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SERIES E: OVERALL NETWORK OPERATION, TELEPHONE SERVICE, SERVICE OPERATION AND HUMAN FACTORS

Quality of telecommunication services: concepts, models, objectives and dependability planning – Use of quality of service objectives for planning of telecommunication networks

Defining operations competency metrics

ITU-T Recommendation E.861

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Defining operations competency metrics

Summary

Improving network and service operations quality and efficiency to significantly reduce cost has become a business imperative for telecommunications service providers worldwide. However, one needs objective metrics by which to measure operations quality and efficiency and to facilitate comparison of them among service providers. This Recommendation describes a set of metrics called Total Operations Competency (TOC) metrics that are designed to cover a comprehensive view of network and services operations. Although each metric is useful on its own, metrics can also be combined to construct quantitative indicators for high-level business objectives. These indicators, in conjunction with cost functions for metrics improvements, can be used to formulate a rich set of optimization problems pertinent to operations.

Source

ITU-T Recommendation E.861 was approved on 13 February 2006 by ITU-T Study Group 2 (2005-2008) under the ITU-T Recommendation A.8 procedure.

FOREWORD

The International Telecommunication Union (ITU) is the United Nations specialized agency in the field of telecommunications. The ITU Telecommunication Standardization Sector (ITU-T) is a permanent organ of ITU. ITU-T is responsible for studying technical, operating and tariff questions and issuing Recommendations on them with a view to standardizing telecommunications on a worldwide basis.

The World Telecommunication Standardization Assembly (WTSA), which meets every four years, establishes the topics for study by the ITU-T study groups which, in turn, produce Recommendations on these topics.

The approval of ITU-T Recommendations is covered by the procedure laid down in WTSA Resolution 1.

In some areas of information technology which fall within ITU-T's purview, the necessary standards are prepared on a collaborative basis with ISO and IEC.

NOTE

In this Recommendation, the expression "Administration" is used for conciseness to indicate both a telecommunication administration and a recognized operating agency.

Compliance with this Recommendation is voluntary. However, the Recommendation may contain certain mandatory provisions (to ensure e.g. interoperability or applicability) and compliance with the Recommendation is achieved when all of these mandatory provisions are met. The words "shall" or some other obligatory language such as "must" and the negative equivalents are used to express requirements. The use of such words does not suggest that compliance with the Recommendation is required of any party.

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As of the date of approval of this Recommendation, ITU had not received notice of intellectual property, protected by patents, which may be required to implement this Recommendation. However, implementors are cautioned that this may not represent the latest information and are therefore strongly urged to consult the TSB patent database.

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1 Scope

1.1 Overview

Ensuring and maintaining an optimal operations environment is critical to any service provider's (SP) business. Current industry conditions and complex business needs, however, pose formidable challenges in their ability to do so. Rapid changes and deployments of new technologies and services in recent years, along with budget and staff cutbacks, have strained the SP's permanent operations staff, resulting in:

- Poor operations planning for new technologies and services;
- OS infrastructures unable to keep up with new technologies and services;
- Less than optimal operations processes, which are unable to respond to customer's demands (e.g., long service-provisioning cycle time);
- Under-utilized network capacity or unnecessary capital expenses; and
- Escalating operations expenses.

To start addressing these challenges, service providers are seeking capabilities and/or resources to analyse, optimize and/or outsource their operations as well as searching for critical benchmarks or standards to plan and measure their operational improvements.

A plethora of metrics and benchmarks in multiple dimensions and categories already exists in the industry today. Service providers (SPs) regularly report their "performance" in different areas to different stakeholders using a variety of parameters and venues. For example, they share their business and financial performance data with the investment community, their compliance-related performance data with government/regulatory bodies and their network and service-related performance (e.g., SLAs) data with customers/users. In addition, they have numerous internal metrics they use to monitor and manage their own internal operations. However, when it comes to measuring, analysing and understanding the "performance" of any given "network operations"[1] work group or work centre, it is difficult to point to a standard set of metrics and benchmarks as representing the "best in class" measures. A set of such "Best in Class" metrics, along with target values and an understanding of the forces impacting the results, will enable a service provider to fine-tune their network operations and quickly quantify the impact of any changes in modes of operation, such as potential cost reductions or customer satisfaction.

1.2 Metrics framework and business value

A variety of operations metrics exists in the industry. Service providers routinely monitor, collect and analyse metrics associated with their internal operations functions, processes and work centres. These are generally custom-defined for specific internal use at corporate or group levels. Many of them are used to "roll up" into higher-level measurements related to customer SLAs, organization objectives, costs, customer satisfaction, etc. Currently, there is no specific set or sets of "operations metrics" that one can point to as an industry standard set.

A review of the different standards organizations and industry forums activities reveals that although there is a need and desire to establish a standardized set of "operations metrics", minimal

[1] In this Recommendation, the term "network operations" is intended to cover both the network and the service operations functions.

progress has been made. In key influential industry forums, there is some definition activity in progress but not at the operations function/task level.

A fundamental construct underlying the "operations metrics" is that they can be viewed as building blocks that can be used individually or in combination to measure or assess a broader functional area of an operations environment. For example, to determine the "efficiency" of a Network Operations Centre (NOC), one can measure "efficiency" of different processes and tasks performed in a NOC, assign different weights to them and calculate the "NOC efficiency". The individual process/task metrics would be the building blocks. Here the complexity lies in determining the critical processes and tasks that should be included in the calculation, the weighting to be applied and the measurements to be collected. There will be different measurement values for different technologies, product types, locations, etc. depending on the service provider's network type and types of services carried on them. As networks evolve with new technologies and services, the number and variety of metrics grow and as business priorities change with market conditions, different aspects of business operations and operations metrics become critical. It is clear that to identify a "meaningful" set of metrics they need to be associated with some meaningful set of "business drivers" or "business needs". Hence, we see some of the efforts in industry forums focused on identifying the "Key Business Objectives (KBOs)" followed by identifying supporting "Key Performance Objectives (KPOs)" (see ITU-T Rec. E.419).

Numerous private and public enterprises, worldwide, have adopted and continue to adopt a performance measurement framework called the "Balanced Score Card (BSC)"[2] system. This framework employs performance metrics from financial, customer, and business processes and technology perspectives and helps managers understand the interrelationships and trade-offs between alternative performance dimensions and business values or objectives. The three key performance dimensions that represent "**business value**" are: "**results** (financial and customer)", "business **operations**" (which include processes, innovation, learning, etc.) and "organization **capacity**"[3]. A key consideration in identifying and defining Total Operation Confidence/Competency (TOC) metrics is that of linkages to service provider "business values". The TOC metrics are a subset of what would be covered by a BSC framework and by definition focus only on "operations" and operations related to "results" and "capacity" dimensions of business values. The remaining aspects are covered by other related efforts.

2 Terms and definitions

This Recommendation defines the following terms:

2.1 **metric**: A standard of measurement.

2.2 **operations metrics**: A set of metrics/gauges that measure characteristics such as quality, competency, efficiency, productivity, etc. of a service provider's "network and service operations" functions. These characteristics are often referred to as "operations performance" throughout this Recommendation.

2.3 **TOC metrics**: "Total Operations Confidence/Competency" (TOC) metrics – A set of operations metrics identified and defined through technical expertise and operations insights. TOC Metrics are **not** measurements of the health or performance (e.g., network reliability) of a network or performance services supported (e.g., packet loss) on the networks.

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[2] Balanced Score Card is a performance measurement framework by Kaplan & Norton, adopted by numerous private and public enterprises.

[3] Developing & Using Balance Score Card – Perform, Volume 2, Issue 2, Howard Rohm.

2.4 metric value: An actual data point for a metric. Example: "Mean Time to Respond (MTTR) for a given Service Provider's FR service" or "percentage of automation of a given SP's wireless provisioning".

2.5 best-in-class value: The reference value for a particular metric, determined as the highest value in the available data (or lowest, depending on which direction is "best" for a particular metric). This value will vary depending on the subset of data being reviewed, for example, the best-in-class for MTTR for POTS will be different for NAR than APAC, and will be different for ATM than POTS.)

2.6 benchmark: A statistically or qualitatively determined reference value. The determination of benchmark values requires large sample sizes and mathematical determination of confidence levels. Since necessary sample size will not be available in this phase of the project, only metric values or best-in-class reference values, where available, will be included.

3 Abbreviations

This Recommendation uses the following abbreviations:

3G	Third Generation
3G1X	Third Generation-One Carrier
3rd Party	Third Party Vendor (normally relates to Lucent provided sub-contracted other technology vendor)
ASR	Automatic Send/Receive
ATM	Asynchronous Transfer Mode
BLAT	Bell Labs Advanced Technologies
BTS	Base Transceiver Station
CDMA	Code Division Multiple Access
CDR	Charging Data Record
CO	Central Office
CTT	Customer Trouble Ticket
DB	Data Base
EMS	Enterprise Management System
eTOM	enhanced Telecom Operations Map
EV_DO	1X – Evolution_Data Only
FCC	Federal Communications Commission
FM	Field Maintenance
FRU	Field Replaceable Unit
FTE	Full Time Equivalent
GNOC	Global Network Operations Centre
IP	Internet Protocol
LD	Low Delay
LEC	Local Exchange Carrier
LGX	Light Guide cross-connect

MS	Managed Services
MSA	Managed Services Architecture
MSC	Mobile Switching Centre
MTTA	Mean Time To Arrive
MTTR	Mean Time To Repair
NTT	Network Trouble Ticket
O&M	Operations and Management
OS	Operations Support
OSC	Operations Support Centre
OSP	OutSide Plant
OSS	Operations Support System
OSWF	On-Site Work Force
PCA	Physical Configuration Audit
PM	Product Management
POTS	Plain Old Telephone System
RF	Radio Frequency
SLA	Service Level Agreement
SME	System Management Engineer
SNMP	Simple Network Management Protocol
SP	Service Provider
TDMA	Time Division Multiple Access
TSS	Technical Support Services
VPN	Virtual Private Network
YPE	Years of Professional Experience

4 TOC metric categories and structure

4.1 TOC metrics categories

Of all possible metrics that could be addressed, 150 specific metrics were identified as being the ones most representative of the quality and competence of an operations infrastructure, organized into nine work categories or "types". Each metric is assigned a type based on what the metric intends to measure. Currently the following types are identified:

- Process metrics;
- SLA/service quality metrics;
- Resources and staffing metrics;
- Productivity and unit cost metrics;
- IT/OS infrastructure metrics;
- Regulatory compliance metrics;
- Organization metrics;

- General support metrics;
- Technology specific metrics.

In greater detail, these types are defined in the following way:

- **Process**

  The quality and efficiency of service providers' network and services operations are highly dependent on their underlying processes. With ever-escalating operations expenditures, service providers are looking to increase levels of automation in their processes to reduce or contain cost, to shorten cycle time and work time. This set of metrics measures the operational robustness of the activities the SP performs, including provisioning, fault management, security management, performance management, account management, supply chain processes, inventory lifecycle management, and data centre operations.

- **SLA/service quality**

  The metrics in this category measure the quality of the services performed by the service provider, and include such areas as MTTR statistics, call-out-intervals, trouble escalation statistics, trouble resolution statistics.

- **Resources & staffing**

  This category measures the size and handling of the human resources in the operations organizations. Key metrics in this area include such items as: staffing ratios, skills and training, staff turnover.

- **Productivity & unit cost**

  This category measures the efficiency factors of operations. Key metrics in this area include: costs and result statistics, access to centralized databases, access to work sites.

- **IT/OS infrastructure**

  Information technology and operations support infrastructure is an integral part of service provider operations. This category measures the robustness of the supporting IT/OS infrastructure, including number of systems in the infrastructure, number of different vendor components, reliability and downtime statistics, remote and off-line availability of functions, levels of interface standardization, amount of GUI support.

- **Regulatory compliance**

  The metrics in this category measure how heavily driven the operations are by compliance with outside agencies. Key metrics include: number of regulatory agencies overseeing this work, percentage of compliance with these requirements, percentage of automation of reporting and filing, average yearly cost of reporting and filing. As regulations tend to differ from nation to nation, and region to region, these metrics will be critical in pursuing business globally.

- **Organization**

  The structure of an organization has significant impact on its efficiency. Key metrics include: chain of reporting, number of organizational interfaces and management layers, and complexity of hierarchical structure.

- **General support**

  This category focuses on those support activities not specifically captured in one of the above, including dispatch activities, customer premises' activities, and physical plant support.

- **Technology specific**

  This category focuses on those support activities associated with a single technology. Examples of this category include number of cell sites per repair technician, and miles of cable per head end distribution.

4.2 TOC metrics structure

At the individual metric level, each metric can be modelled as a data entity/object characterized by the following attributes, also shown in Figure 1:

- **Metric type**

  As described above.

- **MetricID**

  An intelligence-coded identifier for the metric.

- **Metric description**

  A short textual description of the metric.

- **Metric definition**

  The definition of what specific measurement the metric is for; what are the data by which the metric is assessed or calculated. Any variations associated with each applicable operations work group are included.

- **Metric formula**

  The precise measurements to be collected/calculated.

- **Applicable operations workforce**

  The operations areas where the metric is applicable – Field Operations/Maintenance, NOC, Transport Operation and Management, etc.

- **Metric technical domain**

  The technology specific information governing this metric, e.g., wireless network component, core component, video communications, etc.

- **Benchmark/metric value**

  Metric values by service provider, service/product type and country. The database will include other attributes to capture items such as source of data, calendar year of measurement (historical data), any comments, etc. Benchmarks will be established when sufficient samples are available.

- **e-TOM mapping**

  Corresponding/applicable e-TOM category. This object can be repeated for any other necessary mapping, e.g., to an internal quality or business standard.

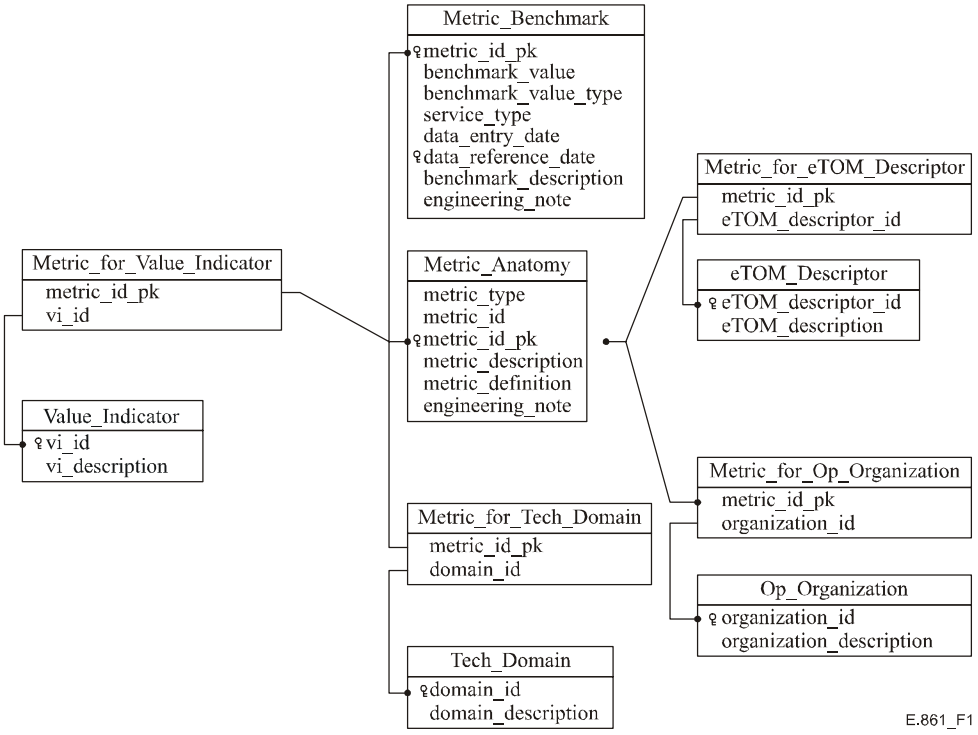

Figure 1/E.861 – Data anatomy of TOC metric

5 TOC metric structure and definitions

This clause gives detailed information about each metric in the nine work groups.

5.1 Process metrics

Metric Type:	**Process**
Metric ID:	TOC-PP1.1.1
Metric Description:	Degree of automation for network provisioning
Metric Definition:	General: Percentage of automation in network/resource provisioning. This metric includes the major steps of provisioning: – order entry; – design; – implementation; – test and turn up. Wireline FM: Applicable Wireless FM: Field maintenance covers only a subset – primarily test and turn up – of the provisioning process. Wireless NOC: Percentage of automation in network/resource provisioning. This metric includes the major steps of provisioning: – order entry; – design; – implementation; – test and turn up.
Metric Formula:	Metric = Percentage of total function points in the process performed non-manually across the above steps.

Metric Type:	Process
Metric ID:	TOC-PP1.1.2
Metric Description:	Degree of automation of service provisioning process
Metric Definition:	General: Percentage of automation in service provisioning: percentage of function points (tasks) which are not manually performed based on the following steps: – order entry; – design; – implementation; – test and turn up. Wireline FM: Field maintenance covers only a subset – primarily test and turn up – of the provisioning process, and only for certain services, e.g., private line. Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	Metric = Percentage of total function points in the process performed non-manually across the above steps.

Metric Type:	Process
Metric ID:	TOC-PP1.2.1
Metric Description:	Network provisioning cycle time
Metric Definition:	General: N/A Wireline FM: Field maintenance covers only a subset – primarily equipment acceptance testing – of the provisioning process. Does not include equipment installation. Wireless FM: Field maintenance covers the on-site workforce components of the provisioning process. This includes: – equipment installation; – pre-service acceptance testing. Wireless NOC: Cycle time of network/resource provisioning in time units: (hours/days). This metric is based on the following steps: – order validation; – design; – implementation; – test and turn up.
Metric Formula:	Metric = Average total elapsed time to complete an ESO type.

Metric Type:	Process
Metric ID:	TOC-PP1.2.2
Metric Description:	Service provisioning cycle time
Metric Definition:	General: N/A Wireline FM: Field maintenance covers only a subset – test and turn up – of the provisioning process. Does not include equipment installation. Wireless FM: N/A Wireless NOC: Cycle time of service provisioning, in time units: (hours/days). This metric is the total elapsed time based on the following steps: – order validation; – design; – implementation; – test and turn up.
Metric Formula:	Metric = Average total elapsed time to complete an ESO type.

Metric Type:	Process
Metric ID:	TOC-PP1.2.3
Metric Description:	Network provisioning work time
Metric Definition:	General: N/A Wireline FM: This metric measures the total amount of resources (e.g., Full Time Equivalent – minutes) required per service order for this set of tasks. This metric is the total resource per service order used based on the following step: – equipment installation testing. Wireless FM: This metric measures the total amount of resources (e.g., Full Time Equivalent – minutes) required per engineering service order for this set of tasks. This metric is the total resource per service order used based on the following steps: – installation; – equipment acceptance testing. Wireless NOC: This metric measures the total amount of resources (e.g., Full Time Equivalent – minutes) required per service order for this set of tasks. This metric is the total resource per service order used based on the following steps: – order validation; – design; – implementation; – test and turn up.
Metric Formula:	Metric = Sum (over all tasks) of FTE – minutes for that task for an ESO type.

Metric Type:	Process
Metric ID:	TOC-PP1.2.4
Metric Description:	Service provisioning work time
Metric Definition:	General: N/A Wireline FM: This metric measures the total amount of resources (e.g., Full Time Equivalent – minutes) required per service order for this set of tasks. This metric applies to certain services, e.g., private line. This metric is the total resource per service order used based on the following step: – pre-service acceptance testing. Wireless FM: N/A Wireless NOC: This metric measures the total amount of resources required for this set of tasks, measured in time units (hours/days). This metric is the total elapsed time based on the following steps: – order validation; – design; – implementation; – test and turn up.
Metric Formula:	Metric = Sum (over all tasks) of full time equivalent – minutes for that task for an ESO type.

Metric Type:	Process
Metric ID:	TOC-PP1.3.1
Metric Description:	Degree of standardization of provisioning process interfaces with suppliers
Metric Definition:	General: N/A Wireline FM: Nowadays, a typical end-to-end service involves many suppliers. For example, wireline test and turn up involves coordination of activities between the LEC and IXC. The standardization of the data set and the implementation of electronic exchange mechanism will greatly boost the process efficiency. This metric is calculated as follows: For each supplier interface, a maximum Score of 2 will be assigned: – 1 point if data set is standardized; – 1 point if electronic data exchange is implemented. The volume across each supplier interface is then weighted by the interface score. Wireless FM: Nowadays, a typical end-to-end service involves many suppliers. For example, installation of wireless equipment may involve coordination of activities between the backhaul provider and the service provider. The standardization of the data set and the implementation of an electronic exchange mechanism will greatly boost the process efficiency. This metric is calculated in the same way as Wireline FM. Wireless NOC: Nowadays, a typical end-to-end service involves many suppliers. For example, an LD service provider has to order access services from a local service provider, via ASR. The standardization of the data set and the implementation of electronic exchange mechanism will greatly boost the process efficiency. This metric is calculated in the same way as Wireline FM.
Metric Formula:	Metric = Sum (over all suppliers) of score × volume/sum (over all suppliers) volume.

Metric Type:	Process
Metric ID:	TOC-PP1.4.1
Metric Description:	Percentage of network provisioning orders requiring rework
Metric Definition:	General: N/A Wireline FM: N/A Wireless FM: N/A Wireless NOC: There are multiple reasons why a service order requires rework: 1) Order data in error; 2) Errors made by provisioning system or provisioning technician during the provisioning process; 3) Network inventory database out of sync with the network; 4) The subscriber change his/her mind before the service is in-effect, causing a supplement to the original order to be issued.
Metric Formula:	Metric = Percentage of service orders reworked per quarter, without differentiating the cause(s) of rework.

Metric Type:	Process
Metric ID:	TOC-PP1.4.2
Metric Description:	Percentage of service provisioning orders requiring rework
Metric Definition:	General: N/A Wireline FM: N/A Wireless FM: N/A Wireless NOC: There are multiple reasons why a service order requires rework: 1) Order data in error; 2) Errors made by provisioning system or provisioning technician during the provisioning process; 3) Network inventory database out of sync with the network; 4) The subscriber change his/her mind before the service is in-effect, causing a supplement to the original order to be issued.
Metric Formula:	Metric = Percentage of service orders reworked per quarter, without differentiating the cause(s) of rework.

Metric Type:	Process
Metric ID:	TOC-PP1.4.3
Metric Description:	Percentage of network provisioning orders supplemented
Metric Definition:	General: N/A Wireline FM: N/A Wireless FM: N/A Wireless NOC: An order can require rework because of supplemental change requested by network planning/design.
Metric Formula:	Metric = Percentage of service orders per quarter requiring rework because of supplement.

Metric Type:	Process
Metric ID:	TOC-PP1.4.4
Metric Description:	Percentage of service provisioning orders supplemented
Metric Definition:	General: N/A Wireline FM: N/A Wireless FM: N/A Wireless NOC: An order can require rework because of supplemental change requested by the customer.
Metric Formula:	Metric = Percentage of service orders per quarter requiring rework because of supplement.

Metric Type:	Process
Metric ID:	TOC-PP1.5.1
Metric Description:	Percentage of network provisioning orders completed on time
Metric Definition:	General: N/A Wireline FM: Field maintenance covers only a subset – primarily equipment acceptance testing – of the provisioning process. Does not include equipment installation. Wireless FM: Field maintenance covers the on-site workforce components of the provisioning process. This includes equipment installation and pre-service acceptance testing. Wireless NOC: Network orders are created with a due date, which is either met (completed on time) or missed.
Metric Formula:	Metric = Percentage of service orders completed on time per quarter.

Metric Type:	Process
Metric ID:	TOC-PP1.5.2
Metric Description:	Percentage of service provisioning orders completed on time
Metric Definition:	General: N/A Wireline FM: Field maintenance covers only a subset – primarily equipment acceptance testing – of the provisioning process. Does not include equipment installation. Wireless FM: N/A Wireless NOC: Service orders are created with a due date, which is either met (completed on time) or missed.
Metric Formula:	Metric = Percentage of service orders completed on time per quarter.

Metric Type:	Process
Metric ID:	TOC-PF2.1.1
Metric Description:	Percentage of automation of alarm forwarding to NOC
Metric Definition:	General: For a centralized work group, e.g., NOC, to have total surveillance of the network, faults/alarms that are detected by the network elements must be transmitted to the NOC instantly via a networked OS infrastructure. Wireline FM: N/A Wireless FM: N/A Wireless NOC: For a centralized work group, e.g., NOC, to have total surveillance of the network, faults/alarms that are detected by the network elements must be forwarded to the NOC instantly via a networked OS infrastructure.
Metric Formula:	Metric = Sum of scores over all instances of major equipment types divided by total instances of all major equipment in the network.

Metric Type:	Process
Metric ID:	TOC-PF2.1.2
Metric Description:	Degree of automation of fault management process
Metric Definition:	General: N/A Wireline FM: N/A Wireless FM: N/A Wireless NOC: Percentage of automation in the fault/alarm process. This metric includes the major steps of: – detection; – reporting/trouble administration; – trouble analysis and sectionalization, including alarm correlation; – dispatch and repair; – verify and test.
Metric Formula:	Metric = Percentage of total function points in the process performed non-manually across the above steps.

Metric Type:	Process
Metric ID:	TOC-PF2.1.3
Metric Description:	Percentage of faults resolved remotely by NOC (without dispatch)
Metric Definition:	General: NOTE 1 – Should the faults that are escalated to equipment vendors be excluded? NOTE 2 – There are two ways to calculate the value for this metric: 1) Each priority of fault has its metric, i.e., Priority 1: 60% Priority 2: 70% Priority 3: 80% Priority > 3: 90% 2) A priority-weighted metric, i.e., Priority 1: weight 5 Priority 2: weight 3 Priority 3: weight 2 Priority > 3: weight 1 Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	

Metric Type:	Process
Metric ID:	TOC-PF2.1.4
Metric Description:	Percentage of network faults detected by the service provider
Metric Definition:	General: N/A Wireline FM: N/A Wireless FM: N/A Wireless NOC: This metric measures the percentage of networks faults that are detected and reported first by the service provider itself, not by an outside agency, e.g., customer. The higher the percentage, the better the service provider's fault management. By raising the percentage, the tangible benefits are: 1) Not having to react to subscriber's report, more flexibility in repair schedule. 2) Reduced cost. The intangible benefit is improved, customer satisfaction.
Metric Formula:	

Metric Type:	Process
Metric ID:	TOC-PF2.2.1
Metric Description:	Network trouble ticket resolution cycle time
Metric Definition:	General: N/A Wireline FM: N/A Wireless FM: Field maintenance covers the on-site workforce components of the fault handling process. This includes: – diagnose fault and perform repair work; – post-repair testing. Wireless NOC: Cycle time of network fault resolution in time units (hours/days) per fault/failure type (e.g., critical, major, minor, by dispatch-in, dispatch-out, remore repair). This metric is based on the following steps: – starts when a network trouble ticket is created; – ends when network trouble ticket is closed (test/verify is complete); – does not include externally driven stoppages ("hold time") e.g., customer premises not available, 12-hour closure-confirm.
Metric Formula:	Metric = NTT_close_time – NTT_create_time – NTT_hold_time (metric collected by di, do, rr)

Metric Type:	Process
Metric ID:	TOC-PF2.2.2
Metric Description:	Customer trouble ticket resolution cycle time
Metric Definition:	General: N/A Wireline FM: Field maintenance covers only a subset – repair, test and turn up – of the fault management process. Wireless FM: Field maintenance covers only a subset – repair, test and turn up – of the fault management process. Wireless NOC: Cycle time of customer trouble ticket resolution in time units (hours/days) per fault/failure type (e.g., critical, major, minor). This metric is based on the following steps: – starts when a customer trouble ticket is created; – ends when customer trouble ticket is closed (test/verify is complete); – does not include externally driven stoppages ("hold time") e.g., customer premises not available, 12-hour closure-confirm.
Metric Formula:	Metric = CTT_close_time – CTT_create_time – CTT_hold_time

Metric Type:	Process
Metric ID:	TOC-PF2.2.3
Metric Description:	Network trouble ticket resolution work time
Metric Definition:	General: N/A Wireline FM: This metric measures the total amount of resources (e.g., Full Time Equivalent – minutes) required per trouble ticket for this set of tasks. This metric is the total resource per trouble ticket used based on the following steps: – isolate fault; – fix the problem; – test and turn up. Wireless FM: This metric measures the total amount of resources (e.g., Full Time Equivalent – minutes) required per trouble ticket for this set of tasks. This metric is the total resource per trouble ticket used based on the following steps: – isolate fault; – fix the problem; – test and turn up. Wireless NOC: This metric measures the total amount of resources required for the following set of tasks, measured in time units (e.g., hours or minutes) per trouble category: – dispatch-in; – dispatch-out; – remote repair; – verify and test.
Metric Formula:	Metric = Sum (over all tasks) of full time equivalent (FTE) – minutes for that task for an NTT type (di, do, rr).

Metric Type:	Process
Metric ID:	TOC-PF2.2.4
Metric Description:	Customer trouble ticket resolution work time
Metric Definition:	General: N/A Wireline FM: This metric measures the total amount of resources (e.g., Full Time Equivalent – minutes) required per service trouble ticket for this set of tasks. This metric applies to certain services, e.g., private line. This metric is the total resource per service trouble ticket used based on the following steps: – isolate service fault; – fix the problem; – test and turn up. Wireless FM: N/A Wireless NOC: This metric measures the total amount of resources required for this set of tasks, measured in time units (hours/days) per trouble type (dispatch-in, dispatch-out, remote repair). This metric is the total elapsed time based on the following steps: – validate trouble ticket; – isolate service fault; – fix the problem; – test and turn up.
Metric Formula:	Metric = Sum (over all tasks) of full time equivalent (FTE) – minutes for that task for a CTT type (di, do, rr).

Metric Type:	Process
Metric ID:	TOC-PF2.3.1
Metric Description:	Degree of standardization of fault resolution process interfaces with suppliers
Metric Definition:	General: N/A Wireline FM: Nowadays, a typical end-to-end service involves many suppliers. For example, wireline test and turn up involves coordination of activities between the LEC and IXC. The standardization of the data set and the implementation of electronic exchange mechanism will greatly boost the process efficiency. This metric is calculated as follows: For each supplier interface, a maximum Score of 2 will be assigned: – 1 point if data set is standardized; – 1 point if electronic data exchange is implemented. The volume across each supplier interface is then weighted by the interface score. Wireless FM: Nowadays, a typical end-to-end service involves many suppliers. For example, installation of wireless equipment may involve coordination of activities between the backhaul provider and the service provider. The standardization of the data set and the implementation of electronic exchange mechanism will greatly boost the process efficiency. This metric is calculated in the same way as Wireline FM. The volume across each supplier interface is then weighted by the interface score. Wireless NOC: Nowadays, repair of a typical end-to-end service involves many suppliers. For example, a fault in a leased backhaul has to order repair services from the backhaul provider. The standardization of the data set and the implementation of electronic exchange mechanism will greatly boost the process efficiency. This metric is calculated as follows: For each interface in the repair process: *Step 1: Supplier Score* For the supplier of that interface a maximum Score of 2 will be assigned: – 1 point if data set is standardized; – 1 point if electronic data exchange is implemented. *Step 2: Weighted Volume* The volume for each supplier is multiplied by the score for that supplier. *Step 3: Metric Equals* Sum of weighted volumes divided by total volume. Value is between 0 and 2.
Metric Formula:	Metric = Sum (over all suppliers) of score × volume/total volume.

Metric Type:	Process
Metric ID:	TOC-PF2.4.1
Metric Description:	Percentage of trouble tickets requiring rework
Metric Definition:	General: N/A Wireline FM: N/A Wireless FM: N/A Wireless NOC: There are multiple reasons why a trouble ticket requires rework: 1) Data in error; 2) Errors made by ticketing system or repair technician during the repair process; 3) Network inventory database inaccurate.
Metric Formula:	Metric = Percentage of trouble tickets reworked per quarter by di, do, rr, without differentiating the cause(s) of rework.

Metric Type:	Process
Metric ID:	TOC-PF2.4.2
Metric Description:	Percentage of trouble tickets for chronic failures
Metric Definition:	General: N/A Wireline FM: N/A Wireless FM: N/A Wireless NOC: Some trouble tickets are opened to fix a trouble that has reoccurred after a recent previous repair, known as "chronic" failures.
Metric Formula:	Metric = Percentage of trouble tickets reporting a chronic trouble by di, do, rr.

Metric Type:	Process
Metric ID:	TOC-PF2.5.1
Metric Description:	Percentage of tickets that exceed SLA commitments
Metric Definition:	General: N/A Wireline FM: N/A Wireless FM: N/A Wireless NOC: This metric is to measure the level of "over-performance" so that SLA may be relaxed to save cost.
Metric Formula:	

Metric Type:	Process
Metric ID:	TOC-PF2.6.1
Metric Description:	Frequency of preventative maintenance testing
Metric Definition:	General: N/A Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	

Metric Type:	Process
Metric ID:	TOC-PM3.1.1
Metric Description:	Degree of automation of performance data collection and filtering
Metric Definition:	General: This metric will be assessed in terms of the following tasks: 1) Enabling of network elements to collect performance data through EMSs; 2) Filtering of data by EMSs; 3) Transfer of data to performance systems or tools. Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	

Metric Type:	Process
Metric ID:	TOC-PM3.1.2
Metric Description:	Degree of automation of performance analysis reporting and feedback
Metric Definition:	General: The metric will be assessed in terms of the following tasks: 1) Report generation; 2) Trend analysis; 3) Capacity analysis; 4) Feedback of the analysis to traffic engineering and capacity planning. Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	

Metric Type:	Process
Metric ID:	TOC-PS4.1.1
Metric Description:	Availability of an updated security policy
Metric Definition:	General: Metric = "yes" if a security policy document is up to date or will be updated in 3 months, else metric = "no". Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: Applicable
Metric Formula:	Metric = "yes" if a security policy document is up to date or will be updated in 3 months, else metric = "no".

Metric Type:	Process
Metric ID:	TOC-PS4.1.2
Metric Description:	Degree of automation of security/fraud detection and trend analysis
Metric Definition:	General: This metric measures the degree of automation of security/fraud detection and trend analysis based on the following tasks: 1) Data collection; 2) Analysis and trending; 3) Source isolation; 4) Reporting/alerting. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: Applicable
Metric Formula:	

Metric Type:	Process
Metric ID:	TOC-PS4.1.3
Metric Description:	Availability of an updated security design and implementation plan
Metric Definition:	General: Metric = "yes" if a security policy document is up to date or will be updated in 3 months, else metric = "no". Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: Applicable
Metric Formula:	Metric = "yes" if a security policy document is up to date or will be updated within 3 months, else metric = "no".

Metric Type:	Process
Metric ID:	TOC-PS4.2.1
Metric Description:	Times per year of security audits
Metric Definition:	General: N/A Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: Applicable
Metric Formula:	

Metric Type:	Process
Metric ID:	TOC-PS4.3.1
Metric Description:	Number of security failures per year
Metric Definition:	General: For telecom SPs, the number of security failures should include those impacting its services and its operations. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: Applicable
Metric Formula:	

Metric Type:	Process
Metric ID:	TOC-PS4.4.1
Metric Description:	Average elasped time (in hours) between a security failure being detected and the infringement being committed
Metric Definition:	General: This metric measures the duration (in hours) of a security failure until it is detected. Of course one will not know when the infringement is committed until the security failure is detected. It is always possible for a security failure to occur. Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	Metric = Time a security failure is detected – Time the security infringement is committed.

Metric Type:	Process
Metric ID:	TOC-PS4.4.2
Metric Description:	Average work-time (in hours) to rectify a security failure
Metric Definition:	General: This metric measures the total FTE (Full Time Equivalent) in hours it takes to rectify a security failure. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: Applicable
Metric Formula:	Metric = Total FTE in hours required to rectify a security failure. The clock starts when a security failure is confirmed.

Metric Type:	Process
Metric ID:	TOC-PA5.1.1
Metric Description:	Degree of automation of billing data collection
Metric Definition:	General: The degree of automation will be assessed in terms of the following tasks: 1) Billing setup. 2) Collection of raw billing data, e.g., CDR or equivalents, as generated by the network elements, e.g., the switch. 3) Filtering and validation of raw data, i.e., data mediation. 4) Transmission of the processed data to bill generator. 5) Bill distribution. 6) Receipt of payment. 7) Billing record audit. 8) Billing data archiving/retention. Wireline FM: N/A Wireless FM: N/A Wireless NOC: The degree of automation will be assessed in terms of tasks 2, 3 and 4 defined above.
Metric Formula:	

Metric Type:	Process
Metric ID:	TOC-PA5.1.2
Metric Description:	Degree of automation of bill generation
Metric Definition:	General: The degree of automation will be assessed in terms of the following tasks: 1) Linkage of billing data, CDR or equivalents, to customer data. 2) Application of the rate tables. 3) Applications of promotions and/or calling plans. Wireline FM: N/A Wireless FM: N/A Wireless NOC: The degree of automation will be assessed in terms of the following tasks: 1) Linkage of billing data, CDR or equivalents, to customer data. 2) Application of the rate tables. 3) Applications of promotions and/or calling plans.
Metric Formula:	

Metric Type:	Process
Metric ID:	TOC-PA5.2.1
Metric Description:	Level of integrated handling for bundled services
Metric Definition:	General: This metric assesses the level of bill integration for bundled services offered by an SP. 1) Level 1: separate bills, separate deliveries, and require separate payments. 2) Level 2: separate bills delivered together, but require separate payment. Wireline FM: N/A Wireless FM: N/A Wireless NOC: This metric assesses the level of bill integration for bundled services offered by an SP. 1) Level 1: separate bills, separate deliveries, and require separate payments; 2) Level 2: separate bills delivered together, but require separate payments; 3) Level 3: single bill, single payment.
Metric Formula:	

Metric Type:	Process
Metric ID:	TOC-PA5.3.1
Metric Description:	Percentage of electronic bill delivery and payment
Metric Definition:	General: This metric measures the percentage of online bill delivery; another question/metric for percentage of online receipt of payment. Wireline FM: N/A Wireless FM: N/A Wireless NOC: This metric measures the degree to which online bill delivery and payment are offered to the subscriber based on the following score scheme: for each service, if online bill delivery is offered, a score of 1 is assigned, else a score of 0.
Metric Formula:	Metric = (sum over all services of service score weighted by respective service volume divided by the maximum possible score) × 100%

Metric Type:	Process
Metric ID:	TOC-PC6.1.1
Metric Description:	SLA governing service-vendor services
Metric Definition:	General: This metric applies when equipment vendor technical support service is a subcontract in an overall field maintenance or NOC contract. Therefore, this SLA is the agreement between the primary contractor and the subcontractor for specific equipment maintenance (e.g., Lucent INS, Nortel). From the NOC perspective, this SLA metric measures the quality of its supply-chain process. On the other hand, the SLA below (metric type SLA) is the agreement between the primary contract and the SP. Wireline FM: N/A Wireless FM: N/A Wireless NOC: N/A
Metric Formula:	

Metric Type:	Process
Metric ID:	TOC-PC6.1.2
Metric Description:	Percentage of service requests referred to service vendors per quarter
Metric Definition:	General: N/A Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: Applicable
Metric Formula:	

Metric Type:	Process
Metric ID:	TOC-PC6.1.3
Metric Description:	Number of SLA violations per quarter per service vendor
Metric Definition:	General: N/A Wireline FM: N/A Wireless FM: N/A Wireless NOC: N/A
Metric Formula:	

Metric Type:	Process
Metric ID:	TOC-PC6.2.1
Metric Description:	SLA governing equipment vendor technical support service
Metric Definition:	General: This metric applies when equipment vendor technical support service is a subcontract in an overall field maintenance or NOC contract. Therefore, this SLA is the agreement between the primary contractor and the subcontractor for specific equipment. Wireline FM: N/A Wireless FM: N/A Wireless NOC: N/A
Metric Formula:	

Metric Type:	Process
Metric ID:	TOC-PC6.2.2
Metric Description:	Percentage of service requests referred to equipment vendors per quarter
Metric Definition:	General: N/A Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: Applicable
Metric Formula:	

Metric Type:	Process
Metric ID:	TOC-PI7.1.1
Metric Description:	Degree of automation of life cycle inventory management
Metric Definition:	General: This metric measures the degree of automation in terms of the following tasks: 1) Data gathering from the network. 2) Data normalization/rationalization. 3) Data loading into inventory database. 4) Ongoing inventory database synchronization with the network. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: Applicable
Metric Formula:	

Metric Type:	Process
Metric ID:	TOC-PI7.1.2
Metric Description:	Degree of synchronization between the network and the inventory database
Metric Definition:	General: Assessing the degree of synchronization is not a trivial task. The sampling can be based on one or more combinations of the following: – Number of times where inventory databases are determined to be incorrect, per quarter (might be available and logged as manual correction to DB). – Percentage of service orders requiring rework due to incorrect inventory. – Frequency of DB synchronization. – Discrepancies between actual equipment in selected subnetworks or offices and the inventory database. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: Applicable
Metric Formula:	

Metric Type:	Process
Metric ID:	TOC-PI7.1.3
Metric Description:	Percentage of network equipment units that can be inventoried via remote polling (i.e., responding to remote polling)
Metric Definition:	General: Not all equipment types have the intelligence to respond to remote inventory polling. This metric assesses the percentage of equipment types manageable by remote polling and weighted by the number of each type installed in the network. This metric measures the degree of remote inventory capability of the network and is a major determinant of the cost and accuracy of inventory management. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: Applicable
Metric Formula:	Metric = Number of devices capable of remote polling/total number of devices in network

Metric Type:	Process
Metric ID:	TOC-PI7.1.4
Metric Description:	Percentage of network equipment units that are being inventoried via remote inventory tools
Metric Definition:	General: As in metric PI7.1.3, but just limited to those that are inventoried by polling. The percentage difference between metric PI7.1.3 and PI7.1.4 quantifies the amount of improvement in inventory management that can be made given the current network equipment. Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	

Metric Type:	Process
Metric ID:	TOC-PI7.2.1
Metric Description:	The levels of spares of critical circuit packs managed centrally (e.g., by NOC/OSC)
Metric Definition:	General: Critical circuit packs can be defined in terms of their impact on a network and the services on it. Criticality 1: circuit packs which, if they fail, can cause total or partial outage to the network, e.g., AM controller cards in a major tandem switch. Criticality 2: circuit packs which, if they fail, can cause total or partial failure of an NE and affects a large number of subscribers, e.g., SM controller cards. Criticality 3: circuit packs which, if they fail, can cause service outage to a small number of subscribers, e.g., multiport line cards. Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	Metric = The number of spare criticality 1 (or 2 or 3) circuit packs as a percentage of the total number of circuit packs of the same criticality installed in the network.

Metric Type:	Process
Metric ID:	TOC-PI7.2.2
Metric Description:	The levels of spares of critical circuit packs managed locally (e.g., by field maintenance)
Metric Definition:	General: Use the same criticality definitions as PI7.2.1. The level of spare circuit packs is defined as the number of circuit packs maintained locally, expressed as the percentage of the total number of circuit packs of the same criticality installed in the subnetwork under the FM group's jurisdiction. Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	

Metric Type:	Process
Metric ID:	TOC-PD8.1.1
Metric Description:	Annual volume of data backups
Metric Definition:	General: How many levels of backups – daily, weekly, monthly, annually. Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	Metric = Sum of over all distinct applications of backups per year.

Metric Type:	Process
Metric ID:	TOC-PD8.2.1
Metric Description:	Degree of standardization of interfaces to data service providers
Metric Definition:	General: Most data centres host multiple applications. Standardization of data centre interfaces to applications can simplify its operations. This metric measures the degree of standardization of these interfaces. Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable

Metric Type:	Process
Metric ID:	TOC-PD8.2.3
Metric Description:	Percentage of automation in provisioning network-centric IP VPN
Metric Definition:	General: N/A Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	

Metric Type:	Process
Metric ID:	TOC-PD8.2.4
Metric Description:	Percentage of automation in site-to-site intranet VPN subscriber provisioning
Metric Definition:	General: N/A Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	

Metric Type:	Process
Metric ID:	TOC-PD8.2.5
Metric Description:	Percentage of automation in remote access VPN subscriber provisioning
Metric Definition:	General: N/A Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	

Metric Type:	Process
Metric ID:	TOC-PD8.2.6
Metric Description:	Percentage of data centre devices supporting SNMP
Metric Definition:	General: N/A Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	

Metric Type:	Process
Metric ID:	TOC-PD8.2.7
Metric Description:	Percentage of devices supporting one-step installation
Metric Definition:	General: For example, simple field installation (load a floppy/CD and go); this could be done in 3-5 minutes by unskilled personnel. Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	

Metric Type:	Process
Metric ID:	TOC-PD8.2.8
Metric Description:	Percentage of devices backed up off-site
Metric Definition:	General: For example, simple field installation (load a floppy/CD and go); this could be done in 3-5 minutes by unskilled personnel. Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	

5.2 SLA/Service Quality metrics

Metric Type:	SLA/Service Quality
Metric ID:	TOC-MTTA1.1.1
Metric Description:	MTTA for trouble priority 1 – city location
Metric Definition:	General: "City", "Suburb", "Rural" are examples of location/site attributes. The value of MTTA in a given SLA is, in general, dependent on site attribute. This metric is actually a set of metrics which define the MTTA for each trouble priority and for each site attribute. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: N/A
Metric Formula:	

Metric Type:	SLA/Service Quality
Metric ID:	TOC-MTTA1.1.2
Metric Description:	MTTA for trouble priority 1 – suburban location
Metric Definition:	General: "City", "Suburb", "Rural" are examples of location/site attributes. The value of MTTA in a given SLA is, in general, dependent on site attribute. This metric is actually a set of metrics which define the MTTA for each trouble priority and for each site attribute. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: N/A
Metric Formula:	

Metric Type:	SLA/Service Quality
Metric ID:	TOC-MTTA1.1.3
Metric Description:	MTTA for trouble priority 1 – rural location
Metric Definition:	General: "City", "Suburb", "Rural" are examples of location/site attributes. The value of MTTA in a given SLA is, in general, dependent on site attribute. This metric is actually a set of metrics which define the MTTA for each trouble priority and for each site attribute. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: N/A
Metric Formula:	

Metric Type:	SLA/Service Quality
Metric ID:	TOC-MTTA1.2.1
Metric Description:	MTTA for trouble priority 2 – city location
Metric Definition:	General: "City", "Suburb", "Rural" are examples of location/site attributes. The value of MTTA in a given SLA is, in general, dependent on site attribute. This metric is actually a set of metrics which define the MTTA for each trouble priority and for each site attribute. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: N/A
Metric Formula:	

Metric Type:	SLA/Service Quality
Metric ID:	TOC-MTTA1.2.2
Metric Description:	MTTA for trouble priority 2 – suburban location
Metric Definition:	General: "City", "Suburb", "Rural" are examples of location/site attributes. The value of MTTA in a given SLA is, in general, dependent on site attribute. This metric is actually a set of metrics which define the MTTA for each trouble priority and for each site attribute. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: N/A
Metric Formula:	

Metric Type:	SLA/Service Quality
Metric ID:	TOC-MTTA1.2.3
Metric Description:	MTTA for trouble priority 2 – rural location
Metric Definition:	General: "City", "Suburb", "Rural" are examples of location/site attributes. The value of MTTA in a given SLA is, in general, dependent on site attribute. This metric is actually a set of metrics which define the MTTA for each trouble priority and for each site attribute. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: N/A
Metric Formula:	

Metric Type:	SLA/Service Quality
Metric ID:	TOC-MTTA1.3.1
Metric Description:	MTTA for trouble priority 3 – city location
Metric Definition:	General: "City", "Suburb", "Rural" are examples of location/site attributes. The value of MTTA in a given SLA is, in general, dependent on site attribute. This metric is actually a set of metrics which define the MTTA for each trouble priority and for each site attribute. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: N/A
Metric Formula:	

Metric Type:	SLA/Service Quality
Metric ID:	TOC-MTTA1.3.2
Metric Description:	MTTA for trouble priority 3 – suburban location
Metric Definition:	General: "City", "Suburb", "Rural" are examples of location/site attributes. The value of MTTA in a given SLA is, in general, dependent on site attribute. This metric is actually a set of metrics which define the MTTA for each trouble priority and for each site attribute. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: N/A
Metric Formula:	

Metric Type:	SLA/Service Quality
Metric ID:	TOC-MTTA1.3.3
Metric Description:	MTTA for trouble priority 3 – rural location
Metric Definition:	General: "City", "Suburb", "Rural" are examples of location/site attributes. The value of MTTA in a given SLA is, in general, dependent on site attribute. This metric is actually a set of metrics which define the MTTA for each trouble priority and for each site attribute. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: N/A
Metric Formula:	

Metric Type:	SLA/Service Quality
Metric ID:	TOC-MTTR2.0.0
Metric Description:	MTTR – Mean Time To Repair
Metric Definition:	General: N/A Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: Applicable
Metric Formula:	

Metric Type:	SLA/Service Quality
Metric ID:	TOC-MTTR2.1.1
Metric Description:	MTTR for trouble priority 1
Metric Definition:	General: Some SLAs may include MTTA as part of MTTR, i.e., mean time to arrive at repair site is considered as part of MTTR. However, more recent SLAs tend to separate out MTTA from MTTR. This metric is actually a set of metrics which define the MTTR for each trouble priority. It is common for vendors to specify an initial MTTR and a target MTTR – for mature services. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: Applicable
Metric Formula:	

Metric Type:	SLA/Service Quality
Metric ID:	TOC-MTTR2.1.2
Metric Description:	MTTR for trouble priority 2
Metric Definition:	General: Some SLAs may include MTTA as part of MTTR, i.e., mean time to arrive at repair site is considered as part of MTTR. However, more recent SLAs tend to separate out MTTA from MTTR. This metric is actually a set of metrics which define the MTTR for each trouble priority. It is common for vendors to specify an initial MTTR and a target MTTR – for mature services. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: Applicable
Metric Formula:	

Metric Type:	SLA/Service Quality
Metric ID:	TOC-MTTR2.1.3
Metric Description:	MTTR for trouble priority 3
Metric Definition:	General: Some SLAs may include MTTA as part of MTTR, i.e., mean time to arrive at repair site is considered as part of MTTR. However, more recent SLAs tend to separate out MTTA from MTTR. This metric is actually a set of metrics which define the MTTR for each trouble priority. It is common for vendors to specify an initial MTTR and a target MTTR – for mature services. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: Applicable
Metric Formula:	

Metric Type:	SLA/Service Quality
Metric ID:	TOC-MTTR2.1.4
Metric Description:	MTTR for trouble priority > 3
Metric Definition:	General: Some SLAs may include MTTA as part of MTTR, i.e., mean time to arrive at repair site is considered as part of MTTR. However, more recent SLAs tend to separate out MTTA from MTTR. This metric is actually a set of metrics which define the MTTR for each trouble priority. It is common for vendors to specify an initial MTTR and a target MTTR – for mature services. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: Applicable
Metric Formula:	

Metric Type:	SLA/Service Quality
Metric ID:	TOC-COI3.1.1
Metric Description:	COI for trouble priority 1
Metric Definition:	General: N/A Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	

Metric Type:	SLA/Service Quality
Metric ID:	TOC-COI3.1.2
Metric Description:	COI for trouble priority 2
Metric Definition:	General: N/A Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	

Metric Type:	SLA/Service Quality
Metric ID:	TOC-COI3.1.3
Metric Description:	COI for trouble priority 3
Metric Definition:	General: N/A Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	

Metric Type:	SLA/Service Quality
Metric ID:	TOC-COI3.1.4
Metric Description:	COI for trouble priority >3
Metric Definition:	General: N/A Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	

Metric Type:	SLA/Service Quality
Metric ID:	TOC-SV5.1.1
Metric Description:	Number of SLA violations per 100 trouble tickets
Metric Definition:	General: This metric measures the frequency of SLA violations in terms of incidences of trouble tickets that take longer than the SLA commitment times to resolve. Wireline FM: For field maintenance, the set of trouble tickets is limited to those relevant to field maintenance. Wireless FM: For field maintenance, the set of trouble tickets is limited to those relevant to field maintenance. Wireless NOC: Applicable
Metric Formula:	Metric = Number of trouble tickets that violate SLA commitment per 100 trouble tickets.

Metric Type:	SLA/Service Quality
Metric ID:	TOC-SV5.2.1
Metric Description:	Percentage of customers for which a formal agreement, e.g., an SLA, is established
Metric Definition:	General: The purpose of this metric is to measure the extent to which formal SLAs exist between vendors and customers/clients. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: Applicable
Metric Formula:	Metric = Number of vendors having formal SLAs with an entity, divided by the total number of vendors of this entity × 100%

Metric Type:	SLA/Service Quality
Metric ID:	TOC-SV5.3.1
Metric Description:	Comparison of SLA against industry average
Metric Definition:	General: This metric is measured as follows: for each metric in the customer's SLA, assign score: 0 Below industry average by 10% for that metric. 1 Meets industry average for that metric. 2 Exceeds industry average for that metric. Divide total by total number of metrics in SLA, the result is average normalized between 0 and 2. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: Applicable
Metric Formula:	Metric = Sum of scores/total number of metrics

Metric Type:	SLA/Service Quality
Metric ID:	TOC-SV6.1.1
Metric Description:	Average span of a trouble ticket by trouble priority
Metric Definition:	General: Span of a trouble ticket is generally defined as the number of organizations or work groups that work on the trouble before it is resolved. In general the smaller the number, the better the trouble resolution process. A persistently high large span indicates potential inefficiency in the trouble resolution infrastructure – process and organization. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: Applicable
Metric Formula:	Metric = Total number of different organizations or work groups that work on a trouble ticket before it is resolved.

Metric Type:	SLA/Service Quality
Metric ID:	TOC-SV6.2.1
Metric Description:	Percentage of trouble tickets escalated to equipment vendor TSS
Metric Definition:	General: N/A Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: Applicable
Metric Formula:	Metric = Percentage of trouble tickets escalated to equipment vendors technical support services

Metric Type:	SLA/Service Quality
Metric ID:	TOC-SV7.1.1
Metric Description:	Percentage of troubles fixed permanently the first time
Metric Definition:	General: This metric measures the quality of trouble clearance by maintenance personnel. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: Applicable
Metric Formula:	

Metric Type:	SLA/Service Quality
Metric ID:	TOC-SV7.2.1
Metric Description:	Number of trouble repairs completed per month per repair technician
Metric Definition:	General: This metric should be moved to Resources & Staffing. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: Applicable
Metric Formula:	Metric = Number of repairs completed per month per repair technician

Metric Type:	SLA/Service Quality
Metric ID:	TOC-SV7.3.1
Metric Description:	The average age of a trouble ticket by trouble priority
Metric Definition:	General: The age of a trouble ticket is defined as the time interval between the ticket's creation and the ticket's closure. This metric differs from MTTR in that, in the MTTR, the "wait time" is deducted. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: Applicable
Metric Formula:	Metric = Time interval in days between the ticket's creation time and the ticket's closure time

Metric Type:	SLA/Service Quality
Metric ID:	TOC-SV7.4.1
Metric Description:	Number of trouble tickets per month per 100 subscribers
Metric Definition:	General: This metric measures the normalized volume of trouble tickets. The metric reflects on the quality of the network and services, as well as the quality of preventive maintenance. This metric can be for FM and NOC. Wireline FM: For field maintenance, the set of trouble tickets is limited to those relevant to field maintenance. Wireless FM: For field maintenance, the set of trouble tickets is limited to those relevant to field maintenance. Wireless NOC: Applicable
Metric Formula:	Metric = Number of trouble tickets generated for a particular service, or group of services per month divided by the number of subscribers, in hundreds of the sevice(s).

5.3 Resources and staffing metrics

Metric Type:	Resources & Staffing
Metric ID:	TOC-RS1.1.1
Metric Description:	Number of switch engineers per switch
Metric Definition:	General: 1) In wireless network, the switch is the MSC. 2) Can have sub-metrics for each major switching technology – circuit switch, packet switch, ATM/frame relay, IP router. 3) Switches have different sizes. To be meaningful, the metric must be based on normalized size – e.g., per 1000 bearer channel interface ports. For phase 1 we will focus on the industry's leading switching products: Circuit switch: 5ESS, 4ESS, DMS100, DMS200 ATM switch: GX550, CBX500 Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	Metric = Number of FTE switch engineers required to support a switch with 10 000 DS0 equivalent bearer channels.

Metric Type:	Resources & Staffing
Metric ID:	TOC-RS1.2.1
Metric Description:	Number of fault/alarms monitored and correlated per operations staff
Metric Definition:	General: Number of different types of alarms monitored multiplied by the number of network elements, divided by the total number of FTE operations staff responsible for alarm monitoring. The higher the value of this metric, the more efficient the centralized fault management function – usually in a NOC environment. Low value of this metric usually points to: 1) Insufficient investment in alarm/fault correlation tools; 2) Inexperienced traffic engineering staff; or 3) Over-staffing. Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	Metric = Sum over all network elements (number of alarms that a specific network element is designed to detect) divided by total number of FTE operations staff responsible for alarm monitoring.

Metric Type:	Resources & Staffing
Metric ID:	TOC-RS1.3.1
Metric Description:	Number of person-hours required per equipment installation – per type of normalized size
Metric Definition:	General: This metric measures the efficiency of the installation crew. Obviously, there will be many metrics because of the large variety of equipment. We will focus on major switching equipment types: digital switches, ATM switches, MSCs, cell site controllers. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: N/A
Metric Formula:	Metric = Number of person-hours required to install an equipment/switch with 10 000 DS0 equivalent bearer channels.

Metric Type:	Resources & Staffing
Metric ID:	TOC-RS1.3.2
Metric Description:	Number of person-hours required per equipment acceptance testing – per type of normalized size
Metric Definition:	General: This metric measures the efficiency of the installation crew. Obviously, there will be many metrics because of the large variety of equipment. We will focus on major switching equipment types: digital switches, ATM switches, MSCs, cell site controllers. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: N/A
Metric Formula:	Metric = Number of person-hours required to complete acceptance testing of an equipment/switch of 10 000 DS0 equivalent bearer channels.

Metric Type:	Resources & Staffing
Metric ID:	TOC-RS1.4.1
Metric Description:	Number of subscriber lines per operations staff
Metric Definition:	General: This metric could be a business metric in that it is related to percentage of revenue spent on operations. Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	Metric = Total number of subscriber lines divided by total number of FTE operations staff.

Metric Type:	Resources & Staffing
Metric ID:	TOC-RS1.5.1
Metric Description:	Number of trouble tickets resolved per month (year) per maintenance staff
Metric Definition:	General: This metric measures the cost-effectiveness of operations and maintenance staff. This metric can reflect a host of factors: 1) The overall health – performance, reliability, capacity utilization, of the network; 2) Level of OS support for operations staff; 3) Efficiency of operations processes, including organization structure. This metric may be divided into two submetrics: one for service-affecting troubles, another for non-service-affecting troubles. Wireline FM: For field maintenance, the set of trouble tickets is limited to those relevant to field maintenance. Wireless FM: For field maintenance, the set of trouble tickets is limited to those relevant to field maintenance. Wireless NOC: Applicable
Metric Formula:	Metric = Total number of trouble tickets resolved per month (year) divided by the total number of FTE maintenance staff.

Metric Type:	Resources & Staffing
Metric ID:	TOC-RS1.5.2
Metric Description:	Number of trouble tickets per service per subscriber per month (year).
Metric Definition:	General: This metric measures service-specific trouble tickets per month (year) per subscriber. Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	Metric = Total number of customer trouble tickets generated for a specific service for the month (year) divided by the total number of service subscribers.

Metric Type:	Resources & Staffing
Metric ID:	TOC-RS1.6.1
Metric Description:	The monthly "book-to-bill" ratio of trouble tickets
Metric Definition:	General: The running ratio of trouble generated in the month to the troubles resolved in the month. The metric can be defined as the quarterly or annual average of the monthly ratio. A number greater than one means trouble tickets are building up, implying under-staffing, conversely a number less than 1 means potential over-staffing. Wireline FM: For field maintenance, the set of trouble tickets is limited to those relevant to field maintenance. Wireless FM: For field maintenance, the set of trouble tickets is limited to those relevant to field maintenance. Wireless NOC: Applicable
Metric Formula:	Metric = Number of trouble tickets opened in a month/Number of trouble tickets closed for the same month.

Metric Type:	Resources & Staffing
Metric ID:	TOC-RS1.7.1
Metric Description:	Number of traffic reports collected and analysed per traffic engineer
Metric Definition:	General: This metric measures the traffic engineering resources required to manage networks or services in terms of the number of traffic reports that can be collected and analysed by a traffic engineer. The higher the value of this metric, the more efficient the traffic engineering function. Low value of this metric usually reflects: 1) Insufficient automation of traffic data collection and analysis tools; 2) Inexperienced traffic engineering staff; or 3) Over-staffing. Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	Metric = Sum over all NEs (sum over different traffic data reports for the NE × frequency the data is collected per year), divided by the total number of FTE traffic engineers.

Metric Type:	Resources & Staffing
Metric ID:	TOC-RS1.8.1
Metric Description:	Number of cell sites per FM technician
Metric Definition:	General: Big wireless SPs have tens of thousands of cell sites. Field maintenance of these cell sites constitutes a big OpEx component. This metric measures the staffing level of cell site maintenance. It is dependent on the following factors: 1) The characteristics of the cell sites – generally referred to as site attributes. 2) The tasks that a dispatched FM technician is required to do. Therefore, for serving areas with closely located cell sites – e.g., urban areas – with easy access to sites, a technician can likely cover more cell sites. Also, centralization of some FM functions, as in the OSC model, can boost this metric as well. Wireline FM: N/A Wireless FM: Applicable Wireless NOC: N/A
Metric Formula:	Metric = Total number of cell sites in a SP's market divided by the total number of FTE FM technicians serving that market.

Metric Type:	Resources & Staffing
Metric ID:	TOC-RS1.8.2
Metric Description:	Number of cell sites per RF engineer
Metric Definition:	General: In a live wireless network, cells are continuously evolving: cell splits, mergers and rehomes entail reassignments of radio frequencies to achieve least interference. This metric measures the engineering resources required to maintain a required level of radio transmission quality. This metric is dependent on the frequency of cell site events – splits, mergers, rehomes, as well as RF engineering tools available. It is likely that in urban areas, the metric value will be lower than in rural areas. Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	Metric = Total number of cell sites in a SP's market divided by the total number of FTE RF engineering staff serving that market.

Metric Type:	Resources & Staffing
Metric ID:	TOC-RS1.8.3
Metric Description:	Number of backhaul carriers per capacity planning engineer
Metric Definition:	General: Backhaul carriers connect base stations to the MSC, e.g., AT&T Wireless has ~52 000 Ts connecting ~20 000 cell site base stations to 140 switches in its MSCs. As their daily functions, carrier engineers monitor the carriers and initiate engineering activities to optimize the performance and utilization of these carriers. Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	Metric = Total number of T1 equivalent backhaul carriers in a SP's network serving a specific market divided by the total number of FTE backhaul capacity planning engineers serving that market.

Metric Type:	Resources & Staffing
Metric ID:	TOC-RS1.8.4
Metric Description:	Number of person-hours required per cell site construction
Metric Definition:	General: This metric measures the person-hours required for cell site construction only – the cell tower and the accompanying fixtures, such as tower lights, fire detection devices and proper camouflage as required by city ordinance. It excludes the resources required to get site permit(s) or prepare the site. The value for this metric is dependent on the types of cell towers. Wireline FM: N/A Wireless FM: Applicable Wireless NOC: N/A
Metric Formula:	Metric = Number of person-hours required to construct a cell site.

Metric Type:	Resources & Staffing
Metric ID:	TOC-RS1.8.5
Metric Description:	Number of person-hours required per cell site equipment installation
Metric Definition:	General: This metric measures the resources required to install cell site equipment, including connection to commercial power supply and set up backup power supply. The types of cell sites are determined by the cell site controller. Wireline FM: N/A Wireless FM: Applicable Wireless NOC: N/A
Metric Formula:	Metric = Number of person-hours required to install the equipment for a given type of cell site.

Metric Type:	Resources & Staffing
Metric ID:	TOC-RS1.8.6
Metric Description:	Number of person-hours required per cell site equipment acceptance testing
Metric Definition:	General: This metric measures the resources required to complete the acceptance test for cell site equipment. Wireline FM: N/A Wireless FM: Applicable Wireless NOC: N/A
Metric Formula:	Metric = Number of person-hours required to complete the acceptance testing for equipment for a given type of cell site.

Metric Type:	Resources & Staffing
Metric ID:	TOC-RS2.1.1
Metric Description:	Annual rate of staff turnover
Metric Definition:	General: This metric measures the annual staff turnover of an organization/workgroup. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: Applicable
Metric Formula:	Metric = Number of staff who leave the organization divided by the monthly staff headcount in that organization averaged over that year × 100%.

Metric Type:	Resources & Staffing
Metric ID:	TOC-RS2.2.1
Metric Description:	Average number of years on current job
Metric Definition:	General: This metric measures the average number of years of service of the staff in an organization. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: Applicable
Metric Formula:	Metric = Sum of each individual staff member's years of service in the organization divided by total number of staff members.

Metric Type:	Resources & Staffing
Metric ID:	TOC-RS3.1.1
Metric Description:	Average length of training in weeks on current job
Metric Definition:	General: This metric measures the average length of training that the staff members of an organization have on the current job. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: Applicable
Metric Formula:	Metric = Sum of all current-job related training that the entire staff of the organization received divided by total headcount of the organization. NOTE – This is typical personnel data.

Metric Type:	Resources & Staffing
Metric ID:	TOC-RS3.1.2
Metric Description:	Average number of years of experience or training on similar jobs
Metric Definition:	General: This metric measures the average years of professional experience (YPE) or training of an organization's staff. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: Applicable
Metric Formula:	Metric = Sum of all staff member's YPE divided by total staff headcount in the organization.

5.4 Productivity and unit cost metrics

Metric Type:	Productivity & Unit Cost
Metric ID:	TOC-PU1.2.1
Metric Description:	Average duration in hours of a field dispatch
Metric Definition:	General: This metric measures the average duration of a field dispatch. The value of the metric includes the travel time and the repair time. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: N/A
Metric Formula:	Metric = Sum of dispatch durations, in hours, in an organization's staff log in a quarter divided by the total number of dispatches in that same quarter.

Metric Type:	Productivity & Unit Cost
Metric ID:	TOC-PU1.3.1
Metric Description:	Average cost of a field dispatch
Metric Definition:	General: The metric is to measure the actual average cost, in dollars, of a field dispatch. The costs include staff time spent on the dispatch and vouchered expenses as per generally accepted accounting practice. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: N/A
Metric Formula:	Metric = Total dispatch cost, in dollars, an organization incurred in a quarter divided by the total number of dispatches in that quarter.

Metric Type:	Productivity & Unit Cost
Metric ID:	TOC-PU1.5.1
Metric Description:	Percentage of staff utilization of field maintenance
Metric Definition:	General: This metric measures the utilization of field maintenance staff in an FM group or organization. The intent of this metric is to quantify how efficiently the maintenance staff is spending their time producing the results that really count – resolving/repair faults. The value of this metric can be a good indicator for efficiency of work scheduling and locations of dispatch centres relative to repair sites. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: N/A
Metric Formula:	Metric = Sum of repair/resolving time of all trouble tickets in a quarter the organization's staff spent divided by the sum of logged work time by the organization's staff in the same quarter.

Metric Type:	Productivity & Unit Cost
Metric ID:	TOC-PU2.1.1
Metric Description:	Number of field technicians per central SME for each business shift
Metric Definition:	General: Field technicians supported by central SMEs require less training/experience and, as a result, an organization's staffing costs can be reduced. However, the ratio of field technicians to central SMEs in a given business shift must strike a balance, for too high a ratio could mean insufficient support for the field technicians, thereby negatively impacting the quality of their work. The ratio is an important metric that determines the cost and effectiveness of a tiered support structure commonly found in field maintenance organizations. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: N/A
Metric Formula:	Metric = Number of field technicians on duty divided by the number of central SMEs on call in a regular business shift.

Metric Type:	Productivity & Unit Cost
Metric ID:	TOC-PU2.1.2
Metric Description:	Access to systems and databases
Metric Definition:	General: Remote access to systems or databases, such as inventory DB, installation and maintenance M&P. This includes information on laptops or other devices that a dispatchee has on hand during a field maintanence dispatch. This metric is a binary metric. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: N/A
Metric Formula:	Metric = 1, if the field technicians on a dispatch call have remote access to knowledgeware in central systems, or on portable devices, else Metric = 0.

Metric Type:	Productivity & Unit Cost
Metric ID:	TOC-PU3.1.1
Metric Description:	Percentage of dispatches pre-authorized to access the repair site
Metric Definition:	General: Not all dispatches are pre-authorized to access the repair sites. This could be a result of organizational and personnel restrictions, such as union rules and building security policies, as well as availability of the best resources for the dispatch assignment at a given time. The higher the percentage of pre-authorized access to repair sites, the better for productivity and cost reasons. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: N/A
Metric Formula:	Metric = Number of dispatches pre-authorized to access the repair sites in a quarter divided by the total number of dispatches recorded for the same quarter.

Metric Type:	Productivity & Unit Cost
Metric ID:	TOC-PU3.1.2
Metric Description:	Average time to reach a repair site
Metric Definition:	General: This metric measures the average time a dispatchee takes from a central dispatching location to the repair site by common modes of transportation. This metric is closely related to the MTTA that a service vendor can commit to a client. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: N/A
Metric Formula:	Metric = Sum over all sites in a given service area of travel time to each repair site by common modes of transportation from the dispatching location(s) divided by the number of repair sites in that same service area.

5.5 IT/OS infrastructure metrics

Metric Type:	IT/OS Infrastructure
Metric ID:	TOC-II1.1.1
Metric Description:	Number of technology platforms in the IT/OS infrastructure
Metric Definition:	General: This metric measures the number of technology platforms in an organization's IT/OS infrastructure. The more the platforms, the more difficult to support, and potentially the more costly to operate the infrastructure. Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	Metric = Number of different platforms that support an organization's IT/OS infrastructure.

Metric Type:	IT/OS Infrastructure
Metric ID:	TOC-II1.1.2
Metric Description:	Number of vendors that provide the equipment in the IT/OS infrastructure
Metric Definition:	General: This metric measures the number of equipment vendors that provide the systems in the infrastructure. Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	Metric = Number of vendors that supply the systems in the infrastructure.

Metric Type:	IT/OS Infrastructure
Metric ID:	TOC-II1.1.3
Metric Description:	Percentage of systems with better than five-nine availability
Metric Definition:	General: This metric is meant to be a simplified measure of the availability of systems in the IT/OS infrastructure. Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	Metric = Number of systems having five-nine or better availability divided by total number of systems in the infrastructure.

Metric Type:	IT/OS Infrastructure
Metric ID:	TOC-II1.1.4
Metric Description:	Availability of baselined IT/OS architecture
Metric Definition:	General: This is a binary metric. It simply captures whether a service provider has a baselined IT/OS architectural document. Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	Metric = 1 if an up-to-date IT/OS architecture document is available, or will be available in 3 months, else Metric = 0.

Metric Type:	IT/OS Infrastructure
Metric ID:	TOC-II1.1.5
Metric Description:	Percentage of standardization of system interfaces
Metric Definition:	General: Standardized system interfaces are easier to support. This metric measures the degree of standardization of system interfaces in the infrastructure. Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	Metric = Number of standardized interfaces in the infrastructure divided by total number of system interfaces in the infrastructure.

Metric Type:	IT/OS Infrastructure
Metric ID:	TOC-II1.1.6
Metric Description:	Percentage of systems that require user interfaces have graphic user interfaces (GUI) for the end users
Metric Definition:	General: GUIs are preferred user interfaces because they are more user-friendly. Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	Metric = Number of graphic user interfaces for systems in the infrastructure divided by total number of user interfaces.

Metric Type:	IT/OS Infrastructure
Metric ID:	TOC-II1.1.7
Metric Description:	Percentage of systems that allow access through the Web
Metric Definition:	General: Access to systems through the Web is a technology trend that facilitates operations support and enhances organizational flexibility. Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	Metric = Number of systems that support Web access/Total number of systems in the infrastructure.

Metric Type:	IT/OS Infrastructure
Metric ID:	TOC-II2.1.1
Metric Description:	Degree of automatic cross-population of data into databases
Metric Definition:	General: When a data element has to reside in multiple databases, it should ideally be entered only once into its recording database. The other databases that also need the data element can receive/retrieve an electronic copy from the recording database. Multiple entries of the same data element into multiple databases increase the probability of data discrepancies across the databases, and increase operations cost as well. This metric measures the percentage of automatic cross-population of data in databases for the following functional data categories, where applicable, for an SP: Customer/subscriber database. Customer service order database. Network service order (e.g., ESO) database. Customer trouble ticket database. Network trouble ticket database. Customer service/circuit configuration database. Network inventory database – transport. Network inventory database – equipment. The scoring scheme is as follows: If customer/subscriber is entered into the customer/subscriber database – its recording database – and if this information is then automatically cross-populated in 2 of the other 3 databases, and is manually populated into the third and last one, then the score for customer data is 2/3 = 66.7%. Similarly for the customer service order data, and so on. Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	Metric = Sum of weighted scores over all data categories/Sum of weight of each data category.

5.6 Regulatory compliance metrics

Metric Type:	Regulatory Compliance
Metric ID:	TOC-RC2.1.1
Metric Description:	Number of government agencies/authorities that have regulatory jurisdiction over wireless field maintenance functions
Metric Definition:	General: This metric measures the number of regulatory authorities that a service provider's operations organization/work group has to work with. This metric is primarily intended for wireless field maintenance. The work functions to be covered in this metric(s) are: 1) Apply for RF Licenses. 2) Apply for Cell site permits. 3) Construct Cell towers. 4) Submit mandated reports/filings. 5) Report physical plant and building disasters – fire, environmental harzards. Wireline FM: N/A Wireless FM: Applicable Wireless NOC: N/A
Metric Formula:	Metric = Number of regulatory auhorities that an operations organization has to work with.

Metric Type:	Regulatory Compliance
Metric ID:	TOC-RC1.1.1
Metric Description:	Percentage of compliance with Government (FCC) mandated SLAs
Metric Definition:	General: This metric measures the percentage of compliance with SLAs mandated by regulatory authorities for the trailing 12-month period. Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	Metric = Number of mandated SLA filings that, in the last 12 months, met or exceeded requirements divided by total number of SLA filings in the same 12-month period.

Metric Type:	Regulatory Compliance
Metric ID:	TOC-RC1.2.1
Metric Description:	Degree of automatic generation of government-mandated reports/filings
Metric Definition:	General: This metric measures the annualized percentage of automated generation of government-mandated reports/filings based on the following tasks: 1) Data collection. 2) Report preparation. 3) Report filing. Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	Metric = Sum over all different reports/filings of the percentage of total function points in the process performed non-manually across the above steps for each report/filing, multiplied by the number of filings per year, divided by the total number of reports/filings per year.

Metric Type:	Regulatory Compliance
Metric ID:	TOC-RC1.2.2
Metric Description:	Number of distinct government-mandated reports/filings
Metric Definition:	General: This metric captures the total number of distinct reports/filings that a SP has to submit to governments at various levels regularly. That is, service tariff filings are excluded. Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	Metric = Number of distinct reports.

Metric Type:	Regulatory Compliance
Metric ID:	TOC-RC1.2.3
Metric Description:	Annual cost of a government-mandated report/filing
Metric Definition:	General: This metric captures the annual cost of reports/filings that an SP has to submit to governments at various levels regularly, excluding service tariff filings. Wireline FM: N/A Wireless FM: N/A Wireless NOC: Applicable
Metric Formula:	Metric = Sum of all costs on an annual basis associated with all regulatory reports/filings.

5.7 Organization metrics

Metric Type:	Organization
Metric ID:	TOC-OG1.1.1
Metric Description:	Chain of reporting
Metric Definition:	General: How the top manager of a specific organization, i.e., NOC, FM, fits into the overall company hierarchy has an impact on the overall effectiveness of the organization. This metric is defined as follows: If the top manager of the specific organization is n-levels removed from the CEO of the company, then the metric value = N. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: Applicable
Metric Formula:	Metric = N, when the top management of the specific organization is N-level removed from the company CEO.

Metric Type:	Organization
Metric ID:	TOC-OG1.2.1
Metric Description:	Organizational interfaces
Metric Definition:	General: This metric measures how many different organizations the organization in question has to interface with in its daily work. The interfaces should not include those that facilitate non-routine transactions. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: Applicable
Metric Formula:	Metric = Sum of all interfaces needed for conducting routine business.

Metric Type:	Organization
Metric ID:	TOC-OG1.3.1
Metric Description:	Organizational structure
Metric Definition:	General: This metric captures the structure of an operations organization. Is the organization's staff centralized or distributed to be closer to where it does the actual work? This is a tertiary metric. Wireline FM: Applicable Wireless FM: Applicable Wireless NOC: Applicable
Metric Formula:	Metric = 1, if the staff of the organization is physically centralized; Metric = 2, if the staff of the organization is physically distributed and virtually centralized, such as a NOC staff can be structured into different teams located in different regions.

Metric Type:	Organization
Metric ID:	TOC-OG1.4.1
Metric Description:	Management layers
Metric Definition:	General: This metric captures how many layers of management are between the working level in an organization to the top management of that organization. Wireline FM: N/A Wireless FM: N/A Wireless NOC: N/A
Metric Formula:	Metric = Number of management layers above the working staff level.

5.8 Technology specific metrics

Metric Type:	Technology specific
Metric ID:	TOC-TS1.2.1
Metric Description:	Average cable miles per cell site
Metric Definition:	
Metric Formula:	

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