for coverage/capacity optimization.
   * AI-powered Beamforming & Antenna Tuning for mmWave.
   * AI-based handover optimization for seamless mobility
2. AI based parameter tuning to optimize cell performance
3. Dynamic Configuration Updates via closed-loop automation
4. Dynamic Network Slicing to provide but not limited to
   * AI-driven QoS & traffic management per slice.
   * Closed-loop SLA assurance using ML.
   * Automated slice scaling based on traffic patterns.
5. EMS should allow operators to download the active configuration file from a device or group of devices.
6. EMS should allow operator to upload an archived configuration file to the device from which it was archived, or uploads an imported configuration to a selected device.
7. The EMS should generate inventory reports containing details of the available hardware components in the network.
8. EMS system should list all reports can be generated, and should include:

a. Inventory reports using tools to sort, query, and configure columns.

b. Custom inventory reports, including user-specified definitions and controls.

1. **Security Management System**
2. Tracking and reporting for all actions on the systems for 1 year. Automatic dump of operation, security, and system logs. Storage period for logs in system 1 year
3. Full control over users, all users shall have User ID and Password that defines their access level to the EMS system.
4. Local access via the Local Craft Terminal to any managed Network Element or node shall be controlled by the offered EMS system.
5. **EMS server**
6. Support for Blade technology
7. EMS server shall be 1+1 hot standby Redundant Management, with the optional capability of geographic redundancy. System with HTML 5 GUI
8. Minimum of 30 concurrently clients/users to be able to connect to the management system and LCT shall be provided without any license or limit on number of users.
9. **NBI**
10. NBI (SNMP or CORBA). NBI should provide collecting data (FM, PM, CM, inventory) in addition to any needed extra features (e.g. MML commands, scripting, etc…)

**SLA, KPI & KQI**

1. Acceptance procedure and requirements
2. The vendor should propose standard acceptance procedures for the offered solution to be considered in measuring the network’s quality and grade of service.
3. Final acceptance templates and KPI/KQI thresholds shall be determined in the low-level design stage as per MIC2 LB standards. Acceptance shall include hardware, software, installation, integration, and performance on site/cluster levels. Below are some general KPIs/KQIs that the vendor should comply to:

1. Service Accessibility Ratio (>99.9%)

2. Completed Session Ratio (>99.9%)

3. Single User Data Rate [Mbps] (Static FTP to local server > 350 Mbps)

4. VoIP Call Setup Time [s] (IDLE  IDLE < 3s, Connected  Connected < 1.5s)

5. VoIP Call Success Rate [%]

6. VoIP Call Drop Rate [%]

7. Speech Quality [MOS-CQ] (Average >3.6)

8. Voice Frame Error Rate (FER) [%]

9. Voice Interrupt Time (HO)

10. VoIP Capacity per Cell [n]

11. Attach Time [ms] - Attach Delay

12. Detach Time [ms]

13. Attach Success Rate [%]

14. Service Request (EPS) Time [ms]

15. Service Request (EPS) Success Rate

16. Service (EPS) Drop Rate [%] (<0.1%)

17. Handover Procedure Time [ms]- S1 and X2, S1<2000ms, X2<200ms

18. Handover Success Rate [%] (>99%)- inter-freq and intra-freq

19. Paging Time [ms]

20. Paging Failure Rate [%]

21. Round Trip Time [ms]

22. Single User Data Rate [Mbps]

23. Packet Loss Rate [%]

24. Service Interrupt Time (HO) [ms]

25. (RB) Packet Loss Rate UL / DL [%]

26. (RB) Single User Data Rate [Mbps]

27. Cell Throughput [Mbps]

28. Block Error Rate (BLER) [%] (<10%)- DL/UL IBLER/RBLER

29. RSRP (dBm)- Idle RSRP and Connected RSRP

30. PUCCH SINR (dB) >-3, PUSCH SINR (dB)> 20

31. RSRQ

32. Jitter [ms]

33. RRC connection setup success rate (>99%)

34. RRC connection setup failures (times)

35. PDP context activation

36. Attach success rate

37. PS call drop rate (<0.3%)

1. Accessibility:

1. RRC Success Rate (>99.5%)

2. eRAB Success Rate (VoIP) (>99%)

3. eRAB Success Rate (VoIP) (>99%)

4. CSFB Success Rate (>99%)

1. Retain ability:

1. Call Drop Rate (VoIP) (<0.1%)

2. Service Drop Rate (including VoIP) (<0.1%)

1. Mobility:

1. Intra-Freq HO (Inter eNodeB) (>99%)

2. Intra-Freq HO (Intra eNodeB) (>99%)

3. Inter-Freq HO (Inter eNodeB) (>99%)

4. Inter-Freq HO (Intra eNodeB) (>99%)

5. Inter RAT HO out (LTE to WCDMA) (>99%)

6. Inter RAT HO out (LTE to GSM) (>99%) if deployed

1. Availability:
2. System Availability Time [%] (>99.999%)
3. Traffic:

1. Radio Bearer (QCI’s)

2. Average User Number

3. Maximum User Number

4. UL Traffic Volume [MB]

5. DL Traffic Volume [MB]

1. KQI Acceptance:

DL RTX (%)

UL RTX (%)

DL RTT[ms]

1. Vendor shall ensure that the activities related to the new project will not impact the current 2G or 3G or LTE KPI's
2. For P1 (Critical/Emergency) incidents, response time 1 hour, restoration time 3 hours, and resolution time 6 hours.
3. For P2 (Major) incidents, response time 3 hour, restoration time 6 hours, and resolution time 24 hours.
4. For P3 (Non Service Impacting) incidents, restoration time 24 hours, and resolution time 5 calendar days.
5. For P4 incidents, restoration time 48 hours.
6. The availability of the Base Station should be higher than 99.999%, the MTBF should be larger than 155,000 hours.

**Implementation time line, setup, civil & power**

1. The PIP time line is completed with the minimum amount of time taking into consideration the latest possible start and finish times for project activities, the uncertainties, the risks and assumptions.
2. The vendor’s Implementation proposal should cover but not limited to the following: installation, configuration, integration, interoperability,…
3. The vendor will assign a single POC/PM that should be aware of deadlines and resource availability issues.
4. Equipment delivery time shall be less than 60 days from PO issuance
5. Proposal includes satisfactory minimum number of resources with their qualifications & proposed organization structure, which is subject to MIC2 approval
6. Proposal includes acceptable level of resource competence needed for the execution of the project (30% of the all contractor and their subcontractors teams are engineers with minimum 2 years experience in similar projects).
7. 40% of Optimization Teams needs to have a minimum of 2 years of 3G/4G practical optimization experience.

**Security level and data protection**

1. The BTS should support encryption protection for both signaling data and user data between the eNodeB and the UE. The 3GPP TS36.331 supports three types of ciphering protection, EIA1 (SNOW3G), EIA2 (AES) and ZUC. The vendor should comply with these security mechanisms in the 3GPP specifications.
2. The Base station should support IPsec mechanism to protect, authenticate, and encrypt data flow for necessary security between two network entities at the IP layer of IPv4/IPv6 network.
3. IP sec is needed for all traffic: control plane (S1-MME) and user plane S1-U in addition to the X2 & OAM traffic. VoLTE traffic in particular need to be secured through IPsec. The BTS shall be able to create separate tunnels (one IPsec tunnel for S1 traffic, another IPsec tunnel for X2 traffic and one other IPsec tunnel for OAM traffic. X2 traffic need to be separately secured and terminated using a demarcation point (pre-aggregation router) close to the BTS.
4. The following protocol and encryption methods are required:

a. Encapsulation modes: transport mode and channel mode.

b. Security protocols: Authentication Header (AH) and Encapsulation Security Payload (ESP).

c. Main encryption methods: NULL, Data Encryption Standard (DES), Triple Data Encryption Standard (3DES), and Advanced Encryption Standard (AES).

d. Integrity protection methods: HMAC\_SHA-1 and HMAC\_MD5, where HMAC stands for Hash Message Authentication Code, SHA stands for Secure Hash Algorithm, and MD5 stands for Message Digest 5.

1. The Base station should support authentication to the transport network using 802.1x (Port-Based Network Access Control), which provides digital certificate authentication between BTS and LAN-Switch, improving security in network domain.
2. The Base station should support PKI (Public Key infrastructure), which could be a framework to support certificate authentication which is applied to IPsec Tunnel between BTS and security gateway, and SSL channel between BTS and NMS.
3. The Base station should guarantee the wireless transmission network traffic security, which means that signaling in control plane and O&M, traffic in user plane should be encrypted.
4. The Base station should support the Virtual Local Area Network (VLAN) complying with the IEEE 802.1p/q protocol, and provides traffic isolation, traffic differentiation, manage data priority and security scheduling at the MAC layer.
5. The Base station should support Access Control List (ACL) on both Layer2 & Layer3. The proposed BTS should provide packages filtering based on Access Control List to prevent some attacks.
6. The Base station should support Security Socket Layer (SSL) which is a layer between the TCP layer and the O&M application layer. SSL provides the secured data transfer function between the BTS and the O&M server.

**Support ,  Maintenance & Spare Parts & Training**

1. Spare Parts (10%)

Quantities and Details

1. Free of Charge 3 years premium support and maintenance /warranty. Notably, the warranty period starts after minimally 30% of total sites’ PAC issuance by MIC2, conditional to the completion of the complete project as per the set deadline in the RFP.
2. The vendor shall provide a quotation of additional 2 years support services
3. The vendor shall provide free SW upgrades to the last SW during the period of 3 years
4. Service verification after upgrade.
5. Automatic rollback to previous software version.
6. Automatic Inventory.
7. eMBMS : eMBMS solution should be supported. The vendor should provide a detailed solution description indicating all related requirements.
8. Vendor should be responsible for any damage/ inconveniences caused by subcontractor.
9. The vendor should ensure that the supplied material is new and of high quality.
10. The vendor is responsible for any defects on equipment due to manufacturing or damages caused during storing or installation and should replace at his own cost.
11. Repair and return is the responsibility of the vendor during the warranty period and provided as a service after the end of warranty period.
12. Repair and return should meet the SLA to be set by MIC2
13. As part of the support services, a local team should be available for emergency and critical problems resolution and follow up.
14. Emergency means critical and acute operating situation which already caused, or has the potential to cause, considerable and not even temporarily-tolerable service and management restriction.
15. Supported optimization functions should include the following based on ongoing live measurements:

a. Coverage Analysis

b. Performance Analysis

c. Terminal Analysis

d. VIP Analysis

e. Complaint Analysis

f. Geographical Analysis

1. Analyses can be aggregated on different levels (static & conditional cell-clusters/VIP groups/terminal types, etc.) with a history of at least 3 months.
2. Drive testing. Vendor should ensure that the logfiles are readbale by Touch's available post processing tool or should provide suitable post processing tool at his own cost.
3. Tools should provide cause analysis and solutions.
4. Capability for MIC2 to report a failure to the regional Vendor Technical Assistance Center through the Helpdesk service hotline
5. The Vendor technical engineers should be able to provide fault diagnosis, troubleshooting and non-fault enquiry concerning the  Vendor equipment within the committed time through telephone support, remote access or on-site support
6. Reported problem should be addressed on a priority basis, and should be quickly and competently responded and resolved within a defined SLA.  The  Vendor should remain in contact with MIC2 until the problem has been fully resolved.
7. Emergency Recovery Service requires a round-the-clock recovery service provided by the Vendor during the emergency situation. Its purpose is to respond to MIC2 and recover the system quickly within the defined SLA, so as to resume the service operation and reduce the economic loss and risks of MIC2
8. Emergency On-site Service requires from the  vendor engineer to perform on-site visits, irrespectively whether required by MIC2 or recommended by the Vendors
9. Software Update Services requires the vendor to provide and install the software update packs (including correction patches and enhancements to basic performance free of charge). In case faulty unit is non-repairable or beyond economical repair, the Vendor shall contact MIC2 to obtain approval to scrap the faulty unit and replace with good unit at no cost to MIC2
10. Hardware Support Service and repair should include but not limited to standard in-factory repair of faulty parts. Upon receipt by HQ Spare Part Centre of the vendor, the faulty parts are repaired and returned to MIC2 within a predefined TAT (Turn Around Time ) according to the SLA.
11. Proposal should include Training contents, Details, Training center
12. The vendor shall provide technical training abroad for 12 Engineers. Travel expenses will be covered by the bidder
13. The vendor shall provide technical training on site for max number of Trainees
14. Knowledge Transfer

**References, Field proven, geographical preference**

1. Vendor needs to provide Commercial references in different countries/operators for LTE-FDD deployments along with the related contact information
2. Vendor needs to provide Commercial references in different countries/operators for carrier aggregation deployments using 800/900/1800/2100 MHz bands along with the related contact information
3. Vendor needs to provide Commercial references in different countries/operators for VoLTE & eSRVCC deployments along with the related contact information

**Interoperability**

1. The Vendor should have an abundant interoperability tests (IOT) experience with other vendors’ BSC/RNC/NodeB/EPC/eNodeB/terminal devices. The Vendor should provide references with other vendors in LTE commercial networks to guarantee IOT quality.
2. Vendor(s) should ensure that the equipment has free of charge & smooth interoperability between existing & new systems and equipments, by opening the parameters of integration interface, etc...
3. The interoperability performance on the CSFB/eSRVCC between different vendors