Truphone allows subscribers to experience near-home network performance internationally

Executive summary

When roaming, voice calls and data sessions typically need to be routed back to the domestic 'home' network of the subscriber – adding latency and reducing data transfer rates and call quality. By treating subscribers more like domestic home subscribers, Truphone is able to reduce latency and provide data rates and voice quality akin to that on a subscriber's own network.

Introduction

Truphone has commissioned Analysys Mason to produce a series of white papers providing an independent assessment of the structure and benefits of the Truphone network compared to the service offered by traditional mobile network operators (MNOs). This first white paper explores Truphone's international performance and network architecture.

Truphone's use of international network access arrangements and the intercontinental positioning of core network elements means that, compared to the roaming architecture of a typical mobile operator, Truphone provides:

- faster data transfer speeds
- improved voice call quality, and
- better monitoring of network performance.

The unique design of Truphone's network includes three patented innovations, the Truphone SIM, the IMSI[1] Broker and the Parachute Box. These elements enable the network to treat subscribers like domestic users when roaming onto partner networks, improving the user experience.

Truphone is a mobile service provider with a global footprint

Truphone is a mobile service provider locally present in multiple countries, providing mobile voice and data services primarily to enterprises. The company particularly targets businesses that have international operations and undertake frequent international travel.

While standard MNOs will often have a presence in many countries around the world, their network in each country is built individually using aggregate transportation to conduct traffic across borders. Truphone's network is built differently, being designed as a single integrated network with the physical presence of POPs[2] in different countries around the world connected by dedicated transport links. The unique functionality this

[1] International Mobile Subscriber Identity: a 64-bit code which uniquely identifies subscribers

[2] Point of Presence: a location through which mobile traffic can be routed to access the core network

solution affords is facilitated by three key patented innovations, the Truphone SIM, the IMSI Broker and the Parachute Box.

- The Truphone SIM is a physical SIM carried by the subscriber that automatically selects the appropriate IMSI for each country within the footprint of Truphone's international network (Multi IMSI).
- The IMSI Broker is embedded in Truphone's network core and monitors the IMSIs being used by each customer's SIMs at all times.
- The Parachute Box is a tool that constantly assesses the Truphone service on partner networks and sends the results back to the Truphone Network Operations Centre (NOC), enabling real-time service performance monitoring.

With this combination of network infrastructure and patented technological innovations, the Truphone proposition offers customers a number of functional and cost-based benefits which aim to make the user experience when roaming as similar as possible to that of a local user.

Potential benefits of the Truphone solution

Data transfer speeds are higher

Due to Truphone's international partner agreements, the company's users have access to the full RAN[3] bandwidth offered by partner MNOs when roaming inside the "Truphone Zone" (Australia, Germany, Hong Kong, the Netherlands, Poland, Spain, the UK and the USA). Depending on the performance of the local RAN and the user's handset, when roaming inside the Truphone Zone a Truphone user can potentially achieve maximum data throughput speeds of 42Mbit/s (HSPDA+ standard), equivalent to those available to domestic national users.

This functionality is enabled by the Truphone SIM, which lets partner networks recognise subscribers and allows data traffic to be carried via dedicated transport links to the nearest physical Truphone POP, instead of being routed to a dedicated POP located in the user's home region via international carriers and common aggregation transport links. This process can reduce the distance between the user's handset and the home network, lowering the distance that data traffic has to travel and thereby increasing data transfer rates and overall quality.

Similarly, outside the Truphone Zone, the fact that POPs are dispersed across four continents (in Amsterdam, Hong Kong, Los Angeles, London, New York and Sydney) makes it possible for signalling traffic to be routed to the nearest Truphone POP. This shorter routing will reduce the number of hops required for data transmission, increasing data speeds and improving call quality.

Higher quality voice calls

As with data transfer, voice call quality when roaming can be adversely affected by latency caused by the distance the signal must travel through international routing and interconnection; quality also suffers due to signal degradation at each hop in the network. When the SIM requests a call, credentials must be validated and routed via the home network, increasing connection time and the likelihood of latency and interference the further the user is from the home network.

[3] Radio Access Network: the mobile masts that deliver the connectivity between the mobile network and the device

Inside the Truphone Zone, the solution described above enables the network to recognise users as home subscribers internationally. This decreases the number of required interconnection points, meaning that the signal is inherently less vulnerable to latency and interference, potentially resulting in a clearer, more stable call and faster connection times than are often experienced when roaming.

Outside the Truphone Zone, again, the geographical spread of the POPs again offers advantages by reducing the number of hops required for voice transmission, improving the overall quality of voice calls.

Proactive management of networks can reduce problems

Even if MNOs have networks in several countries, these networks act as independent cores and users are unable to have the status or performance of their network monitored or affected while they are roaming internationally. In contrast, as the Truphone core network is not bound to a single country, it effectively treats each RAN as an equal part of the same network, which permits Truphone to monitor network quality evenly across its footprint. For subscribers, this means that any network problems can be more proactively managed.

The Parachute Box is designed to enable real-time service performance monitoring by constantly sending data and voice traffic from different areas of the network and reporting back the results of the test scenarios to the Truphone Operational Centre. Truphone can monitor this traffic from its NOC, giving it the opportunity to proactively monitor the network as a whole. In this fashion, users who are travelling internationally can benefit from faster, more responsive network maintenance and query handling than is permitted by a typical approach segmented by national borders.

The Truphone proposition is enabled by a unique global infrastructure

Looking at typical domestic call-routing arrangements will help to explain how Truphone's solution works and is different from most MNOs. When initiating voice or data traffic on a domestic network, the SIM uses the IMSI to request permissions from the network. Receiving the signal via the RAN and POP, the network authenticates the IMSI against the records held on the home location register (HLR), verifies that the subscriber has authorisation, and offers the relevant content (e.g. via billing data records and the Intelligent Network) to make the requested connection. Once user authentication is verified, traffic transport can begin.

Roaming (whether domestically or internationally) adds another step to this routing process, in the form of the Visitor Location Register (VLR). When a signal collected by the RAN is determined to be that of a visitor IMSI from another network, the signal must be routed back to the HLR for that IMSI, which will be on the nearest POP in the domestic core network. This means that the signal must be routed from the RAN back via whichever interconnect pathways – depending upon distance from origination to the domestic POP – are in place.

The Truphone Zone concept effectively extends the experience of being a domestic user to customers in multiple countries around the world. This is achieved by reducing the distance and number of interconnection points that signalling, voice and data traffic must traverse when originating or terminating on a partner network, thereby minimising latency and interference, and improving user experience.

The following section uses step-by-step diagrams to compare the processes involved in call routing when roaming on a standard network, and on Truphone's network.[4]

Call routing when roaming typically involves long distances and multiple interconnection points

Figure 1: Schematic showing typical RAN interconnection for a roaming user [Source: Analysys Mason, 2014]

Figure 1 above shows an example of call routing for a UK subscriber calling a US subscriber while the UK subscriber is roaming in the USA. When the roaming user initiates a call, their voice traffic takes the following routing path:

1. Calling subscriber sets up the call.
2. The RAN transports call setup to the VLR.
3. The VLR determines that the IMSI is from a visitor network, and must route the signal back to the user's domestic intelligent network (IN) core to request authentication and authorisation to initiate the call.
4. Signalling must traverse the distance between the RAN currently local to the user and their home network via whatever international aggregation transit is in place (e.g. IP transfer points, submarine backhaul, etc.).
5. The signal reaches the domestic signal transfer point and is directed to the home IN.
6. Once at the IN platform, the user's call request is authorised with the applicable permissions.
7. The traffic is routed back via the international transit to the VLR.
8. The VLR queries the HLR for the correct identification of the roaming user.
9. Once back at the RAN, the approved signalling can be directed to the called user
10. Both voice traffic paths are now established.

[4] The schematics are representative of these scenarios and are simplified for better understanding. Different countries also have different regulations, and Truphone like any other national MNO must fulfil regulators' requirements on a country-by-country basis, meaning that some differences may exist in certain countries.

Figure 2: Schematic showing Truphone's network interconnection for a roaming user [Source: Analysys Mason, 2014]

As shown in Figure 2 above, the Truphone network changes this traditional routing model by effectively bringing the network closer to the roaming user. The process works as follows:

1. As above, the calling subscriber sets up the call.
2. The RAN transports the call setup to the VLR.
3. Due to the Truphone SIM mechanism, this time the VLR determines that the IMSI is national and should be treated like a national user, without requiring additional authentication procedures.
4. The VLR interrogates Truphone's IN to request call authorisation. The signalling is now handled internally, and all quality standards are controlled directly by Truphone. The signal reaches the IN platform which authorizes the user.
5. As above, the VLR queries the HLR for the correct identification of the roaming user and the signal is distributed from the RAN.
6. The voice call is transmitted via the local network to the US subscriber, as above
7. Both voice traffic paths are established.

The functionality of Truphone's international network design is enabled by the Truphone SIM and the IMSI Broker

To create an architecture that is able to work fluidly across international borders, Truphone has in place full network access agreements with carriers in the eight countries in the Truphone Zone (Australia, Germany, Hong Kong, the Netherlands, Poland, Spain, the UK and the USA), creating RAN access with POPs on four

continents. Embedded in this network are elements including an HLR, IN, SMS centre, OSS/BSS[5], Mobile Switching Subsystem (MSS) and several Media Gateways distributed over the four continents.

Traffic can be routed from any one of these RAN networks to one of the six physical POPs, all of which operate a GPRS Gateway Support Node (GGSN) for data, and a Media Gateway (MGW[6]) for voice.[7] From these POPs, traffic is routed to the IP/VPLS[8] transport packet core network, dual-located in Amsterdam and London.

Figure 3: Simplified international routing pathways for the Truphone network [Source: Analysys Mason, 2014]

The functionality of this network is enabled by the Truphone innovations in the handset and in the network. In the handset, the Truphone SIM allows multi-IMSI functionality, so a single hard-SIM can carry multiple IMSIs. At the network level, the IMSI Broker is able to update the SIM with the necessary IMSIs to roam within the Truphone Zone as a national subscriber. The combination of this SIM solution and having POPs spread over four continents effectively enables any Truphone subscriber to roam inside the Truphone Zone, behaving like any national user. Outside the Truphone Zone, service is supported via several international roaming agreements, and once again the POPs on four continents facilitate an increased level of control over the traffic quality, resulting in a better service.

By eliminating steps in the routing and transport of traffic, this architecture changes the boundaries of the 'home' network for the subscriber. Instead of the concept of roaming by connecting together pieces of different

[5] Operations Support Systems and Business Support Systems: computer systems used by service providers to manage their networks

[6] Media Gateway: A part of a communications network that can translate digital traffic between different types of network, for instance from fixed line to mobile

[7] With the exception of Los Angeles, which has no GGSN

[8] Internet Protocol/Virtual Private Local Area Network Services: A dedicated high-speed internet connection between multiple locations over a fixed, managed network

networks, the Truphone network works to expand a single, integrated network to cover the user internationally, effectively treating each nation within its footprint as a different part of a single home network, all connected equally to the network core.

Conclusion

The design of the Truphone network significantly shortens control and user plane paths to improve voice and data service quality and performance for roaming users. The combination of the regionalised signalling infrastructure and the Truphone SIM and IMSI Broker creates a network that works fluidly across the traditional national boundaries of MNO networks. By eliminating the unilateral ties between a single SIM, IMSI, POP and HLR, the Truphone network architecture creates an international home network, providing similar network performance for subscribers when roaming to that which they would expect of their domestic network.