Network Audit and Optimisation

Achieving leading edge performance while ensuring best possible utilisation of investments

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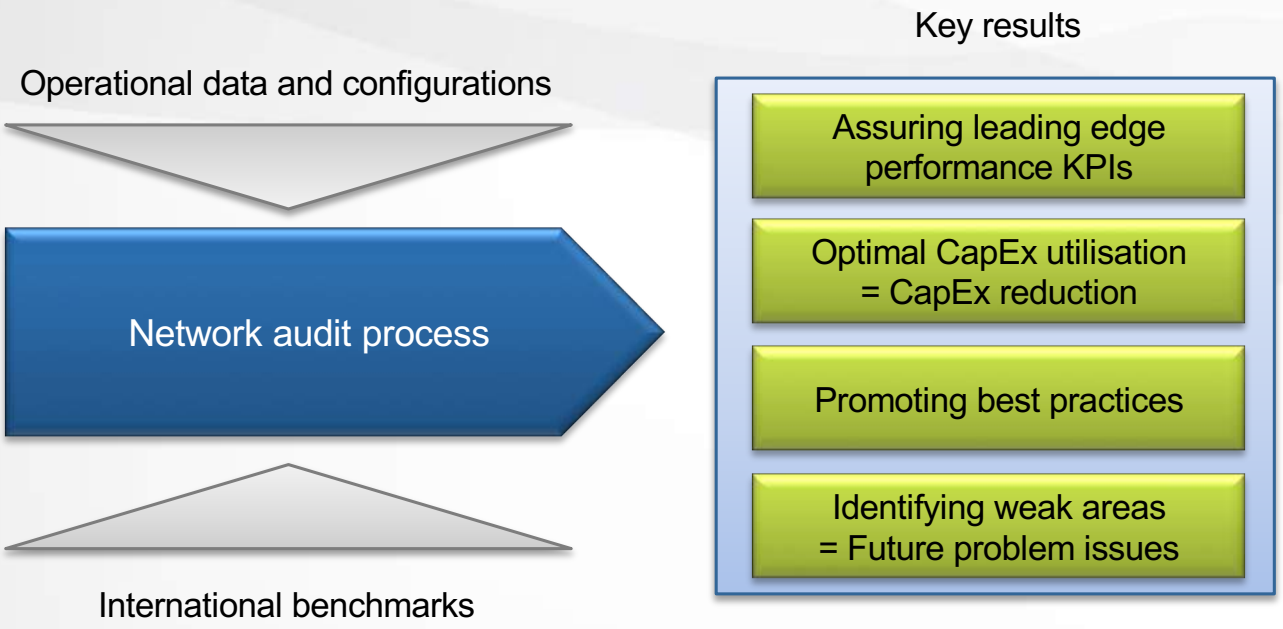
The key objectives of the network audit

Regular technical audits of mobile network operations will assure best possible utilisation of network investments as well as providing a basis for tuning and optimisation which ensures performance KPIs in accordance with leading benchmarks.



- The key objective is to ensure optimal CapEx utilisation while at the same ensuring leading edge performance
- This translates into improved customer satisfaction (impacting revenue and market share), while keeping tight control of CapEx. Significant CapEx reductions are often possible.

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Introduction

Network Audits, Scope & Methodology

How we can help

Project examples and references

Our company

RAN audit – Detailed scope of work

The table below provides a top level overview of how we see the original scope mapped against tasks and networks/services included in the audit.

SOW

- Design process
- Configuration
- Performance
- Configuration/ performance

	2G	3G	4G
RF Design	900/1800/1900 MHz	2100 MHz	700/2100// 2500 MHz
RAN Design	BTS / BSS	RAN	eRAN
GPRS / EDGE, HSPA, LTE Design	GPRS / EDGE	HSPA+	LTE
Features & Parameters review	Spectrum efficiency	Data speeds	Multiband VoLTE
KPI Review	CSSR CDR HOSR	SHO, IRAT	RSRP, RSRQ
Capacity Planning	Channel Allocation	Throughput	Multiband
Drive tests & site inspections	Voice C/I-C/A	Quality Data	Throughput/quality data VoLTE quality (if used)
Issues identification and solutions	Final analysis and reporting	Final analysis and reporting	Final analysis and reporting

RF Design

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Overview of RF design audit, data sources & tools, additional (optional) tools.

- RF Design
- RAN Design
- GPRS / EDGE, HSPA, LTE ? Design
- Features & Parameters review
- KPI Review
- Capacity Planning
- Drive tests & site inspections

2G	3G	4G	Tools / Client	Additional tools (NGP)
Review site locations relative to clutter and terrain			Site DB	Metricell, visualisation of key information.
Site-to-site distances relative to Link Budget in various clutter types, sector orientation and tilts			Planning tools	
Suitability of site types (macro, micro, distributed RRU, etc.) versus clutter type and traffic			Vector data	
Link Budgets for various site configurations, Re-use schemes (ad-hoc, BCCH vs. TCH, SFH...), frequency planning (+MAIO and other parameters)			Mapping data	
Micro, Macro, Repeater, Outdoor and Indoor design				
Antennas (types heights, azimuths, tilts), high/low sites, various abnormalities				
Neighbouring plan audit (mutual, one-way, parameter conflicts etc.) Each technology plus inter-technology				

RAN Design

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Overview of RAN design audit, data sources & tools, additional (optional) tools.

- RF Design
- **RAN Design**
- GPRS / EDGE, HSPA, LTE ? Design
- Features & Parameters review
- KPI Review
- Capacity Planning
- Drive tests & site inspections

2G	3G	4G	Tools / Client	Additional tools (NGP)
Channel / TRX configs, etc.	NodeB configs	eNodeB configs	OSS data	
Indoor solutions strategies				Metricell visualization of traffic data geographically
Voice strategies				
Multiband /multi-carrier strategy				
BSC, BSC Load Transcoder & PCU review	RNC design review	MIMO design review		
LAC & RAC Design	LAC & RAC Design	TA design	Prediction Tools	Metricell visualisation of data
Review network traffic (call profiles, etc.) Review planning and dimensioning process			OSS Data	Metricell, traffic distribution

GPRS/EDGE, HSPA, LTE

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Overview of GPRS/EDGE, HSPA, LTE design audit, data sources & tools, additional (optional) tools.

- RF Design
- RAN Design
- **GPRS / EDGE, HSPA, LTE, VoLTE Design**
- Features & Parameters review
- KPI Review
- Capacity Planning
- Drive tests & site inspections

2G	3G	4G
EGPRS dimensioning review: (e.g. cell level dimensioning for EGPRS data, min/max PDCH setting, and other parameter setting for dynamic PDCH) BCCH strategy for PDCH, multislot, voice vs. data	HSDPA dimensioning review, e.g. cell level definitions for HSPA data (HSDPA Power, HS-DSCH Codes, HS-SCCH, Iub Bandwidth, etc.)	MIMO Settings, Carrier Aggregation, Band width, RS Settings and powers, DRS/DMRS planning, PRACH/RSI Review, PCI Review. VoLTE optimisation
EGPRS Parameter Settings: Fixed / Dynamic PDCH, Dynamic Abis, Modulation schemes, Link Adaptation, Incremental Redudancy/Resegmentation, Extended TBF, NACC, PSI…	Parameter Settings: Dynamic Power/Codes allocation, Scheduling algorithm, CQI Table .	PDCCH Dimensioning and planning, PUCCH Planning, TA Planning, RSRP and RSRQ/SINR design levels.

Tools / Client	Additional tools (NGP)
Network info, OSS Data	
Network Settings	

Parameters & Features review

Overview of Features & Parameters review, data sources & tools, additional (optional) tools.

- RF Design
- RAN Design
- GPRS / EDGE, HSPA, LTE ? Design
- **Features & Parameters review**
- KPI Review
- Capacity Planning
- Drive tests & site inspections

2G	3G	4G
Review BSS parameter values		Review of e-NodeB parameter templates
Review consistency of parameters		
Review active/inactive features		
Review MSC parameters (Paging, Authentication, Ciphering, Security, Identity Check, etc.)		Review of MG and MME parameters. VoITE parameter setting
Review multistandard features (traffic shifting, distribution)		

Tools / Client	Additional tools (NGP)
OSS Data	Metricell visualisation of key parameter consistency
Network Data base	
Drivetest data	

KPI review

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Overview of KPI review, data sources & tools, additional (optional) tools.

- RF Design
- RAN Design
- GPRS / EDGE, HSPA, LTE ? Design
- Features & Parameters review
- **KPI Review**
- Capacity Planning
- Drive tests & site inspections

2G	3G	4G
Top Down Approach: Network level, RNC / BSC levels, group of cells level, Top worse cells, etc.		
Accessibility, retainability, mobility, integrity, availability, throughput		
Identify failure causes (Congestion, System, Transmission, Radio)		
Correlate with parameters, RF & RAN e-RAN designs, Drive-Tests, other KPI, alarms		
	Analysis for CS, PS, HSPA	Analysis for VoIP, CSFB, Throughput vs bandwidth.VoLTE
Benchmark(global commonly used/useful/missing)		

Tools / Client	Additional tools (NGP)
OSS	Metricell visualisation of performance data
Statistical tools	
Call traces	
Probes if available and suitable	
Drivetest data/Tools	

Capacity planning

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Overview of Capacity planning review, data sources & tools, additional (optional) tools.

- RF Design
- RAN Design
- GPRS / EDGE, HSPA, LTE ? Design
- Features & Parameters review
- KPI Review
- **Capacity Planning**
- Drive tests & site inspections

2G	3G	4G	Tools / Client	Additional tools (NGP)
Analyse existing traffic model, call profiles			OSS/Traffic Data	Metricell KPI visualisation
New Traffic Model: Propose new traffic model/mix based on call profiles				
Dimensioning	Correlation of UL Carried traffic with RTWP	Cell Dominance		
Channel allocation	Identify CE licenses re-balancing opportunities	PDCCH dimensioning and allocation		
	Bearer Optimisation			
Identify traffic re-balancing opportunities between cells Analysis of Traffic pattern, traffic trend analysis, identification of potential short and medium term bottlenecks				

Drive tests and site inspections

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Overview of Drive Test process / site inspections, data sources & tools, additional (optional) tool

- RF Design
- RAN Design
- GPRS / EDGE, HSPA, LTE ? Design
- Features & Parameters review
- KPI Review
- Capacity Planning
- **Drive tests & site inspections**

2G	3G	4G	Tools / Client	Additional tools (NGP)
Identify areas of deficient coverage			TEMS or similar	Metricell Automobile
Identify areas of non dominant server			Tools for identification of crossed Sectors (Features)	
Identify areas of high overlap between cells				
Identify crossed sectors				
Identify overshooting cells				
Identify missing neighbours Verify impact of parameter settings				
GPRS/EGPRS throughput	HSPA throughput	LTE/LTE-A throughput, VoLTE testing		

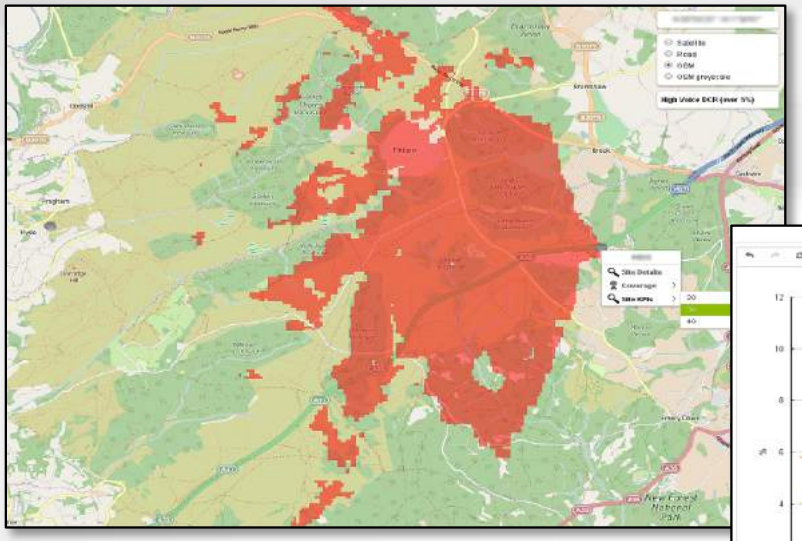
Usage of optional tool

NGP have access to powerful visualisation tools which can be used to visualise various network and performance data serving as basis for further analysis.

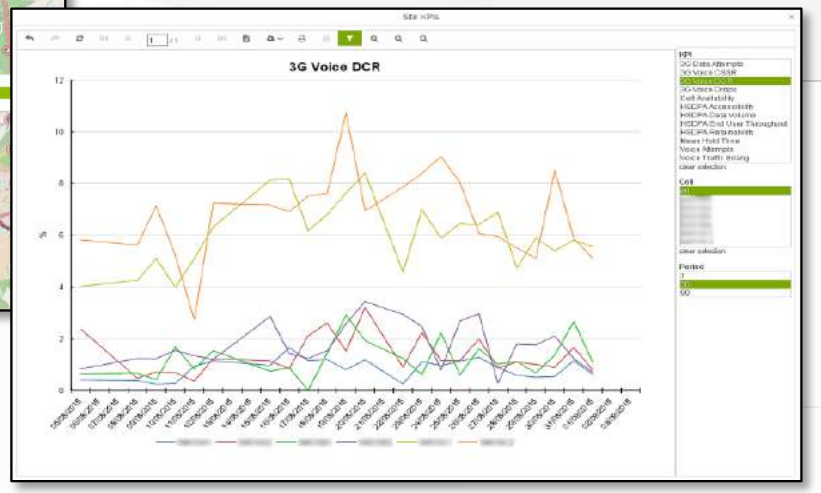
- Business Intelligence and visualisation tools collect data from OSS and can be presented in very efficient and useful ways. It provides the main functionality for performing the root cause analysis and investigation and troubleshooting
- Several layers of information can be viewed simultaneously providing valuable insight to analysis

Output examples from optional tool

Examples of visualisation output from Metricell tools*



Areas with 3G Dropped Call Rate >5% and failing cells highlighted with graph data.



* NGP is a partner of Metricell.

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Network Audits, Scope & Methodology

How we can help

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Network Audit – Service offerings

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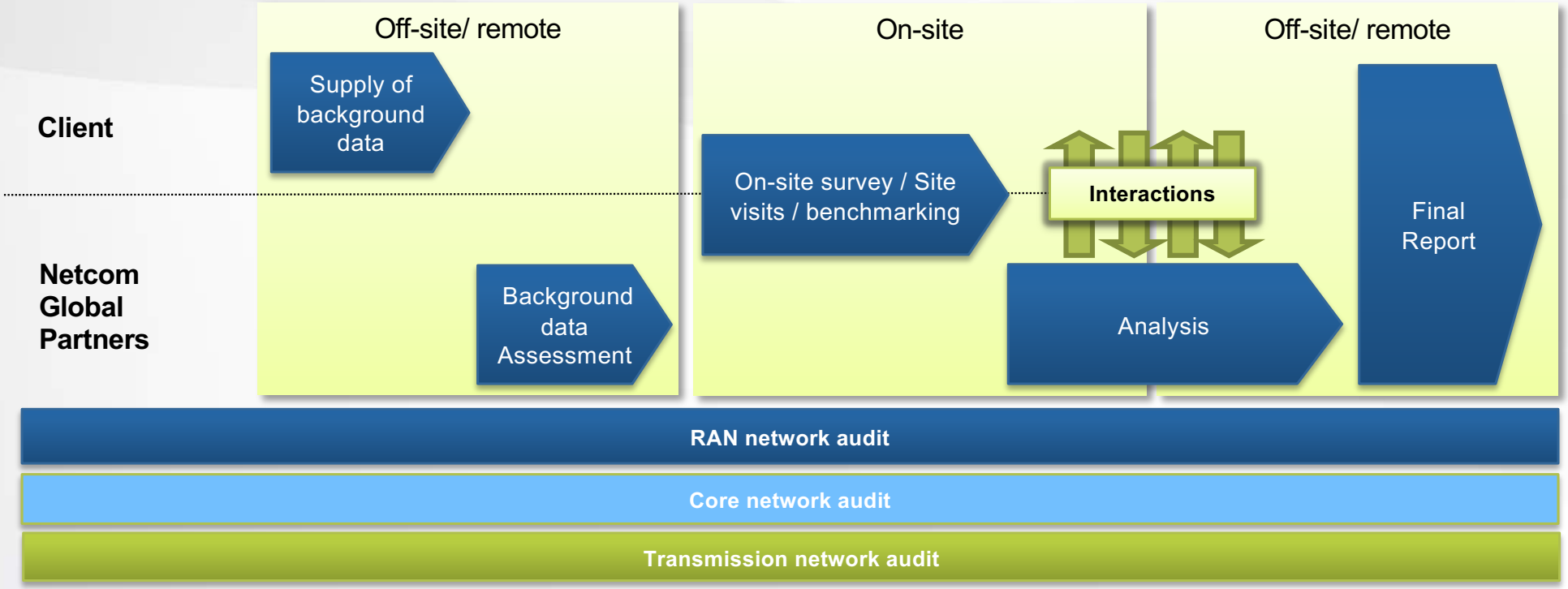
As a specialised provider, we undertake technical audits of mobile network operations (RAN, core and transmission) based on well established processes and tools, supported by global benchmarks.

RAN	Core	Transmission	CapEx KPI Review
• GSM, UMTS, LTE • Review of network design process • Review of network configuration • Utilization • Physical audit on sample sites • Review of network performance • Identification of issues, recommendations & related action plans • Counters and Statistics • Features, Alarms • Testing of a selection from the recommendation. • Link budgets, Interference	• MSC, MSS, MGW, SGW. PGW, HLR, IN, VAS VoLTE and interfaces • Network diagrams • Nodes & platforms configurations • Core CS PS KPIs • IN&VAS KPIs • IN & Core CDRs • Core Network Design rules and processes • Call Profiles • Processes (planning, optimization, growth)	• Network topology SDH / PDH / ATM / Fiber/ Ethernet / Leased Lines • Interconnections to other networks etc. • Network Management Systems • Transmission KPIs • Transmission Design rules and processes • Connectivity and topology analysis • Sync audit • SDH network - Protection / Capacity / Resilience	• Compares capex metrics to size of operation and network quality metrics • It is an independent review, but may also serve as basis (decision criteria) for a wider Capex Governance project to be considered as next step

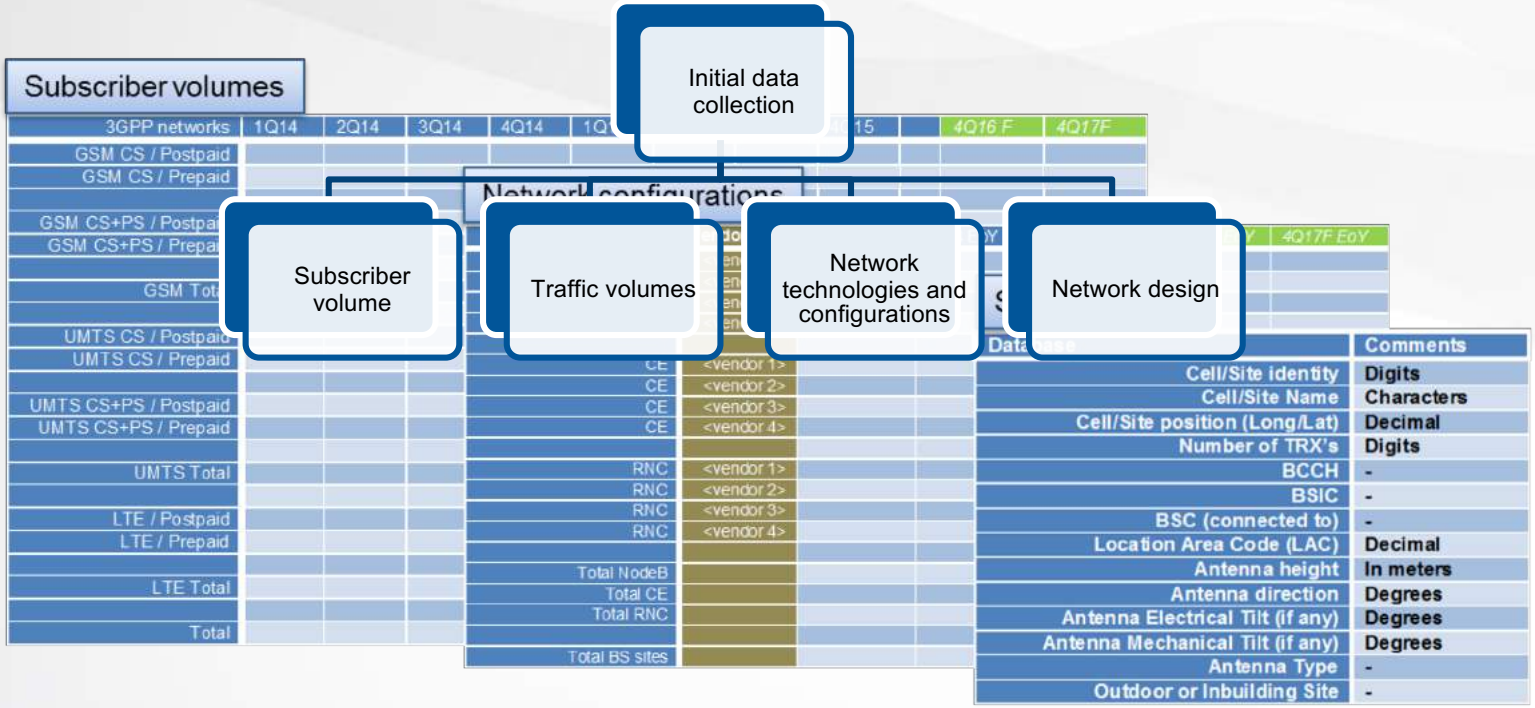
Project process overview – Example

Each of the sub-audits (RAN, Core, Transmission, CapEx KPI), are typically conducted in parallel as a combination of on-site and off-site (remote) activities.



Data collection process – Initial Questionnaires

A defined set of questionnaires for initial data collection will be sent to the operator/client as a first step of the project (normally immediately after contract signature).



- The questionnaires are tested in multiple projects and ensure the most effective and efficient communication between operating staff and the audit team
- They assist the client in preparing information so that audit team can have material ready to start work immediately upon arrival onsite
- Some analysis can start before arrival on site

Project scope / RAN audit - Example

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Method / Scope	Data Collection	Network design and KPI analysis, 2G, 3G, LTE	Analysis of identified issues	Conclusions
Sources	• Site/Parameters databases • Counters and statistics • MRR/RMS, U2000 etc • Features • Alarms • Drive-Tests etc.	• RF& BSS KPIs • RF& BSS Design rules and processes • QoS for Voice • QoS for Data (Ping, RTT etc)	• Identified issues affecting Network Quality	
Activities	• Collect network data	• RF Design review • BSS Design review (Dual Band, micro/macro strategy) • Design Levels • KPI correlation and evolution • Call Profiles • VoLTE parameters and settings • Processes (planning, optimization, evolution)	• Detailed Issues Analysis: Availability, Coverage, Quality, Capacity, Efficiency, Others • Top Down Analysis: City, MSC, BSC/RNC, BTS's, Node-B, e-NodeB, Cell Clusters etc. • Top Issues	• Action plan to resolve identified issues with weight on customer impact, relevance and potential investments required.
Tools / Templates	• Input Questionnaire	• Excel/Access • MAPINFO • Planning Tool (operator side) • Visualisation tool (*) (*) NGP standard tool from Metricell or other tools provided by client	• Tools available in the network (traces, analyzers, vendors tools,…)	• Detailed Radio Audit Report template • Word / Power Point

Recommended action list

We will analyse and present all recommendations in order of priority.

Clasification	Description
Critical	Red: Business Critical - Immediate Action Required
Important, but non-critical	Orange: areas for improvement, non- critical, but should be resolved quickly
Desired improvement	Yellow: areas for improvement, non-critical, low priority - Will Improve quality and/or promote best practices.

#	Recommendations	Reason / Problem addressed	Priority / classification
			Critical
			Important, but non-critical
			Desired improvement

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Network Audit experience

NGP has extensive experience of network audits and similar projects through the experience and benchmarks collected by its partners world wide over more than 15 years.

RAN Audits, Operator in Middle Eastern country

- RAN audit and optimisation of leading operator Network, improving all relevant KPI's resulting in increased revenue and improved customer experience

RAN Audits, India

- Working on behalf of a large Global operator, performing RAN Audits in almost all circles of India over a number of years.

Various Network Audits, Global Operator, Asia, Africa and Latin America

- Repetitive audit processes covering all networks of the group during several years, reducing CapEx, improving peformance and promoting best practices through extensive work with both internal and external benchmarks and KPI's.

Network audit, Operator in Eastern European country.

- Technical audit of a leading operator, identifying key network issues as basis for a consideration of future investment requirements.

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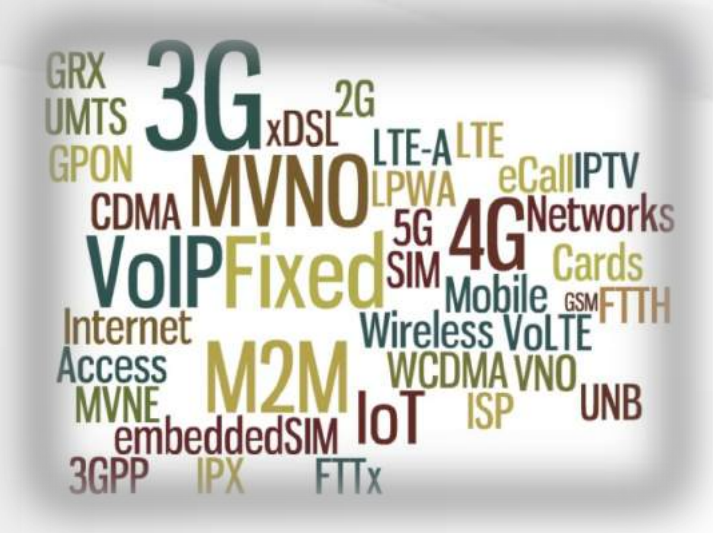
Our company

NGP is a global consultancy providing telecommunications sector clients expert advice and support on strategy, technology, operational and other issues, enabling clients to profitably compete and grow their businesses.

- The collective telecom expertise of our team of advisors, all specialists in their field, sets us apart as consulting partner to progressive telecom companies worldwide
- Our teams are engaged in projects worldwide, mostly in Scandinavia, Europe, Asia, Africa and Latin America.
- The global reach of our partnership creates the foundation for an international perspective and cross-cultural understanding of market and organisational issues
- As a strongly focused consultancy, with an in-depth understanding of our niche market, Netcom Global Partners is a responsive and flexible partner for the most demanding clients

Service overview

Based on our extensive experience in design, deployment and operation of telecommunications services, we help clients converting business ideas and technologies into successful products and services.



Market and business planning

- Providing effective market strategies and business plans

Network sharing, interconnection and regulatory related issues

- Providing expert advisory services in connection with network sharing opportunities, licence award processes, spectrum auctions, interconnection and access, and other regulatory issues.

Network planning, design and deployment

- Supporting procurement and deployment of networks, systems and infrastructure
- Network planning and design, review/audit and optimisation

Service development & product management

- Managing development and launch of innovative and profitable services

Organisation and operations

- Assisting telecommunications operators in improving operational performance and efficiency

Our expertise and capabilities

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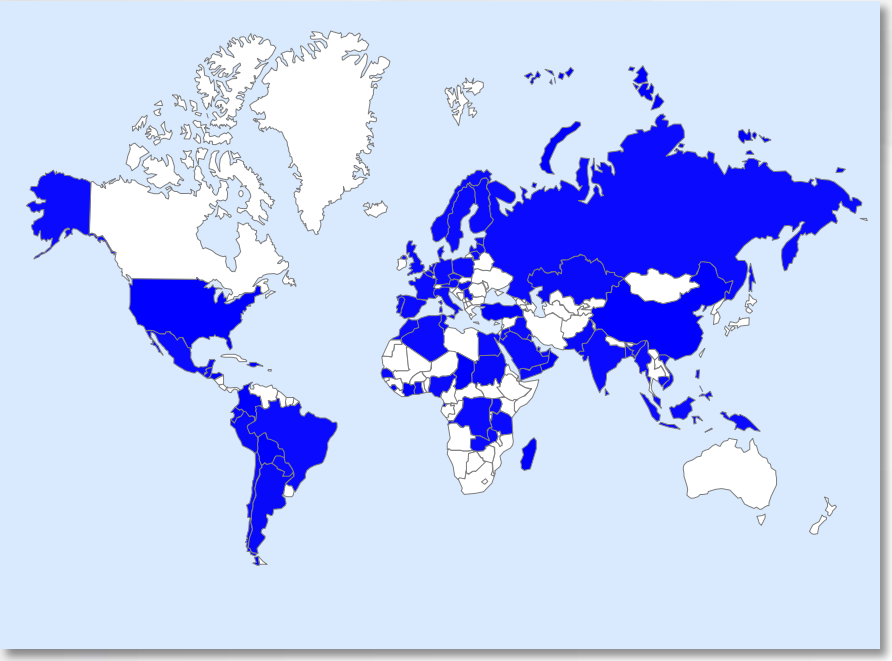
We provide advisory and management expertise in planning, design, deployment and operation of telecom networks and services.

Some project examples:

- Operational reviews and audits
- Market opportunity evaluations
- Network planning and design
- Managed Services feasibility reviews
- Indoor coverage solutions
- Network consolidation strategy definition
- Market entry consultancy services for mobile operators and service providers
- License acquisition support / spectrum valuation
- Interconnection, access and wholesale agreements
- Roaming and clearing audits - commercial and technical
- Regulatory, standardisation issues, network numbering
- Number portability implementations (mobile/fixed)
- Fibre rollout, fibre unbundling and fibre sharing and access
- M2M/IoT technologies, solutions and concepts
- Operational KPI benchmarking Service feasibility studies
- Customer Experience management
- Project portfolio and governance strategy
- Project Management Office (PMO) implementation
- Management of service launch and transition projects. Some recent examples: VoLTE, MVNO
- Network procurement RAN, Core
- Project management of mobile and fixed broadband network roll-out
- IMS Migration projects
- Power solutions, “Green Connectivity”
- Commercial and technical due diligence
- Tower, Network and Infrastructure Sharing agreements and implementation

Our global experience

Our partners, coming from leading telecom operators, vendors and consultancies, bring experience from work with clients in a wide range of countries and regions with different market and regulatory conditions.



Some clients our partners have worked for:

- Amara Communications
- Axiata
- Bell Canada
- Batelco
- CellularOne
- Canadian Imperial Bank of Commerce
- Digicel
- Du
- Emtel
- Ericsson
- FarEasTone
- Hi3G / 3
- 3GIS
- ICE / Net1
- Intelig, Brazil
- Meteor
- Mobifone
- Mobtel
- Nokia Networks
- Orange / Getesa
- Orange / Jordan
- Orange /Switzerland
- Umniah / Jordan
- Orascom Telecom (now Global Telecom Holding / Vimpelcom)
- Ooredoo Group
- OnePhone
- Sabafon
- SmarTone
- Smart Philippines
- Sumitomo Group
- Swedish Post and Telecom Authority
- TAL
- TDC
- Telefonica
- Tele2
- Telenor
- TeliaSonera
- Telkomsel
- Teracom
- T-Mobile / Germany
- T-Mobile /Poland
- Tigo / Millicom
- TIM Brazil
- Turkcell
- Viettel
- Vivendi
- Vinaphone
- VMS
- Vodafone
- Alcatel
- Huawei
- ZTE

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Netcom Global Partners Pte Ltd
10 Anson Road
#14-01 International Plaza
Singapore 079903