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**APT REPORT ON**

**MOBILE QOS BENCHMARKING ASSESSMENT**

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1. **Introduction**

The unprecedented growth in telecommunication technologies and market has derived the increase of the variety of services and providers available to booming consumers. The market is becoming intensely competitive for service providers. Competition has brought not only lower prices for advanced services but also improved quality. However, cutting price is often the preferred way of competing partly because of it can be done faster than improving the quality. Thus, in term of certain aspect, if cutting price involves cutting cost, it can reduce the quality. So price is no longer the sole factor in service purchasing decision, quality is the key. Unlike prices, which users can easily compare across providers, the telecom industry often make measurement for themselves but rarely publicizes the real quality of their service. Benchmarking measurements published by National Regulatory Agency (NRA) perhaps with target level, can oppose forces that can tend to lower quality level in some competitive markets.

This study intends to introduce practice of regulatory scheme in term of benchmarking assessment for the APT region and uses Vietnam as a case study. Within the scope of the study, mobile telephony and Internet access service will be considered.

1. **Current status of the APT member market**
	1. **Market information**

Currently, Asia Pacific is the largest mobile market in the world, and is continuing to show strong growth. Asia Pacific accounts for half of the total mobile connections in the world, with 3 billion lines. Most of the major markets in the region have at least five network operators. This is contributing to rapidly declining prices and operator margins in most markets. The mobile sector is one of major contributor to Asian economic growth, which accounts for an estimated US$ 864 billion or 4.7% of GDP with 3.7 million jobs[[1]](#footnote-1). With the move from traditional network, which based on dedicated service-channel and separate networks for each service, toward integrated (transport) service on a single packet based transport infrastructure, which delivers all service via single network access point, broadband network, voice, data and video services can now be offered on the same platform.

* 1. **Questionnaire Response from APT member**

As you would recall, the 23rd APT Standardization Program Forum (ASTAP-23) was completed successfully in Pattaya, Thailand from 03 – 07 March 2014. The meeting has approved the questionnaire to to collect information about current status of quality of service monitoring from APT member. The result of response is presented below

Table 4.1. Number of respondent by type

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Service Provider/ Network Operator | Regulator /Administration | Standard Developing Organization | Terminal or Network Equipment Manufacturer | University/ Institute/R&D Organization |
| None | Japan (JPN), Papua New Guinea (PNG), and Thailand (THA) | None | None | None |

Table 4.2. Response detail

| **No** | **Question** | **Responses** | **Comments** |
| --- | --- | --- | --- |
| 1. | Is there regulation on quality of telephone service on the Public Land Mobile Network in your country? If yes, please provide the reference | Yes: THA, No: PNG, JPN | **PNG**: There is no regulation regarding quality of telephone service on PLMN in Papua New Guinea. But for various services, QoS is mentioned as a sub-section within the various regulated documents of specific services or networks. |
| 2. | Please give brief summary of service regulation status in your country | Regulation oriented: JPN, PNG, THA Customer oriented: Other, specify: | JPN: Regulation for Telecommunications facilities for telecommunication business |
| 3 | Challenges in terms of achieving desired mobile QoS from your point of view | **Service Provider/ Network Operator:**- JPN: + Establishing a voice quality standard between terminal facilities preliminarily and notifying the standard to the minister; + Conforming with the standard**Regulator / Administrator**: - PNG:+ Standardization+Customer protection+ Balance between service competition and infrastructure competition+ Simultaneously monitoring and control the performance of mobile network |  |
| 4 | Is there national technical regulation (standard) on quality of telephone service on the PLMN in your country?If Yes, please provide ITU-T/ETSI/IETF/Other SDOs recommendation(s) which the standard harmonized to | **Yes**: JPN, THA**No:** PNG- JPN: Harmonized to ITU-T recommendations;- THA: harmonized to ITU-T E.800, ETSI TS 102 250-2, ETSI EG 202 057-4; ETS TS 102 250-5 |  |
| 5 | What criteria/parameters do you use to test and measure quality of service?If a target level is set for those criteria, please specify. | 1. **THA**:

 Target:\_\_2\_\_ [%] (*intra, 2000 – 2100 avg*)Target:\_\_\_\_\_\_\_\_\_Target:\_\_\_\_\_\_\_\_[s]Target:\_\_\_\_\_\_\_\_[%]Target:\_\_\_\_2\_\_\_\_[%]- Successful call ratio+ intra : 90% (*2000 – 2100 avg*)+ inter: 85% (*2000 – 2100 avg*)- charging error complaint ratioTarget: 2% per month- response time for accessing operator call centerTarget : 60 s avg- Service supply timeTarget: ≤ 60 s- Customer complaint resolution timeTarget: 30 days1. **PNG**

Mobile operator have to comply with requirements including some QoS parameter specified in Special Terms and Conditions for Network Licensees.The operator has to measure and assess their own network performance to fulfil the regulator’s requirements and meet the international best practices in quality service delivery to the public in the country. The licensed mobile operator is responsible for procedures and methods used for measurement of QoS parameters.Target: 99.99 [%]Other parameters includes:* Call-drop rate: ≤ 2%.
* Rate of Call-Failure due to Network

Congestion: ≤ 1%.* Licensed Operator (licensee) must repair 95% of Network faults occurring in main centres, mid-sized centres or small or remotest part of the country within the specified maximum repair time .
* Assessing licensee’s (operator) compliance with Network performance, the performance will be measured over the period of a calendar year.
 | Some of the measurement and assessment criteria/parameters specified below (section 2.2) is detailed in the Special Terms and Conditions for Network Licensees who provide Public Cellular mobile services in Papua New Guinea. Otherwise, these parameters are usually perform by the incumbent mobile operator(s).It is the regulator’s requirement that the services deployed by the mobile operator is of exceptional quality and more so, meets the international best practices in quality service delivery to the public in the country |
| 6 | Please describe your measurement method and procedure needed to perform the measurement and assessment of above QoS parameter | 1. **THA:**

- Objective Testing- Network counters1. **PNG**
2. **JPN**
 |  |
| 7 | Do you perform benchmarking for voice service of different networks within your own national boundary?If yes, describe the typical measurement profile which are required to enable benchmarking, please select from the list below: | **YES:** **1.** THA- Stationary Test: + Outdoor measurement + Indoor measurement- Drive-Test (in a car);- Walk Test (Indoor)- Call Scenario+ Mobile to Mobile+ No fixed call window- Respective access technologies**NO:** PNG | **PNG:** A lot of benchmarking parameters for voice service of different networks is performed by individual licensed mobile operator. NICTA specifies only some practical aspects such as Network performance, Coverage areas, Performance bond and Repair on network fault in the Special Terms and Conditions for Network Licensee who provide voice services of different networks. |
| 8 | General recommendations /suggestions for future ASTAP activities on mobile QoS area | 1. **PNG:**
* Regulators should track the evolution and expansion of the mobile operators network in the country. That is, regulators should do monitoring of any developments within the operators network.
* Tracking service outage or degradation and finding applicable measures to address customer satisfaction in service delivery.
* Standardization of mobile access with respect to the international best practices for quality service delivery.
* Price regulation mechanisms to provide a fair-play between the mobile operators and the users .
* Encourage competition in the telecommunication market. This will encourage operators to provide quality services in-order to win customers and dominate the market.
 |  |
| 9 | Area or issues of interest that needs to foster in term of mobile QoS | 1. **PNG**
* Monitoring the content quality – which includes voice or data.
* Rate monitoring: This includes determining the degree of satisfaction or dissatisfaction of a user of a particular service(s).
* Information about Measurements and Assessments of mobile QoS parameters should be made available to regulators for monitoring and compliance requirements.
 |  |

From the response and other relevant sources, we have learnt that APT regulators are playing a critical role as enablers of future mobile-driven economic. The industry must continue to grow, in sustainable way, in order to facilitate further economic and societal change. Effective regulatory policy-making in quality of service monitoring has potential important influence of the market growth.

Benchmarking assessment in combination with other activities in term of quality of service monitoring will be the key factors to promote fairly competition among businesses, to provide consumers with information for choosing best service and give the authority more power control on quality monitoring.

1. **Recommended activities in quality monitoring focused on benchmarking assessment**

Quality of service benchmarking assessment by regulator can have some aims:

* Help customer to make informed choice;
* Checking claims by provider;
* Understanding the state of the market;
* Maintaining and improving the quality in the presence of competition;
* Helping promote healthy competition through improved service quality

In such conditions, there is a need for regulators to consider an approach to anchor the national regulatory framework around the concept of QoS, which includes quality monitoring with a focus on benchmarking assessment. This process may require multi steps of standardizing, obtaining appropriate information on the level of QoS through measurement, publishing the QoS performance information getting through measurement, imposing regulation on performance, undertaking a constructive dialogue with the operators concerned to encourage and foster the improvement and considering appropriate regulatory approach.

To fulfill the process, recommended activities are: defining measurement and setting the threshold, making measurement and auditing measurement, publishing measurements, ensuring compliance and reviewing the achievement.



Figure 1. Activities in service quality monitoring

* 1. **Defining measurements**

It is important to harmonize with the widely adopted standardization organization’s recommendation while defining measurement. According to ITU-T E.800[[2]](#footnote-2), quality of service is “the collective effects of service performance, which determine the degree satisfaction of a user of the service”, that means QoS concerns aspect of service that users directly experience.

Choice of measurements depends on what customers are most concerned about. Choice of targets depends on what operators can hope to achieve. Getting the right balance needs an understanding of under-laying network capacity, performance and desire of the various kind of customer. For the popular service on mobile networks, ITU-T has recently adopted ETSI Recommendation TS 102 205-2 for defining QoS parameters and their computation and published as recommendation E.804[[3]](#footnote-3). According to the recommendation, there are 3 main parts of QoS parameter:

* Service independent, including Radio Network Availability, Attach Failure ratio, etc
* Direct Services, including Telephony, File Transfer Protocol, Web browsing, etc
* Store and Forward, including SMS, MMS, E-mail, etc

The proposed parameters in the ITU-T E.804 recommendation are well defined and related to user’s experience aspects of the service. It is advisable to choose the parameter from the ITU-T E.804 recommendation to be applied in the measurements. The recommendation also specifies typical measurement profiles which are required to enable benchmarking of different mobile networks both within and outside national borders.

It is advisable for NRA to choose those parameters that are user-oriented and are not intended to address the quality of interconnect services explicitly. There are two important basic services to define measurement: telephony and Internet access. The parameters which are defined for those services have to meet following purposes:

* Specifying the level of the services under the term and condition of provision;
* Enable to compare the quality of service of different providers, which requires benchmarking assessment;
* Study on the underlying quality of service aspect of the measured services.

Particularly for benchmarking, it is recommended to define a specific profile to enable comparing like-to-like services between service providers:

* For Telephony, it requires that measurement profiles are defined for telephony service might be applicable for different scenarios and achieve comparable statistic when performing benchmark. It requires that there no fixed pause between test calls; instead a fixed call window is defined in which the call has to be performed. If the call fails or drops, the next call attempt shall only be made when the next call window arrives.
* For the mobile Internet access, Fixed Data Transfer Test of “Windowed” approach is applied. In this approach, for the measurement of FTP downlink, not a file with a defined size is used (“Best effort” approach) but the duration for the downloading session is defined. The speed is defined as a fraction of an amount of data transferring along the network in a period of time.
	1. **Making Measurements**

There are 3 dominant ways of measuring QoS:

* By using **K**ey **Q**uality **I**ndicator (KQI), that requires gathering all data of network gauge. This method has been often chosen by operators to make periodical report to regulator or customer;
* By conducting live testing which may be performed with the help of a customized vehicle and dedicated equipments, antennas and other facilities capable of gathering QoS data. The goal of this method is to present QoS of the particular area in the particular moment in time. For benchmarking purpose, this method is recommended to use;
* Or by survey: this method provides great feedback from customer, addition to the two above methods it is suitable for investigating customer experience.

Of three above listed methods, live testing is irregularly used by operator because of its cost. However this is a best way for NRA to perform benchmarking assessment with a set of indicators for different services, depending on the scope of regulation, definitions, measurement guideline and expected level of quality while considering following matters:

* Specific measurement profile;
* Measurement environment: Understandably, conducting tests in all these locations is impossible. However, the purpose is not to take exhaustive measurements, but to collect adequate samples that can be used as an indicator of the networks’ overall performance. With this end in view, locations where the service is most used were chosen, i.e. in the larger urban area and on the major road/street;
* Measurement equipment: enable of benchmarking not only services but also the number of measured service providers.
	1. **Publishing measurements**

Measurements result should be published by the regulator to help with comparisons between operators. To simplify the task, the number of measurements to be published could be reduced. The published information may include the measurement methodology, study sample (measurement environment, sample distribution), final and aggregated result. The measurement published should be:

* Accessible to customers: using suitable medium, clearly publication locations and times, do not contain extra or irrelevant number, figures.
* Helpful to customers: most concerned services, customer directly experienced aspect of service, easy to understand and compare (i.e. presented in figures, chart)
* Fair to involved operators

Structurally, the report should include following information:

* Introduction of the measurement;
* Measurement methodology;
* Sample size;
* Test location and time;
* The aggregated result and detailed result.
	1. **Imposing regulation and maintain constructive dialogue**

In general, ensuring compliance is highly recommended in QoS regulation. In case of the measurements show the fault of compliance, the penalties should be imposed. On the other hand, whenever it is feasible, the regulator should engage in constructive dialogue with operators about quality of service problems. Within the scope of the study, we do not go further details in this matter.

1. **Approaches for regulatory scheme in term of mobile QoS benchmarking assessment**

The next step that regulator has to do is to consider appropriate approach for regulatory scheme. There are basically two alternative approaches:

* A regulation oriented approach where
* Report is to the regulator;
* Performance targets are set in the regulation;
* Fines are payable to regulator if targets are not achieved.
* A customer oriented approach where:
* Reporting is to customer;
* Target and minimum performance is required in the contracts of service provision;
* Compensation for poor performance is payable to the affected customer.

In the early stages of the market development, the first approach may be more appropriate if the performance is low and the focus is on achieving a minimum level of QoS performance. During this period, supervision of quality should focus on improving and maintaining the quality of service. Benchmarking assessment should be applied if the long-run measurement results of all operators show the stability and beyond the target level required by the regulation.

In the later stage of development the customer oriented approach may be preferable so that the regulator can reduce its involvement and the operator is pushed to have a closer relationship with the customer. In this stages, the benchmarking assessment play important role of promote the healthy competition, provide customer with information to choose appropriate services.

Benchmarking measurement result to be published should relate to aspects of service that users experience directly (not the underlying technical cause). Publication of the measurement need to ensure that they reach beneficiaries, that they are easily understood without being misleading and that they allow for comparison between operators. Benchmarking measurement result will provide publicly available to end – user comparable, clear and comprehensive, up to date information on the quality of service provided.

Whatever approach selected, benchmarking assessment in combination with other activities in quality of service regulating should aim at:

* + Helping customers to make informed choices;
	+ Checking claims by operators;
	+ Understanding the state of the market;
	+ Maintaining or improving quality in the presence or absence of competition;
	+ Helping operators to achieve fair competition; and
	+ Making interconnected networks work well together.
1. **Vietnam case study**

In recent years, there has been an increase in number of mobile operators and booming of subscribers in Vietnam. It makes Vietnam to be intensely competitive market for operators. As a result, the management policy on quality of service has to be changed to adopt. This lead to some major changes has been made in regulatory scheme of quality of service monitoring. In this session we will demonstrate the Vietnam case study to demonstrate the best practices.

Vietnam NRA has been setup regulations for quality monitoring since 2000. The technical regulation for mobile telephony service has been published 1st version in 2003, revised in 2006 and 2011; the regulation for mobile Internet access service is published in 2014.

1. **Defining measurement**

We have been performed benchmarking assessment for telephony since 2012. The table below is summary of the parameters that we have used for quality monitoring.

*Mobile Telephony*

| **No.** | **Key Performance Indicator** | **Content** | **ITU-T E.804 harmonized** |
| --- | --- | --- | --- |
| 1. | Call Setup Success Ratio (\*) | The probability that end user can not access the service when requested | Yes. Section 7.3.6.1 |
| 2. | Call Cut-off ratio (\*) | Probability that successful call attempt is ended by a cause other than user’s intentional termination | Yes. Section 7.3.6.4 |
| 3. | Speech Quality (\*) | Full reference, intrusive algorithm, which is conformed to ITU-T P.862 or ITU-T P.863; | Yes. Section 7.3.6.3 |
| 4. | Accuracy of Charging; | Accuracy of charging for voice call duration |  |
| 5. | Accuracy of Billing | Accuracy of billing for voice calls |  |
| 6. | Service availability |  |  |
| 7. | Customer’s complaint ratio | Ratio between the number of complaint and total number of subscribers |  |
| 8. | Response to customer complaint | Each customer complaint shall be responded within 48 hours |  |
| 9. | Customer care availability | Availability of customer care centre |  |

*Mobile Internet*

| **No.** | **Key Performance Indicator** | **Content** | **ITU-T E.804 harmonized** |
| --- | --- | --- | --- |
| 1. | Radio Network Availability (\*) | The probability that end user can access to the radio network | Yes. Section 7.2.1 |
| 2. | Service access availability (FTP) (\*) | Probability that a subscriber can establish a PDP context and access the service successfully | Yes. Section 7.3.1.1 |
| 3. | Service access set-up time (FTP) (\*) | Time period need to access the service successfully, from starting the dial-up connection to the point of time when the content is sent or received | Yes. Section 7.3.1.2 |
| 4. | Session Failure Ratio (FTP) (\*) | The proportion of uncompleted sessions and sessions that started successfully. | Yes. Section 7.3.1.5 |
| 5. | Mean Data Rate (FTP) (\*) | Average data transfer rate measured through the entire connection time to the service | Yes. Section 7.3.1.7 |
| 7. | Customer’s complaint ratio | Ratio between the number of complaint and total number of subscribers |  |
| 8. | Response to customer complaint | Each customer complaint shall be responded within 48 hours |  |
| 9. | Customer care availability | Availability of customer care centre |  |

 (\*): Chosen for benchmarking assessment

 For telephony, according to benchmarking assessment requirements, we have applied *fixed call window* for mobile telephony service testing in which the call has to be performed. If the call fails or drops, the next call attempt shall only be made when the next call window arrives.

For Internet access service, Fixed Data Transfer Test of “Windowed” approach is applied instead of Best effort approach. From practical experience we find that the “Windowed” approach features some advantages over the “Best effort” approach:

* Low variation between minimum and maximum measurement time. This is very important if the measurement is done in regular intervals;
* Required measurement time for slow connection is reduced while maintaining the accuracy for high speed connections;
* Keep balance of number of sample across benchmarked services of different operators;
* Better distribution of measurement in drive tests. Using “Windowed” the same number of tasks or jobs execution per time interval can be achieved regardless of access technology (2G/EDGE or 3G/UMTS);
* Better resource utilization by providing reliable statistics of measurement value for fast connection while not wasting network capacity for slow connection
1. **Making measurement**

Because of difference in market share and access technology between operators in Vietnam, it is necessary to split operators into 2 groups to perform benchmarking measurement to ensure that the result is comparable between group’s members.

In order to ensure those benefits of benchmarking measurement, it is incumbent upon Vietnam Telecommunications Authority (VNTA) to choose the QoS parameters to be measured, the measurement profile and environment, requirements for test equipment and also the contents, form and manner of measurement result to be published. VNTA has selected following technical performance parameters to perform benchmarking assessment:

* Telephony:
* Network coverage, Rx Level for GSM and RSCP for UMTS/3G;
* Call Setup Success Ratio;
* Call Drop Rate;
* Speech Quality, assessed by ITU-T P.862/P.863.
* Internet access:
* Radio Network Availability
* Service access availability (FTP)
* Service access set-up time (FTP)
* Session Failure Ratio (FTP)
* Mean Data Rate (FTP)

The **measurement environment** was selected as following:

* Drive-test on highway, streets around the densely populated area, trading areas, etc, average speed of the vehicle was around 30 km/h;
* Stationary test: outdoor fixed point e.g. center of district capital, gate of crowded market, in the university, inside the hospital, airport, bus station, railway station, exhibitions areas, etc.

**Measurement Equipment:** Rohde & Schwarz SwissQual Diversity Benchmarker, part of the SwissQual Evolution concept, is a drive test system for mobile networks has been chosen for collecting RF performance and QoS Key Performance Indicators (KPI’s) on the field. Data post-processing was performed by NQDI, which can provides a detailed analysis of the quality of voice, video, and data services using primary RF measurements, network trace events and call control parameters for all radio technologies. The chosen system conforms to requirements stated in ITU-T E.804 for a benchmarking system.

1. **Publishing benchmarking assessment result in Vietnam**

Since 2006, VNTA regularly publishes periodical measurement report on its website. The summary report [[4]](#footnote-4) for telephony consists of: tested area, test condition and result. Detail report is accessible to operators for better understanding network status.

1. **Conclusion and proposal**

This study intends to provide survey result on the current status of mobile quality of service benchmarking assessment in APT countries and introduce the best practice of regulatory scheme for the region and use Vietnam as a case study.

Within the scope of the study question, we have:

* Proposed a questionnaire to survey the current status of APT member, which was adopted by plenary and circulated by APT secretariat after ASTAP-23. We have received 03 responses from Japan, Papua New Guinea and Thailand, which are summarized above;
* Introduced a best practice of regulatory scheme for the region
* Presented Vietnam status of quality of service monitoring focused on benchmarking assessment.

From our experience with Vietnam market, we have learnt that the live testing measurement alone is not enough to fully evaluate the quality of service anytime and any location. With the emerging broadband service, it is advisable to combine with other methods which are much cost saving and customer oriented such as crowd-sourcing open tools such as Root Metrics, Open Signal and take advantage published information from independent measuring organization (Akamai, Speedtest, etc). We hope that this report will contribute to active and better informed discussion about service quality monitoring regulations. We believe that competitive mobile market will be better with proper benchmarking assessment.

1. GSMA report of mobile economy 2014, http://asiapacific.gsmamobileeconomy.com/GSMA\_ME\_APAC\_2014.pdf [↑](#footnote-ref-1)
2. Recommendation ITU-T E.800 (2008), Definitions of terms related to quality of service [↑](#footnote-ref-2)
3. Recommendation ITU-T E.804 (2014), QoS Aspects for Popular Services in Mobile Networks [↑](#footnote-ref-3)
4. Vietnam Telecommunications Authority, Benchmarking assessment report 2012, 2013 [↑](#footnote-ref-4)