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Keep the mobile customer satisfied

GPRS operators are to optimise service quality and reduce exposure to churn, they need to put in place real-time network monitoring systems.

There is nothing worse for a mobile operator's credibility than to promise service and not deliver. Dropped voice calls, inaccurate billing and lost data connections all encourage churn and can inflict serious damage on financial results.

To avoid acquiring a poor reputation for quality of service (QoS) -- and to differentiate themselves in the marketplace -- control over network performance is becoming more and more important. After all, it would be a dangerous strategy for mobile operators to try and gain a competitive advantage simply by decreasing tariffs.

But if network performance monitoring is to be effective, it has to be done in real time, automatically and pro-actively.

Delivering QoS

QoS is determined by various technical parameters and forms the basis of service level agreements (SLAs). The SLA is agreed between the network provider and the customer, and is monitored with the help of so-called key performance indicators (KPI). Three different measurement methods are used: fault management, monitoring systems and end-to-end service test systems.

Fault management systems provide information about any network component failing; monitoring systems passively collect signalling information between network components; and end-to-end service test systems collect information about the state of the complete network by simulating real-user behaviour. All these different pieces of information have to be gathered in order to receive a complete overview of network quality.

The services offered to customers are not always available as agreed. One reason lies in the physics of the air interface as a moving mobile necessarily lowers the quality of the connection. Other reasons are the continuous maintenance and enhancement of the network, in which single network components are subject to change (hardware replacement or software upgrade). In a worst-case scenario, problems lead to non-availability of service or a reduction in speech quality.

Pro-active and automatic

Although the information given by the fault management and monitoring systems is important, they can only tell the administrators about the state of single network components or single parts -- not about the customer experience of the service in question.

To get round this problem, pro-active service testers are being increasingly used. With a pro-active service test system, mobile network providers can test their network from the end user's point of view and make sure they find the errors first before the customer does.

To do this effectively, QoS parameters and KPIs have to be constantly checked and various test scenarios carried out. This would include an end-user simulation in a live network with test carried out from his point of view. These systems allow for a periodic surveillance of the network and are indispensable whenever new services are introduced in a network.

There are, however, a few problems with this type of testing. Test engineers usually carry out end-to-end service tests manually with mobiles in their hands and are very labour

intensive. Another disadvantage is they cannot be executed at various places at the same time and do not cover the complete network. An automatic system, which is centrally administered and distributed over the whole network, would therefore be a far more efficient way of doing things.

A further complication for end-to-end tests in a live network is that they require the administration of a high number of SIM cards for the simulation of various customer profiles.

The complete personalisation of a GSM subscriber is concentrated on the SIM (subscriber identification module) and its unique data is the key for parameters like the home network, credit or debit billing -- but there is other 'hidden' information like the HLR (home location register) affiliation. In other words an appreciable number of SIM cards must be managed and administrated by an automated GSM end-to-end test system. To keep these things manageable and flexible, SIMs should be stored in separate devices away from the test mobiles -- SIM Multiplexers (Figure1). The SIMs must be 'virtually' transferred to the mobiles on demand.

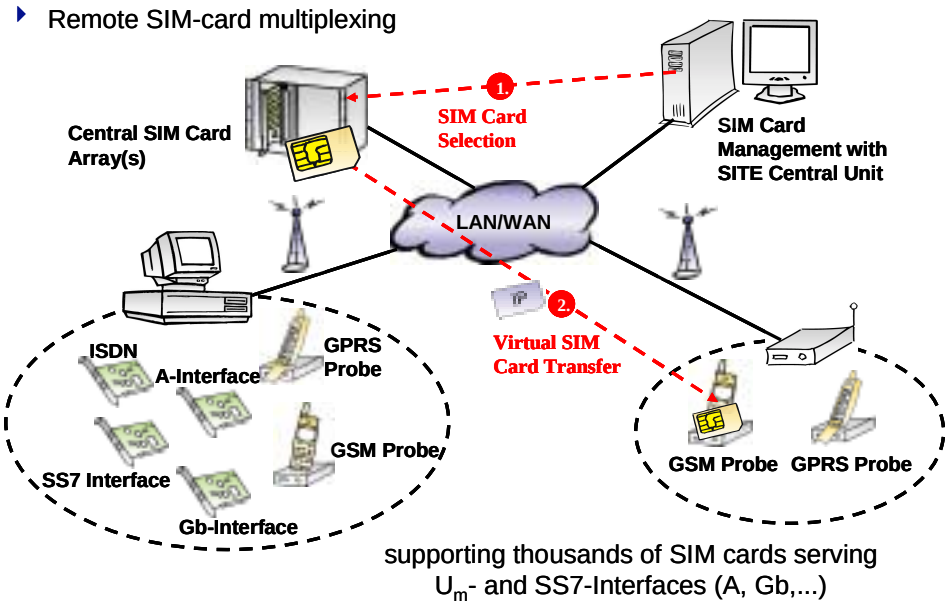

Figure1

In such an end-to-end test system, distributed tests can be carried out simultaneously with various SIMs and various profiles. It simulates a wide range of subscriber actions ranging from international roaming to voice mailbox services. Errors can be detected at a very early stage, and the technicians can investigate where and why these errors occur. Peak-time behaviour of the network can be tested easily in order to make sure that there is no capacity overload. All tests can be repeated under exactly the same conditions, and test reports and statistics are an enormous help in troubleshooting.

The GPRS factor

The introduction of general packet radio service (GPRS), and greater service variety expected by the customer, poses new network monitoring challenges for the operator. MMS (multimedia messaging service), e-mail (POP3 and IMAP), as well as HTTP and FTP, will all be enabled by GPRS. And with its 'always-on' internet connection, GPRS opens up an enormous range of service possibilities. Online banking, shopping and entertainment will each bring a new dimension to interactive mobile communications.

As a supplement to today's circuit-switched data, GPRS has a theoretical maximum speed of up to 171.2Kbps if all eight timeslots of a GSM cell are used at the same time. This means it could be about three times as fast as the data transmission speeds possible over today's fixed-line networks and ten times as fast as current circuit-switched data over GSM. In reality the current maximum transfer rates are much lower leading to

one generic problem with GPRS -- capacity. Other challenges include billing, security and roaming.

Capacity restrictions

As there are only limited radio resources that can be deployed for different users, GPRS will impact a network's existing cell capacity. Using it for one purpose precludes simultaneous use for another. For example, voice calls and GPRS both use the same network resources (timeslots). The extent of the impact depends upon the number of timeslots that are reserved for exclusive use of GPRS. Although GPRS can dynamically manage channel allocation, the operator must fine-tune the network to have a maximum of efficiency for his subscribers.

But limiting GPRS resources means limiting the quality of services. It is a well-known fact that the air interface is trouble prone, so that during a GPRS data connection the data packets are repeated when they have been lost. While the repetition does not cause any problems during a data transmission on the internet, it will cause a severe bottleneck with GPRS as several time slots will have to be used again at the same time.

The network provider needs correct predictions in order to optimise his network dimensioning. With an end-to-end service tester the network provider has the possibility to monitor the technical parameters of a data transmission during a service and so recognise quality problems and react to them before the customer notices anything.

In GPRS service connections, parameters like transmission data rate and duration play an important role in QoS. These parameters are examined periodically by the test system and made available to the network provider, who can thus obtain a continuous overview of the most important technical parameter of his services.

Billing challenges

Since GPRS networks transmit information in packets, it needs to count those packets to charge customers for the volume of data sent and received. But it is unlikely that circuit-switched billing systems will be able to process a large number of new variables created by GPRS. Moreover, the packet count facilities must be installed on the new GPRS network components -- the GPRS service nodes (GSN).

It may well be the case, therefore, that the cost of measuring packets is siginificant compared to their value. As a single traffic monitoring application can generate tens of thousands of packets per day. If there are any interruptions, or if packets do not reach their destination, the whole transmission has to be repeated. The repetition, however, must not be billed by the network provider even though the same customer uses the same time slots again. As billing with GPRS is a lot more complex, network operators are challenged to find attractive tariff models. They might rather offer flatrates

Further, to detect billing problems, active service test systems play an important role as they can execute tests under set circumstances and calculate the billing data based on the connection parameters (kind of service, time, duration) in order to compare it with the billing data gathered in the network. Thus the network provider can run the services for billing tests automatically and can automate the billing data comparison and by this way verify accounts.

Security concerns

GPRS network operators have to make sure that data transfer is reliable and secure, otherwise end-users will refrain from using online shopping and online banking facilities with their mobile. Fear of hackers who could steal or manipulate access data is -- not without reason – omnipresent. This issue has to be taken seriously and solved before GPRS networks are launched.

Roaming hurdles

Mobile subscribers expect their mobile services to work everywhere and roaming forms an essential part of an operator’s revenue. The same expectations are true of GPRS.

Special scenarios (IR.35) have been defined by the GSM Association for GPRS roaming, and partners are obliged to test roaming according to these scenarios in order to guarantee that it works smoothly.

However, there are some problems that may arise when different networks work together. In spite of all testing, network providers cannot guarantee a hundred per cent that the services of their network are fully available at any time in any of the roaming networks, simply because they have so many roaming partners.

At the moment it would require too much effort to observe and verify the functionality for all of the several hundred partners manually. Reasons for failures are numerous and omnipresent; due to a simple software update, for example, a roaming feature can become unavailable or only available on certain roaming networks. Another problem is lack of a uniform approach to network address translation. Operators also have to build a common infrastructure if they want to simulate real end-user tests, which, as we have seen, they have to do.

In order to minimise time and cost for GPRS roaming tests -- and so check the constant availability of the destination network for roaming partners -- automated service test systems are indispensable. Only they will allow the periodic and time-saving execution of essential roaming tests for the most important roaming partners and thus a constant monitoring of the availability of GPRS services. These service test systems should be able to carry out the GPRS roaming tests as defined by IR.35.

Final thought

The problem scenarios described above underline the importance of test systems. It is a must for any network provider to detect faults as early as possible and to correct them before the customers are unnerved and turn away. Low customer acceptance -- as with WAP, which was caused by starting problems -- must be avoided with GPRS. Active service test systems need be enhanced and adapted to the special needs of 2.5G. With a pro-active test system, bottlenecks can be detected early enough to optimise cells quickly.

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