

MEASUREMENT STRATEGY GUIDE

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1 INTRODUCTION

This Measurement Strategy Guide is intended to assist Communications Providers in understanding:

- The range of potential measures that may be adopted to demonstrate compliance with the Metering & Billing Direction (the Direction); and
- How those measures may be presented in a Measurement Strategy Document (MSD) and the monthly measurement result reports.

In forming an opinion regarding compliance with the Direction, both the Communications Provider and their Approval Body should seek objective evidence of compliance. In practice some measures are clearly objective in nature, such as the measurement of call timing accuracy, and others are more subjective, such as measuring the effectiveness of procedures and documentation covering all aspects of the Total Metering and Billing System (TMBS) for which a Communications Provider is responsible.

The MSD is the vehicle for a Communications Provider to present the rationale for the measurements adopted and agree these with their Approval Body as described in **Clause 10** of the Direction. The MSD will describe how the measurements are conducted and how the results will be presented each month in a format conducive to demonstrating compliance with the Direction. The MSD is therefore an important element for assessment in its own right and forms the basis for auditing the operation of TMBS performance measurement by an Approval Body.

It is recognised that implementing and maintaining a measurement capability carries a cost burden to Communications Providers and they are not expected to construct a measurement system that is prohibitively expensive. The guidance that follows should therefore be read in the context of their own particular operating circumstances.

The general use of the word measured includes audited, assessed etc.

2 CHARACTERISTICS OF COMMUNICATIONS PROVIDERS

The products and services offered by Communications Providers, and the means of delivering these products and services, vary considerably such that no two TMBSs are the same.

One Communications Provider may do everything “in house” while another may outsource some or all of their network functionality, billing operations, Bill printing, customer services etc. Some Communications Providers are simply termed as Carriers because they service the Reseller industry and deliver Call Data / Detail Records (CDRs).

Communications Providers may adopt colloquial names for the departments involved in operating the TMBS components under their direct control, for their business processes and for any measurement tools and may place operational responsibilities in different departments to suit their local or global structure.

Hence the extent to which the requirements of the Direction apply to any given Communications Provider’s TMBS will be dictated by their particular circumstances. The Approval Bodies consider that the Measurement Strategy and System will need one individual to act as “owner” and take responsibility for all aspects whilst recognising that no single department or individual can control or operate all the measures required to demonstrate compliance.

3 DIRECTION CLAUSES RELATING TO MEASUREMENT

Clauses 3 to 10 in the Direction specify requirements necessitating a means of compliance verification that in most cases implies measurement activity.

The measurement implications of relevant Clauses are considered below but the examples given are illustrative only.

An important principle to bear in mind is that the Direction relates to the **actual** accuracy and reliability of metering and billing as experienced by End-users and not the **potential** accuracy and reliability of metering and billing possessed by a TMBS.

The significance of this distinction is best illustrated by examples. If a TMBS experienced a major error in tariff tables the **potential** for incorrect charging would exist if Chargeable Events were processed. But if the error was corrected before any Chargeable Events were processed then no **actual** charging errors would arise and there would be no impact on compliance with the Direction. On the other hand, a TMBS may have the **potential** for very accurate metering and billing, but if the persons operating it fail to follow the stipulated procedures, the **actual** performance may be very much worse than that which the TMBS is potentially capable of.

3.1 CLAUSE 3.1 IN THE DIRECTION

"All charges must be consistent with the Published Tariff or Previously Agreed Tariff applicable to the End-user charged."

Measurement Considerations:

For each tariff relating to a material¹ product or service there should be a means of verifying that End-users' use of services relating to each tariff results in the correct charges being applied. In practice anomalies could arise because of switch timing errors, rounding errors in Chargeable Event data, tariff table errors, algorithm errors, etc.

A possible measurement strategy would be an End-to-End measurement that creates or samples individual Chargeable Events and verifies that the corresponding charges that are applied are correct². If sampling is adopted it should be designed to represent End-users' actual use of products and services to avoid an unrepresentative bias in any results obtained.

An alternative measurement strategy would be to measure the "incremental contribution" of any errors, for example by having measures that report the effect of tariff table, switch, mediation, rating and billing errors and combining the results.

Clause 3.1 does not specify any performance targets or limits, these being defined in clause 3.2 of the Direction.

3.2 CLAUSE 3.2 IN THE DIRECTION

"Unless otherwise specified in the Published Tariff or Previously Agreed Tariff, a charge shall be determined in accordance with all of the following limits that apply to it..."

Measurement Considerations:

¹ Some published tariffs may relate to products or services that are excluded from the scope of the scheme on the grounds of materiality, see clause 9 of the Direction.

² As represented on end users bills in the case of post-paid accounts or decremented from account balances in the case of pre-paid accounts.

3.2.1 Clause 3.2 (a) in the Direction

Where charges are dependent on the duration of a Chargeable Event **Clause 3.2 (a)** defines the timing tolerances permitted in recorded duration³.

The reference point against which recorded duration could be compared may be defined as that perceived by the End-user or as that recorded;

- by call sending or other test equipment;
- in an event record, e.g. a CDR, signalling event; or
- at some arbitrary point(s) in a network

The definition⁴ of actual call duration that relates closely to End-users' perceptions for the purpose of this guide and any Communications Provider's measurement strategy is:

"Actual Call Duration" means the period of time for which each End-to-End connection is available to both users for communications, be they real or virtual, for example as in the form of Interactive Voice Response technology. This period may include any set-up and / or termination times and tolerances, as described in the Communications Provider's Published Tariff, Previously Agreed Tariffs and / or Terms and Conditions.

A Communications Provider may propose reasonable alternative definitions for consideration by their Approval Body, subject to the definition when agreed being made visible to users in Published Tariffs, Previously Agreed Tariffs and Terms and Conditions.

The definition of actual call duration used must facilitate objective measurement of any differences between the actual call duration, as defined, and the recorded duration in order to verify compliance with **Clause 3.2 (a)** of the Direction.

3.2.2 Clause 3.2 (b) in the Direction

Where charges are dependent on the time of day **Clause 3.2 (b)** requires the time of day to be recorded to with ± 1 second traceable to an appropriate time reference, unless Published Tariffs or Previously Agreed Tariffs state otherwise.

From a measurement point of view an Approval Body would expect a Communications Provider to have a means of verifying that the real time clocks used to time-stamp Chargeable Events are maintained within the permitted tolerances and that the actual time-stamping of Chargeable Events is within the permitted tolerances.

The former could be addressed through procedures and / or audits conducted by the Communications Provider and the latter through test call sending, both aspects being subject to audit by the Approval Body.

3.2.3 Clause 3.2 (c) in the Direction

Where charges are dependent on the counting of events **Clause 3.2 (c)** sets the permitted error limits.

As for **Clause 3.1** a possible measurement strategy would be an End-to-End measurement that creates or samples individual Chargeable Events and verifies that the corresponding charges that are applied are correct. If sampling is adopted it should be designed to represent End-users' actual use of products and services to avoid an unrepresentative bias in any results obtained.

³ Neither the Direction nor the Scheme Guide defines any reference point against which these tolerances should be measured.

⁴ Offered by the Approval Bodies' Forum

3.3 CLAUSE 3.3 IN THE DIRECTION

Table 1 – TMBS Reliability limits.

Measurement Considerations:

Table 1 in the Direction differentiates between Logging / Metering and Billing (and imposes different performance requirements) but does not define where the boundary between these functions lies.

Interpretation of Table 1 is advised below.

3.3.1 Table 1, Column 1 Logging / Metering in the Direction

Column 1, Logging / Metering refers to the recording and conveyance of data representing Chargeable Events up to the point that the data is used for the purposes of calculating charges. i.e. the Logging / Metering function could logically include mediation processes provided no rating or application of tariffs is involved.

Errors that could be attributable to Table 1 Column 1 (and therefore require measurement) include, inter alia, switch clock errors, Chargeable Event duration errors, lost / missing event records, duplicated event records and "incorrect A or B numbers", (especially relevant where Number Translation Services are involved).

The measures and tolerances permitted are specified in Table 1, Column 1 of the Direction.

Logging / Metering data may be conveyed and represented on End-users' Bills in the form of itemised usage records showing duration and / or time of day for End-user information only. A strict interpretation of the Direction leads to the conclusion that provided such records were correct (within the permitted limits) when used for rating Chargeable Events then any inaccuracy in the presentation of itemised records showing duration and / or time of day on End-users' Bills should not be counted against the limits of Table 1 in the Direction.

3.3.2 Table 1, Column 3 Billing in the Direction

When data representing Chargeable Events are used to calculate charges (i.e. rating or billing) then Table 1, Column 3, "Billing" applies.

Errors that could be attributable to Table 1 Column 3 (and therefore requiring measurement in terms of both number and value) include, inter alia event records incorrectly rated, records arriving after the relevant Bill was produced, records held in suspense⁵ and not available at the time of Bill production.

The measures and corresponding tolerances are specified in Table 1 Column 3 of the Direction.

3.3.3 Table 1, Column 2 in the Direction

Whereas Columns 1 and 3 provide the preferred criteria, it is recognized that not all TMBS will lend themselves to such analysis. This might be because of the structure of the TMBS and the parts related to Metering and / or Billing or the number of Communications Providers involved.

Table 1, Column 2, "End-to-End" caters for either or both of the above situations by direct use or permitting equitable apportionment of the limits stated in Column 2 between the various Communications Providers. Section 7.4 of the Direction refers.

⁵ If the reason for suspense is due to an error in the switch the inaccuracy should be measured against the requirements of Table 1 Column 1

3.4 CLAUSE 4 IN THE DIRECTION

“The Communications Provider shall employ safeguards to prevent gross errors being included in individual End-users’ Bills.”

This Clause sets general expectations regarding the business processes that should be in place to ensure individual Bill accuracy.

Measurement Considerations:

The Communications Provider would be expected to have some routine means of ensuring individual End-users' Bills do not contain gross errors. Bills about to be dispatched may be reconciled with previous Bill trends to confirm reasonableness. Alternatively, a sample of individual Bills may be checked or verified prior to dispatch.

Measurement reports might include the number of Bills identified as exceptions for investigation as a proportion of total Bills issued, the number of Bills found to be actually in error, the root causes of errors and impact analysis. Whilst such reports may not normally be supplied to an Approval Body on a regular basis they may be the subject of audit to gain assurance that effective controls are in place.

The Communications Provider would be expected to have data showing the number of upheld End-user Complaints that count towards compliance with Table 1 and to have interpreted and reported their impact in relation to Table 1. Upheld End-user Complaints can be useful to validate measurement data is complete, i.e. if measurements are showing no errors but there is a significant level of upheld End-user Complaint then the measurement strategy should be reviewed.

3.5 CLAUSE 5.2 IN THE DIRECTION

“The timeliness of Bill Issue or Bill data file Issue shall be subject to systematic processes.”

This Clause sets limits on the age of Chargeable Events that may be included on Bills.

Measurement Considerations:

To comply with this Clause, Communications Providers must identify Chargeable Event records that exceed the permitted age limit(s), quantify the number and value of such events and include them in the reporting of Undercharged Events in Table 1, unless permission to do otherwise has been obtained from affected End-users. An exception is made for trivial Bills (MABG3).

Typically such screening could be applied during the rating or billing process and would result in reports being generated that would satisfy the measurement requirement.

3.6 CLAUSE 5.4 IN THE DIRECTION

This Clause addresses the timeliness of Bill delivery.

Measurement Considerations:

Effectual Bill or Bill data file delivery schedule shall be verified by the Communications Provider possibly through contracted reports from the delivery agent as the Direction states the existence of such a contract shall be subject to audit.

3.7 CLAUSE 6 (TARIFFS) IN THE DIRECTION

Measurement Considerations:

Tariffs should not conflict with each other or the data uploaded to the rating engine. Measurements should be conducted to demonstrate that rating is functioning as described in the tariffs issued. Mechanisms should be in place to confirm the consistency of all appearances and uses of tariff data, the outputs from such mechanisms providing a measure that could be interpreted in terms of Table 1.

3.8 CLAUSE 7.3 (INTER-WORKING BETWEEN COMMUNICATIONS PROVIDERS) IN THE DIRECTION

This Clause places an obligation on the issuing and / or receiving Communications Provider to have in place a sufficient level of checking, as agreed with an Approval Body, to confirm the integrity of issued or received data.

Measurement Considerations:

Integrity and reasonableness tests that might be applied to data include checking for duplicate or missing records, verifying completeness of Chargeable Event records (i.e. no missing fields), date and time-stamping of chargeable events (valid entries and within billable time period, see **Clause 5.2** of the Direction), valid originating and receiving party numbers (i.e. within expected ranges for billing purposes) etc. The tests applied should facilitate measurement and reporting of the impact of uncorrected errors in relation to Table 1.

3.9 CLAUSE 8.1 (TMBS) IN THE DIRECTION

This Clause places an obligation on the Communications Provider to effectively use procedures and documentation covering all aspects of TMBS operation for which it is responsible.

Measurement Considerations:

A Communications Provider operating a TMBS could have a document register / inventory that acts as a review record which will demonstrate to an Approval Body the procedures within the TMBS.

3.10 CLAUSE 8.2 (SUB-CONTRACTORS) IN THE DIRECTION

This Clause requires sub-contractors operating or maintaining part of a TMBS be contractually committed to maintaining compliance with those aspects of the Direction that apply to them.

Measurement Considerations:

In addition to any contractual commitment placed on a sub-contractor consideration should be given to the feasibility of objectively measuring the sub-contractor's compliance.

For example if network functionality is operated by a sub-contractor such that they are responsible for generating Chargeable Event records it would be possible to apply controlled tests to generate Chargeable Events and confirm the integrity of the data received - call sending would be a practical example⁶.

If rating, billing and Bill dispatch was outsourced to a sub-contractor, test accounts could be created and Chargeable Events generated to confirm that accurate and timely Bills were received.

⁶ The generation of test calls may result in charges being raised which involve VAT that would normally be re-claimable.

3.11 CLAUSE 9 (MATERIALITY) IN THE DIRECTION

This Clause permits products and services falling below a materiality threshold to be excluded from the scope of Approval under the Direction.

Measurement Considerations:

The determination of materiality is based on turnover and number of End-users subscribing to products or services. Since both of these parameters will change over time it is necessary to measure them with respect to each product or service to ascertain if it should be included or excluded from the scope of Approval.

Typically, management reports or the marketing function in a Communications Provider would provide the necessary data to identify when the materiality thresholds are, or will be, crossed and a mechanism should be in place to alert the Approval Body when this is expected to occur to allow time for planning any actions necessary.

3.12 CLAUSE 10 (MEASUREMENT SYSTEMS AND MEASUREMENT STRATEGY) IN THE DIRECTION

This Clause requires the creation of a MSD that sets out the basis agreed with the Approval Body for demonstrating conformity with the Direction.

Communications Providers may elect to have more than one MSD especially if they employ more than one TMBS. Two or more MSDs belonging to one Communications Provider could refer to common areas or measurement controlled by and held in a separate document.

4 THE MEASUREMENT STRATEGY DOCUMENT

The MSD should detail the rationale for any measures, the measurement techniques, Equipment and reports that it is proposed will be used to demonstrate compliance with the Direction for the TMBS elements for which the Communications Provider is responsible. It should identify and describe:

- the rationale for the measurements proposed in relation to the Clauses of the Direction;
- the methods of measurement proposed;
- the scope of measurements proposed;
- departments and job titles of those responsible for measurement, audit, and reporting;
- frequency of measurement / audit;
- means of recording results;
- format of results to be reported; and
- means of reporting results to the Approval Body.

Communications Providers should produce a MSD that is expected to be a controlled document or suite of documents covering all areas of the TMBS they operate and the external interfaces they share with third parties.

Neither the Approval Bodies nor Ofcom provide, recommend or dictate measurement systems, but an Approval Body will assess the Communications Provider's MSD, its implementation and reporting arrangements to determine the capability to demonstrate compliance with the Direction on a case-by-case basis and agree it when appropriate.

Compliance would normally be demonstrated by a meaningful, repeatable and recorded audit regime covering the aspects described in the measurement strategy and supported by historic numerical evidence

of compliance with Table 1 of the Direction. Day-to-day Revenue Assurance activities and adherence to quality management principles are inherently auditable processes and may thus be used to demonstrate compliance and should therefore be included in the MSD.

If Communications Providers have documents describing measurements and / or audits then the MSD can refer to these as long as they are controlled documents and fit for purpose.

5 MEASUREMENT STRATEGIES

Fundamentally the Direction relies on four principal reference points:

- the Communication Provider's tariffs;
- a traceable reference to real time of day;
- Service Usage as perceived by End-users; and
- the Bills (or Pre-Paid balances) presented to End-users reflecting the above

In practice intermediate reference points will exist within a Communication Provider's TMBS that may contribute towards determining compliance with the Direction.

In addition to the above, **Clause 3.3** of the Direction requires performance to be expressed in terms of the total number and value of Chargeable Events so an Communications Provider must be able to provide, for those items within scope, the total:

- number of Chargeable Events; and
- value of Chargeable Events.

5.1 BLACK BOX MEASUREMENT STRATEGY

The performance of a TMBS may theoretically be determined by treating it as a black box and monitoring its responses to external stimuli as illustrated in **Figure 1**. This approach could be realised by adopting call sending techniques and / or monitoring live traffic (as close to End-users' Service Usage as possible) and correlating data from these events with the corresponding outputs, i.e. Bills or account balances. The Black Box approach requires an adequate variety of stimuli to ensure all possible functions are exercised. In a practical situation, this may lead to an unrealistically large requirement for stimuli.

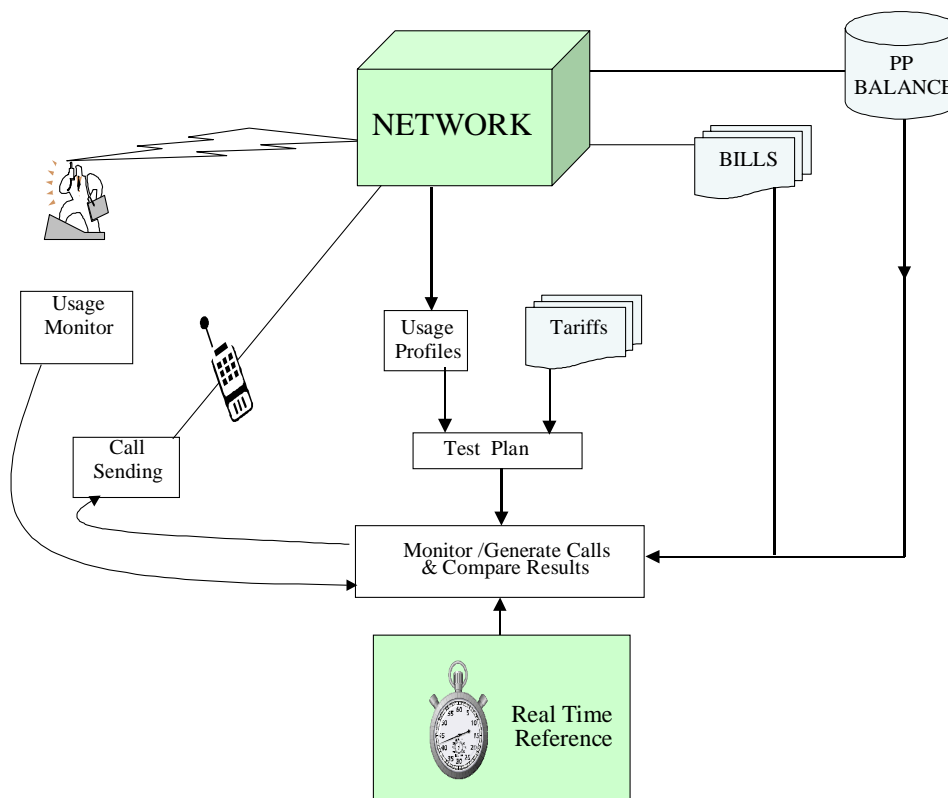


Figure 1 Black Box Measurement Strategy

A “black box” approach should consider the total number of Chargeable Events passing through the TMBS, the type of events (e.g. calls to different destinations relying on different tariffs, SMS, MMS) and their total value in order to develop an appropriate test plan. The now obsolete paper MABG 2 provided guidance on the statistical approach, and in reality indicated that it had drawbacks in terms of the fact that very large numbers of test calls or monitored events are required to provide confidence that the requirements of the Direction are satisfied.

A black box approach does not adequately demonstrate the accuracy of provisioning, fulfilment, cessations and complaint handling as experienced in an operational environment. Therefore additional measurement methods are necessary.

For these reasons the “black box” approach is not recommended by the Approval Bodies.

Where a Communications Provider operates only part of a TMBS similar considerations also apply.

5.2 MEASUREMENT STRATEGY BASED ON KNOWLEDGE OF TMBS

Figure 2 illustrates the typical processes in an End-to-End TMBS and examples of measurement reports.

If some knowledge of the inner workings of a TMBS is taken into account (e.g. the failure modes and effects are understood) then a measurement strategy may be constructed based on that knowledge.

Figure 2 - MSD Overview – typical measurements included in MSD & monthly reports

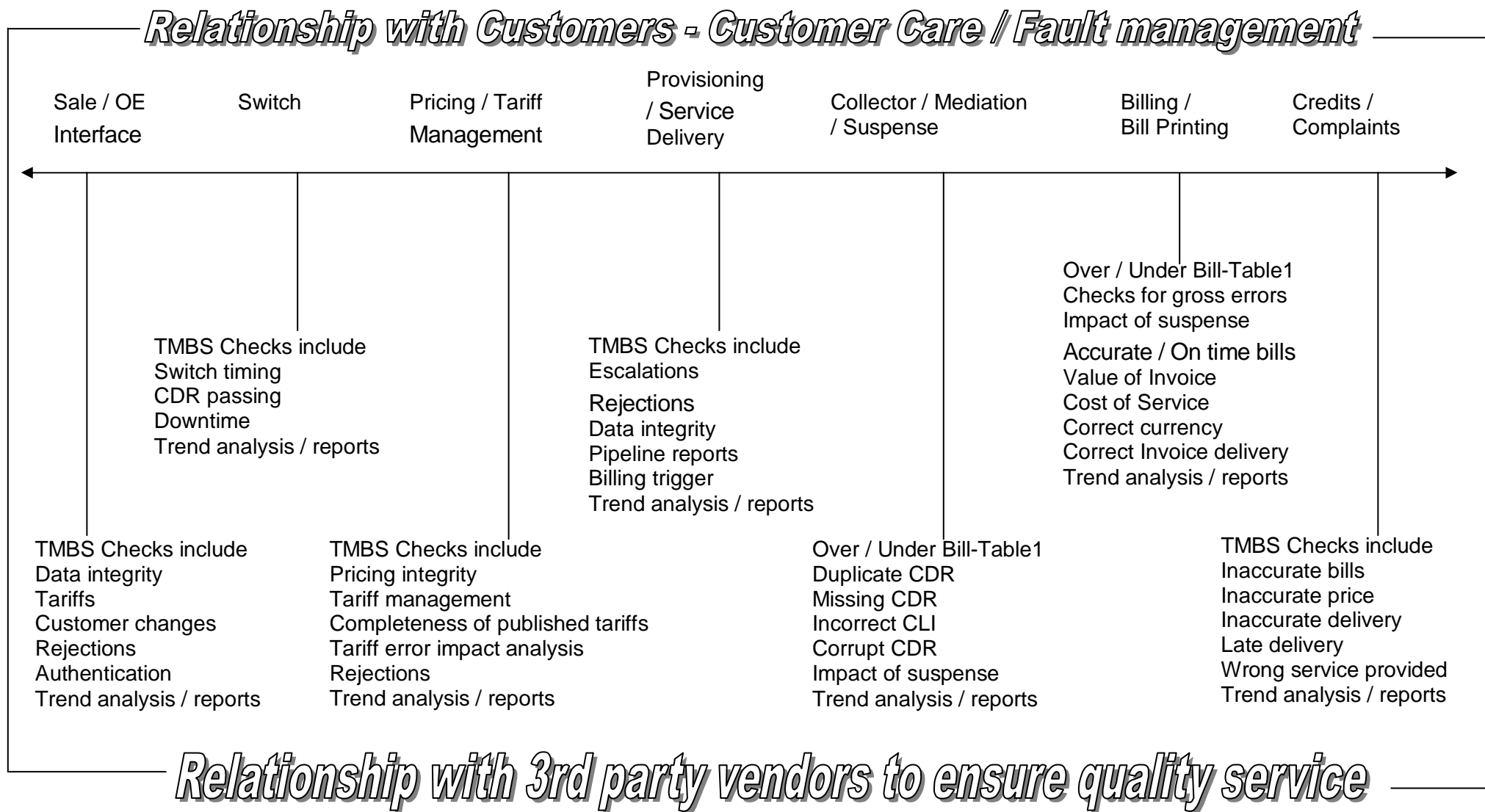


Figure 3 illustrates typical elements supporting the processes depicted in Fig 2. Although the elements shown relate to mobile operations the measurement principles are equally applicable to fixed line operations. Table B describes possible measurement methods and factors to consider in interpreting any results.

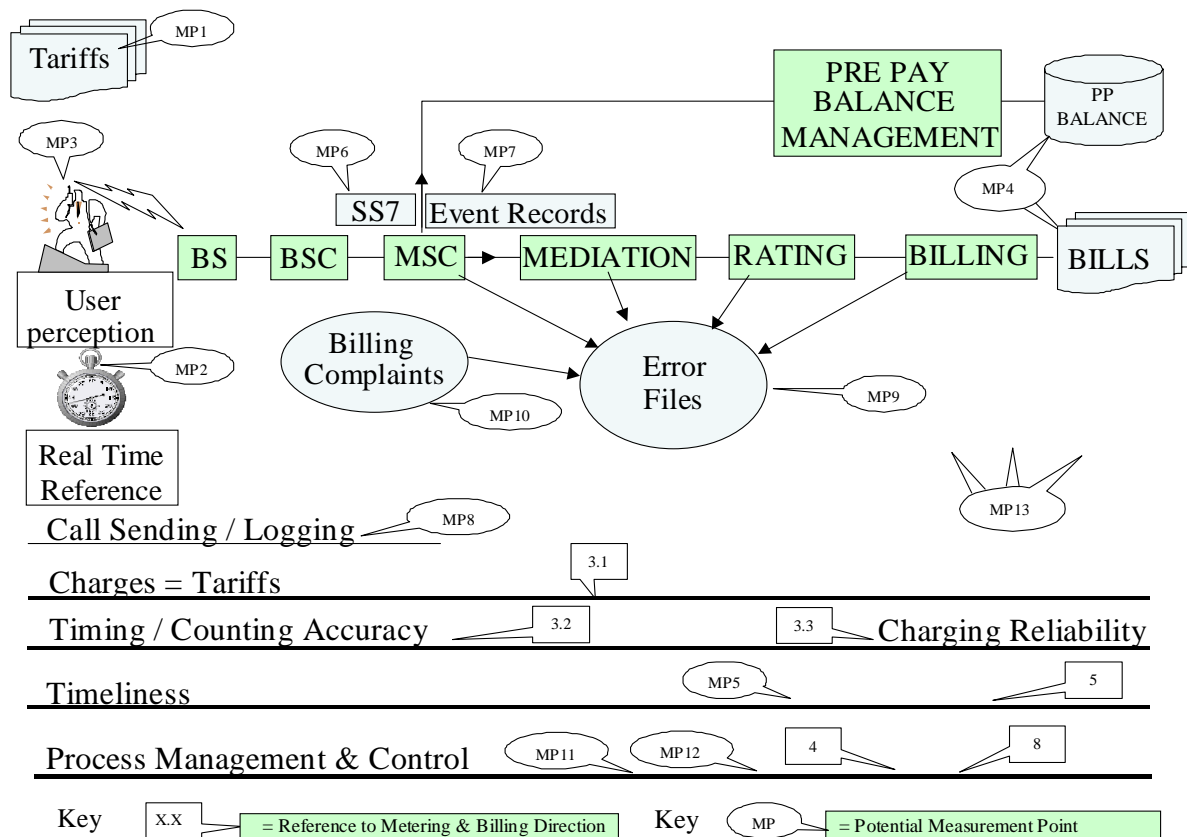


Figure 3. Metering and Billing Elements

In support of this approach, a Communications Provider should undertake an appraisal / risk assessment of potential failure modes to identify:

- potential failure modes
- potential impact of each failure mode
- measurement objectives for each failure model

Table A offers some examples.

Failure Modes	Failure Effects	Measurement Objectives
Radio link loss	Dropped calls with excess duration or failure to create usage record	Report correlation between user perception and event records
Switch clock wrong	All event records wrong time stamp	Report switch clock accuracy
Switch clock drift correction	Event record durations wrong for those events in progress when correction made	Report details of switch clock correction
Switch parameters set incorrectly for event record creation	No event records created for certain classes of event	Confirm event record creation for all classes of event
Rating table error	Event records using the affected rate incorrectly rated	Report rate table errors and impact
Event records cannot be rated / billed	Delayed or no billing	Report number, value & delay in billing and / or not billed
Pre-platform loses contact with switch(es)	Over or under-charging	Report number and value of chargeable events over or under-charged

Table A. Failure Modes, Effects & Measurement Objectives

For each potential measurement point factors to consider are the:

- measurement method;
- expected measurement accuracy / measurement uncertainty; and
- rationale for interpreting and aggregating measurement results for comparison with the Direction.

Table B offers some examples.

Measurement Point	Measurement Method	Uncertainty	Interpretation
MP1 Tariffs	Communications Provider's declared master used as basis for comparison with any other derived representations of tariffs	Not applicable - provides a primary reference point	Discrepancies in derived representations evaluated to determine number & value of chargeable events affected
MP2 Real time	Comparison between Communications Provider's master reference and GPS, NPL, UTC, Rugby or equivalent national reference	Unknown. How does Communications Provider verify accuracy?	Likely to be very small difference but would affect all timestamps
MP3 Customer perception	Logging customer activity and/or call sending	Tolerances in equipment performance uncertain. Call senders unable to generate typical calls in increments of fractions of a second, i.e X+(0-999ms) seconds	No independent reference available to "calibrate" call sender performance. Test calls do not replicate live traffic durations.
MP4 Bills / PP Balance	Extract bill-print files. Access / extract PP balance files.	Time delays between chargeable events occurring & corresponding appearance in files. Non-itemised records will make correlation with bill more difficult	Time of file extract and/or its analysis must relate to period under test - timelines of billing refers
MP5 Timeliness	Compare originating time of chargeable events with appearance on bills, may be based on live traffic	As for MP4 above	Late, missing or "written off" chargeable events to count as undercharged events
MP6 SS7	Extract SS7 data representing End-user activity for comparison with event records	Relationship to event records unknown	Unknown until relationship to event records is defined
MP7 Event Records	Extract event records relating to test calls and/or live traffic. May be correlated with SS7 signalling	Relationship to customer' experience can only be tested by call sending or monitoring live traffic	As for MP6 above

Table B. Measurement Method, Uncertainty and Interpretation

Measurement Point	Measurement Method	Uncertainty	Interpretation
MP8 Call sending	Correlation between chargeable events and End User experience	As for MP3 above	As for MP3 above
MP9 Error Logs	Analyse content of error logs to determine effect and impact in terms of Direction	Accuracy and completeness of data. Rigour and completeness of analysis if relying on manual methods.	Risk of “multiple counting” some events, but effect likely to be small.
MP10 Customer complaints	Identify number of upheld billing complaints. Review root cause analyses, recovery actions and related credits.	May be open to interpretation and misclassification. Time lag between events and remedial action may make impact analysis difficult. Under-billing unlikely to be the subject of customer complaint.	Estimated impact of underlying problems before remedial action takes effect.
MP11 Process management	Audits	Subjectivity in audits	Peer and management review to form balanced consensus
MP12 Totals	Total number of chargeable events and total value of chargeable events provide the denominators used to determine reliability performance.	These “totals” can only be derived from network data, but any errors in the network will mean these totals are inaccurate	Adjustment of the form $X/Y+X$ could be applied where X = number or value in error, Y = total number or value recorded by network
MP13 Reconciliation	Reconciliation of data from multiple sources to provide "checks and balances" and audit trail evidence.	Depends on data sources and the time of extraction for comparison. Often perfect correlation is not possible due to timing synchronisation difficulties.	Can provide good evidence of completeness and timeliness of chargeable event processing end-to-end

Table B. (Cont'd) Measurement Method, Uncertainty and Interpretation

6 ACCUMULATION OF MEASUREMENT RESULTS AND REPORTING

Accumulation of Results is particularly relevant, but not limited, to Undercharged Events and Overcharged Events. Results accumulate in two ways. The first is from different sources and the second is through time.

The Approval Bodies are in agreement that as a general guide a minimum of six months historic cumulative measurement data demonstrating compliance would be required to support an Approval, but the actual period necessary can be considered on a case-by-case basis.

Before an Approval Body can be confident that measurement results are a true indication of actual performance, it is necessary to examine the results accumulated over a finite period of time. How long this period will be is influenced by several factors, including:

- robustness of systems;
- effectiveness of change management systems;
- effectiveness of overall process controls;
- sample sizes;
- margin between achieved / required performance; and
- consistency of results.

6.1 ACCUMULATING MEASUREMENT RESULTS FROM DIFFERING SOURCES

Measurement data may be accumulated from switching elements, from mediation devices, from billing systems, from customer care systems and from other sources.

6.1.1 Overcharged Events

Overcharged Events occur for a number of reasons including but not limited to those listed below:

- provisioning errors;
- incorrect duration recorded;
- usage records presented for billing more than once;
- bundles or discounts incorrectly applied;
- incorrectly applied rentals or one-off charges;
- new lower rates uploaded to the rating engine late;
- End-users provisioned against higher tariffs;
- duplicate entries on the Bill; and
- cessations not completed correctly.

All Overcharged Events from these and other sources are to be added to produce the monthly and rolling cumulative figures.

6.1.2 Undercharged Events

Undercharged Events occur for a number of reasons including but not limited to those listed below:

- provisioning errors;
- chargeable event records not generated or progressed to rating correctly;

- bundles or discounts incorrectly applied;
- End-users provisioned against lower tariffs;
- incorrectly applied rentals or one-off charges;
- suspense ineffectively managed; and
- write-off.

All Undercharged Events from these and other sources are to be added to produce the monthly and rolling cumulative figures.

6.2 ACCUMULATING MEASUREMENT RESULTS OVER TIME

The accumulation of measurement results would not normally be considered complete until the full range of measures has been accumulated and reported for a nominal six-month period.

It is recognised that some measurement data pertaining to the Logging / metering and billing of events may take time to become available. For example, measurement results for logging / metering accuracy may be available shortly after a month end whilst measurement results for billing accuracy may not become available until after Bills have been issued and any End-user Complaints relating to incorrect charging have been evaluated.⁷

Therefore a comprehensive report of performance for any given month will not be available until some time after the month to which it relates. **Table C** illustrates an example where measurement data is collected from three different sources A, B, and C and the time taken to collect, analyse, consolidate and report results occupies a three-month elapsed period. **Table C** shows the status of reporting at the end of June, i.e. comprehensive reports comprising the three sets of data are available for the months of January, February and March; six months of complete data will not become available until September.

A Communications Provider is encouraged to share with its Approval Body the monthly accumulation of results, as they become available and to present results on at least a six month rolling basis to indicate performance trends.

Elapsed Time	Reporting Month					
	January	February	March	April	May	June
January						
February	Data A _J					
March	Data A _J +B _J	Data A _F				
April	Data A _J +B _J +C _J	Data A _F +B _F	Data A _M			
May		Data A _F +B _F +C _F	Data A _M +B _M	Data A _A		
June			Data A _M +B _M +C _M	Data A _A +B _A	Data A _M	
July						

⁷ For example, if upheld complaints were found to be due to a factor not measured by existing measurement techniques additional analysis to determine the impact would be required.

Data A	Results from measurement data "Set A" for the reporting month. Data would typically be from the measurement of logging / metering accuracy.
Data A+B	Results from measurement data "Sets A and B" combined for the reporting month. Data set B would typically be from the measurement of billing accuracy.
Data A+B+C	Results from measurement data "Sets A, B and C" combined to provide final consolidated report for the reporting month. Data set C would typically be from the measurement of payments processing and billing complaints.

Table C. Example of Performance Report Consolidation Over Time

7 REPORTING RESULTS TO AN APPROVAL BODY

Communications Providers are required to provide monthly performance reports to their Approval Body that:

- clearly identify performance in relation to the measurements agreed;
- does not normally require the Approval Body to calculate or interpret data; and
- includes a commentary which highlights any significant detected errors and comments on investigation, root cause(s), corrective actions etc. plus follow up on any points left open from previous reports.

Prior to Approval, measurement results would not normally be considered complete until the full range of measures have been recorded and presented for a nominal but continuous six-month period.

8 RETENTION OF RESULTS AND RECORDS

Communications Providers must retain all source records and calculations used to produce monthly measurement reports and the reports themselves for fifteen months as required by Condition 11 of the General Conditions of Entitlement.

9 FURTHER GUIDANCE

If as a Communications Provider, you decide to employ call logging / call sending equipment to assist in demonstrating conformity to the Direction then it must be evident to you that this alone does not provide an End-to-End solution. Each test call would have to be reconciled through mediation and rating and the rest of the TMBS such as provisioning, discounting and Bill printing and distribution will have to be measured for example.

10 GLOSSARY

BS	Base Station.	GPS	Global Positioning System.
BSC	Base Station Controller.	MABG	Metering And Billing Guide.
CDR	Call Data / Detail Record.	MP	Measurement Point.

MSC	Mobile Switching Centre.	PP	Pre-Paid.
MSD	Measurement Strategy Document	SS7	Signalling System 7.
MMS	Media Message Service / System.	SMS	Short Message Service / System.
NPL	National Physical Laboratory.	TMBS	Total Metering and Billing System.
OE	Order Entry	UTC	Co-ordinated Universal Time
Ofcom	Office of Communications.		

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