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TECHNICAL REPORT

Universal Mobile Telecommunications System (UMTS);
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Study on alternatives to E.164 for Machine-Type Communications (MTC)
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Contents

Foreword

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Introduction

There are currently unprecedented demands within the telecommunications industry for E.164 MSISDNs resources and these demands are expected to accelerate in the years to come. Accordingly, some countries and their national regulatory authorities have expressed concerns over the numbering requirements of new services involving Machine Type Communications (MTC) services and their expected rapid growth.

MTC demand is forecast to grow from 50M connections to over 200M by 2013. A large number of these services are currently deployed over circuit-switched GSM architectures and therefore use E.164 MSISDNs although such services do not require 'dialable' numbers, and generally do not communicate with each other by human interaction.

Without technical alternative to using public international numbering resources as addresses, and considering the current forecasts and pending applications for numbers made to numbering plan administration agencies, there is a significant risk that some national numbering/dialling plans will run out of numbers in the near future, which would impact not only these MTC services but also the GSM/UMTS service providers in general.

1 Scope

This document seeks to study and highlight the challenge of using the existing public numbering resources to support Machine Type Communication (MTC) services and proposes that 3GPP develop an alternative to using public numbering resources for MTC communications.

2 References

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 41.101: "Technical Specifications and Technical Reports for a GERAN-based 3GPP system".

[3] IETF RFC 3986 "Uniform Resource Identifier (URI): Generic Syntax".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

(void)

3.2 Symbols

For the purposes of the present document, the following symbols apply:

(void)

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

NIMTC Network Improvements for Machine Type Communications
MNO Mobile Network Operator
MTC Machine-Type Communications

4 Use cases

4.1 Use case 1 (Wireless Vending Machines)

4.1.1 Short Description

The Snack Company owns 100,000 snack vending machines in the Tri-City area. Each machine is connected to Snack's central network via a wireless connection and sends a report of sales every hour. These scheduled reports are staggered so they don't collide within Snack's systems. These reports are short bursts of no more than a few hundred bytes of data, and typically take less than 3 seconds to transmit. On occasion, Snack's network will contact a machine by sending it an SMS, to which the machine sends a response.

Snack would like to add another 250,000 machines across the state, but their wireless service providers cannot provide enough MSISDNs. One provider, however, has implemented SIP capability, and makes available radio modules that use all-IP connections over the radio network. The main benefits to this new service is that each machine is assigned a SIP URI rather than a MSISDN (an alphanumerical SIP URI that doesn't encapsulate a phone number), and that the service provider expects network loads and costs to decrease by going with all-IP traffic. The service provider's network can easily handle the traffic load from 350,000 vending machines.

The service provider has assigned Snack its own domain, vending. snack.com, so Snack can assign its own names to the machines. Snack has chosen to use its internal asset numbers for machine names to simplify the mapping from their asset management system to the messaging interface provided by the service provider. Messages are generated by Snack's system and sent via the Internet to a web service provided by the service provider. The service provider then delivers the messages to the machines using SMS over IP. The machine modules are pre-configured to send scheduled reports to a web service provided by the service provider that transmits them to Snack's network. All messages are encrypted in transit.

Because the service provider was able to "recover" 100,000 previously issued MSISDNs, it was able to expand its coverage to wireless service consumers, generating much greater margins in the process.

4.1.2 Actors

- Snack Company
- Its wireless service provider

4.1.3 Pre-Conditions

- The service provider has available to it IP-ready radio modules
- The service provider's network can support SIP or IMS, and is able to map a SIP URI to an IMSI or IMPI in its HLR or HSS node. The service provider can support SIP URIs with a domain name of <XYZ>vending.snack.com.
- The service provider has a messaging gateway, maybe not much more than a web service
- The radio modules are capable of establishing an IP connection in response to a page over the paging channel

4.1.4 Post-Conditions

- Vending machines transmit sales and trouble reports according to the schedule
- Snack's network receives and processes the reports
- The service provider's network supports the traffic load
- Machines are reachable via their SIP URI and the service provider's message gateway
- The service provider's experience allows it to lower the price charged to Snack by 25%

4.1.5 Normal Flow

In the course of normal operations, there are three main events for a given vending machine:

1) When it first powers up and registers with the network
2) When it generates and sends a report to the network
3) When the Snack network sends a message to the machine

Each of these events is comprised of a sequence of smaller steps.

Registration:

1) The machine powers up

2) The radio module registers through the GPRSnetwork in the normal way

3) The radio module registers with the SIP server on the service provider's network. This sets up the mapping between the SIP URI in the HSS and the newly assigned IP address

Note: this would normally require a MSISDN+IMSI (IMSI for authentication and MSISDN generally required in all back-office IT/IS).

Remote-originated messages:

1) The machine "wakes up" on schedule and establishes a SIP session with the SIP server

2) The machine generates a report as a short message then transmits that to the SIP server as a message payload. If the message is more than 1500 bytes, then concatenated messages are sent.

3) The SIP server acknowledges receipt of the message

4) The machine terminates the SIP session

5) The machine goes back to "sleep"

Remote-terminated messages:

1) The Snack network generates a message addressed to a specific SIP URI

2) Snack sends the message to the service provider's message gateway

3) The service provider's HSS contains the mapping of SIP URI to IMSI or IMPI, and to the currently assigned IP address

4) The service provider pages the machine over the paging channel using the IMSI or IMPI

5) The machine responds by establishing a SIP session with the SIP server

6) The service provider delivers the message to the machine as a message payload

7) The machine responds

8) The machine terminates the SIP session

9) The machine goes back to "sleep"

4.1.6 Alternative Flows

The messaging interface also allows the machine to send trouble reports that go directly into Snack's trouble ticketing system. These messages are generated by on-board logic in the machine and sent to a different web service. The steps required to do this are the same as for remote-originated messages described above.

4.1.7 Exceptions

Due to the standard nature of the communications, the main exceptions occur when a message cannot be delivered for some reason. The most common reason, based on early experience, is that the web service Acme occasionally goes down. This is a result of the way Snack's services are configured and not related to SIP or the service provider's network. When this happens, the web services on the service provider's network queue the messages and deliver them in the order they were received when Snack's services come back online. The service provider has implemented Web Services messaging and security practices.

4.2 Use case 2 (Smart Bridges and Tunnels)

4.2.1 Short Description

The State of California would like to install up to 150,000 sensors on the Golden Gate Bridge to monitor structural elements by measuring displacement, temperature, humidity, and magnetic or ultrasonic resonance. These measures are used to detect structural deficiencies in the bridge that require attention, perhaps immediate attention. Each sensor takes measurements on a periodic basis, “wakes up,” and transmits a short burst of data of less than a few hundred bytes to the state’s central system where it is analyzed. On occasion, the state’s system will contact a sensor by sending it an SMS, to which the machine sends a response. Most often, this is a result of the system needing more information based on the report of another sensor nearby. The sensors use an IP data connection.

Due to the expense and time required to install wire-based connections and the advancements in battery technology, the state wants to use wireless network. To avoid having to buy, install, and run its own radio network, the state decides to use a service provided by a mobile network operator. To preserve the limited supply of MSISDNs in the area, one provider, suggests using a SIP capability and has offered to create a domain specifically for the Golden Gate Bridge, goldengate.bridge.ca.net, allowing the state to assign its own names to the sensors. Messages are generated by the state’s system and sent directly to the SIP URI assigned to a sensor when it was configured via a web service gateway offered by the service provider. The service provider then translates the SIP URI into the IP address assigned to the sensor when it first powered up and registered with the network. The sensors are pre-configured to send scheduled reports to a web service provided by the state via the service provider’s messaging gateway. All messages are encrypted in transit.

4.2.2 Actors

- The State of California
- Its wireless service provider

4.2.3 Pre-Conditions

- The service provider’s network can support SIP or IMS, and is able to map a SIP URI to an IMSI or IMPI in its HLR or HSS node. The service provider can support SIP URIs with a domain name of <XYZ>.goldengate.bridge.ca.net.
- The service provider has a messaging gateway, maybe not much more than a web service
- The radio modules are capable of establishing an IP connection in response to a page over the paging channel

4.2.4 Post-Conditions

- Sensors transmit data and trouble reports according to the schedule
- The state’s network receives and processes the reports
- The service provider’s network supports the traffic load
- Sensors are reachable via their SIP URI and the service provider’s message gateway

4.2.5 Normal Flow

In the course of normal operations, there are three main events for a given sensor:

1) When it first powers up and registers with the network
2) When it generates and sends a report to the network
3) When the state’s network sends a message to the sensor

Each of these events is comprised of a sequence of smaller steps.

Registration:

1) The sensor powers up
2) The radio module registers through the GPRSnetwork in the normal way
3) The radio module registers with the SIP server on the service provider’s network. This sets up the mapping between the SIP URI in the HSS and the newly assigned IP address