**Source:** **UMTS Forum**

**Title:** **3G Offered Traffic Characteristics**

**Agenda item:** **11**

**Document for:**

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| Decision | |
| Discussion | |
| Information | **X** |

## 1 Introduction

The attached UMTS Forum Report is intended for use by the PCG members only.

**Report No. 33**
**Report from the UMTS Forum**

# 3G Offered Traffic Characteristics

## *Final Report*

UMTS Forum, November 2003

One of the key issues currently occupying the minds of the UMTS Forum's Spectrum Aspects Group (SAG) is that of the nature of the traffic that will flow across the UMTS networks, and how the characteristics of the expected traffic (especially its uplink/downlink asymmetry) might affect spectrum arrangements. The initial focus of this SAG work is in relation to the possible frequency arrangements for the 2500-2690MHz band. The SAG group has created a sub-group (the Ad-hoc Group on Traffic Characteristics) to gather information on traffic characteristics. This is a challenging task as there is little historical experience of the varied multimedia, content, messaging and internet/intranet services that will be supported by UMTS. To underpin this activity the UMTS Forum has commissioned this study of the likely characteristics of the traffic that might be offered to the UMTS networks. The study, by Telecompetition Inc, was undertaken under the active guidance of the SAG Ad-hoc Group, and the work is based on the six services identified if the earlier UMTS Forum Reports on the revenue opportunities for UMTS (UMTS Forum Reports #9 and #13). This Report is a significant input to the ongoing work of the Spectrum Aspects Group, and it will be used alongside inputs provided by the Forum's members and material from other appropriate sources. However, as it is believed that the topic of traffic characteristics is of general interest to the Forum's members, the document is being issued as a UMTS Forum Report.

This report follows on from other reports which have dealt with: a regulatory framework, and spectrum and technical aspects, impact of licence cost levels, licensing conditions, minimum spectrum requirements, an extended vision, market forecasts, and other issues. Reports on these and other topics are listed in the Bibliography and can be found on the UMTS Forum Web site, www.umts-forum.org/reports.html.

Many statements in this report represent the views of the original author, Telecompetition, Inc., and have been subject to formal approval in the UMTS Forum. Thus, most operators and manufacturers within the UMTS Forum support the main conclusions and key findings in the report. The National Administrations that are members of the UMTS Forum have actively supported the development of the report. However, the views and conclusions expressed in this report do not necessarily represent the views of the National Administrations. All possible care has been taken to assure that the information in this report is accurate. However, no warranty of any kind can be is given with regard to this material. Neither the UMTS Forum nor Telecompetition, Inc. shall be liable for any errors contained in the report or for incidental consequential damages in connection with the use of the material.

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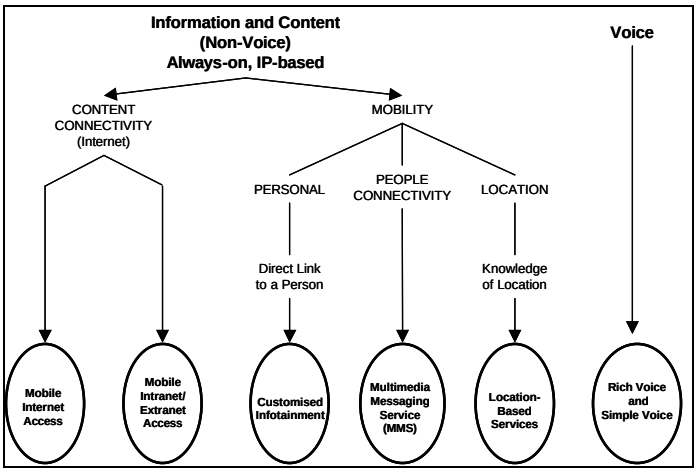
# 1 Introduction

The purpose of this study is to provide a first estimate of the offered traffic characteristics for UMTS/3G network, in particular how these translate into uplink and downlink requirements. When reviewing all mobile aggregate traffic, 2G traffic, which is outside the scope in this report, should also be taken into account. Whilst there are clearly many unknown factors, this study provides a reasonable picture of the offered traffic of future 3G services.

Most of the mobile services studied do not currently exist. These results are therefore dependent upon the service assumptions made. A sensitivity analysis determined which assumptions had significant impact of the aggregate results. Those assumptions are presented.

This study builds upon previous market analysis work completed by the Forum, using the services category framework shown in Figure 1.1[1]. This framework includes all anticipated possibilities for 3G services. The framework cleanly segments the services by user segment, type of functionality, and connectivity. Its specific design is broad enough to include new individual service concepts while at the same time, eliminate double counting of revenue and subscribers.

Figure 1.1. 3G services framework with its six service categories.




Source: UMTS Forum and Telecompetition, Inc., Report 13, September 2000.

The use of this framework along with the underlying subscription forecasts from previous UMTS Forum market studies prevents double counting of traffic volume and ensures consistency with market forecasts using a representative mix of service types for study.

## 1.1 Service Traffic Characteristics Defined

Service traffic characteristics describe the unrestrained end user traffic offered to the UMTS/3G network; not considering network imposed asymmetry or other hardware and software limitations or remedies (such as traffic caching). Service traffic characteristics therefore refer to the expected nature of the traffic offered to the network, not the actual traffic characteristics over the air interface. No impediment to the build up of traffic is considered (such as the non-availability of devices or spectrum). The traffic loads are based on forecasted traffic in 2010, after networks have been deployed for more than five years.

Traditionally, the examination of service traffic for the purposes of spectrum calculations has only considered the technical characteristics of a particular application or service. For example, the spectrum requirements for voice have simply considered the speech coder characteristics (i.e. data

[1] The UMTS Forum services category framework was originally presented in Report 9, and used as the basis for service forecasts in Reports 9, 13, and 17.

rate), the spectrum efficiency of the modulation scheme and network and the predicted offered traffic. This was possible in the past, because circuit-switched voice service is symmetric and only the bulk traffic was taken into account.

Mobile multimedia services, however, introduce new challenges, such as traffic asymmetry, driven by the wide variety of multimedia-based activities available to the user. For example, web browsing typically has much more traffic coming to the user (downlink) than from the user (uplink). Telecompetition's *ATIVA Research Tools*, which analyse the "propensity to buy" for any given service enables the determination of unrestrained traffic demand, taking into account a number of variables, which are explained below. Thus, the methodology adopted incorporates this variety of activities and service variables in a way that relates them to their forecasted market demand.

Specifically, in this report, service traffic characteristics includes all traffic that end users would offer the network based upon baseline location and subscriber profiles plus seven service variables and states,[2] shown in Figure 1.2. This is the unconstrained traffic offered to the network. Many other factors may affect the actual network traffic characteristics - both technical (e.g., traffic shaping, required overhead) and market-oriented (e.g., pricing plans).

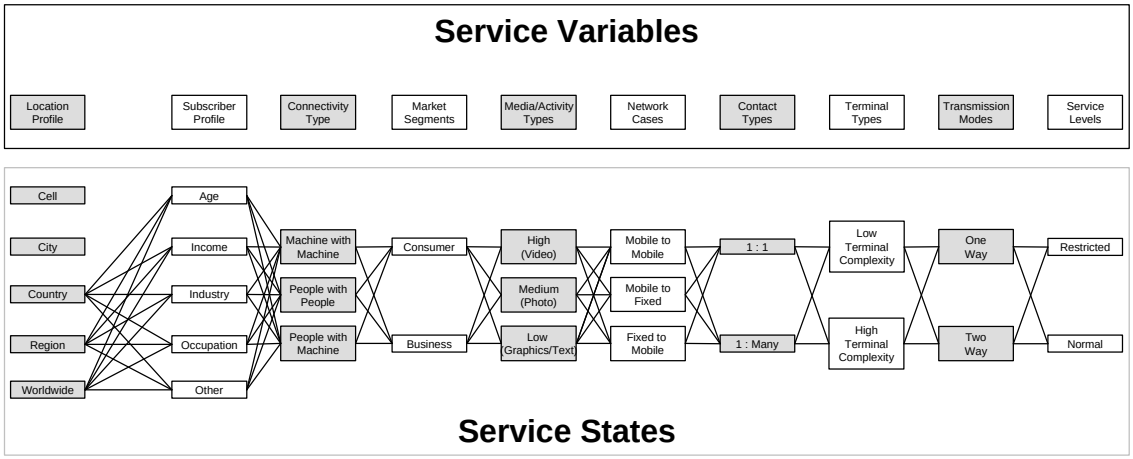
The first step in this study was to develop a structured way to consistently analyse each service category. The structured approach chosen is based on nine service variables and their associated states. These variables capture the most significant attributes of mobile service that impact the traffic loads and asymmetry. The nine service variables are:

- Location profile
- Subscriber profile
- Connectivity Type
- Market segment
- Media / Activity Type
- Network cases
- Contact type
- Terminal type
- Transmission mode
- Service level

These service variables and their states are shown in Figure 1.2 and further described in Section 2.

[2] The volume and proportion of traffic for each of the service variables was determined by using the *ATIVA Research Tools*, which forecasts the propensity to buy (or use) such services, based on large, detailed and well qualified social data, as described in Section 8.

Figure 1.2. Service variables and associated states used to analyse traffic characteristics.




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

For each of the six service categories, relevant states for each service variable shown in Figure 1.2 are analysed. This analysis resulted in a large number of permutations of the service variable states – each representing a potential individual service. After identifying the permutation that represented reasonable realistic services, related assumptions included the following:

- File sizes for non-real time sessions for the uplink (UL) and downlink (DL).
- Asymmetry of relevant service permutations (UL/DL).
- Data rates – customer expectation of speed over the air interface (UL and DL).
- Session frequency and duration.
- Busy hour characteristics and traffic distribution.
- Subscriber adoption of individual services.

Total offered traffic includes the average aggregate offered traffic over all service categories.

The total offered traffic has to be considered separately for uplink and downlink because it is possible that the traffic asymmetry for one service will be offset by another service.

The volume and proportion of traffic related to the first two service variables (location and subscriber profiles) was determined by using the *ATIVA Research Tools*, which uniquely forecasts the propensity to buy (or use) such services, based on large, detailed and extremely well qualified social data. This is described further in Section 8.

## 1.2 Study Scope

The study considers the following:

- Six service categories.
- Up to 288 service permutations within each service category.
- Two market segments within each service category.
- Unconstrained offered traffic only based on future market demand (at saturation).
- Average aggregate daily and busy hour traffic.
- Average 3G subscriber demographic profile and service demand in a Western European country.

The study results address:

- Expected asymmetry per service per market segment

- IP session duration
- Busy hour offered traffic, including identification of the busy hour
- Number of subscriptions per service
- Total traffic per subscription (uplink + downlink)
- Total traffic per country and per service category
- Total traffic per 3G subscriber
- IP sessions ("call attempts") per subscription
- Service level

The following general methodology is used in this study[3]:

- Choose the UMTS Forum service forecasts from a representative Western European country as the baseline for determining subscriber and subscription levels.
- Use the service forecasts for the year 2012 to project the anticipated traffic offered to the network once 3G has reached a mature subscriber penetration level.
- Using location and subscriber profiles, determine service subscription and per-subscription frequency of use and session duration for each service category to develop individual subscriber offered traffic volumes.
- Analyse each service category based on the seven service variables and states. Exclude states that don't apply.
- Estimate the traffic volume for each service permutation.
- Develop traffic distributions and service asymmetry for each market segment and service category.
- Calculate traffic load, busy hour and aggregate asymmetry.
- Test sensitivity of service assumptions to determine the most critical traffic assumptions.
- Aggregate service level traffic and busy hour loads to determine overall traffic characteristics.

[3] This study analyses traffic characteristics for a representative Western European country. Thus traffic characteristics and estimates are presented on a total country basis and are not analysed in more granular detail, such as by cell site or specific metro area. Because it is recognised that network engineering requires this granular level of detail, the study also provides the data on a per subscription or per subscriber basis.

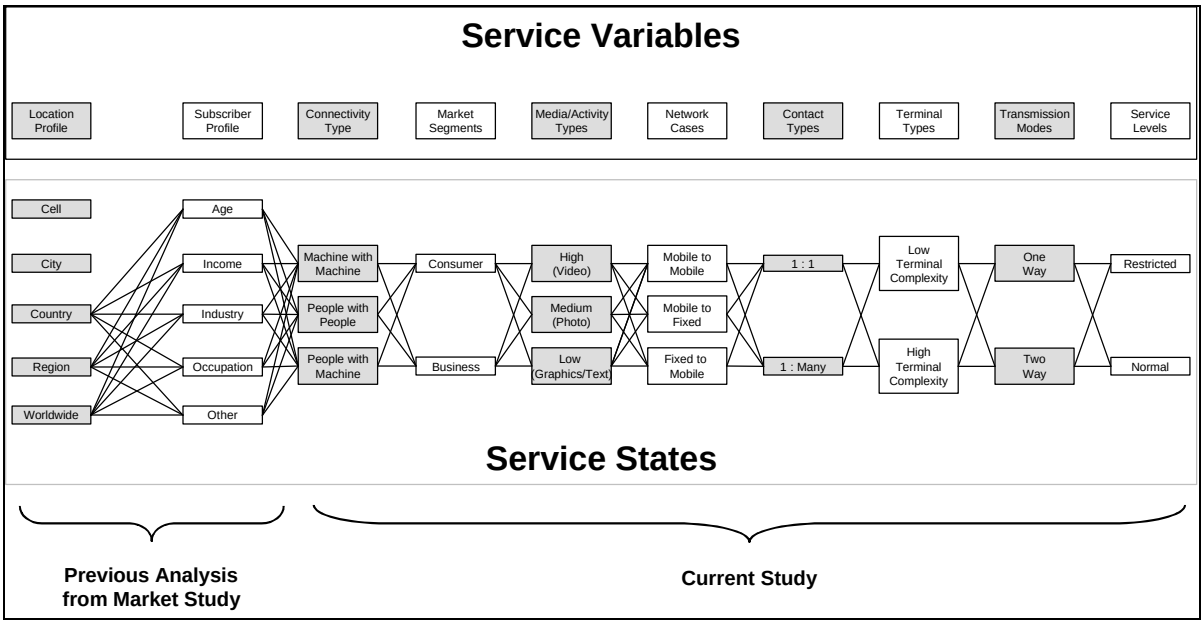
# 2 Study Approach

This study builds upon previous market analysis work completed by the UMTS Forum, using the services category framework shown previously in Figure 1.1. While actual service offers by mobile operators may bundle a number of capabilities and services, the framework will "force" any individual service under analysis into only one category, thus eliminating the potential for double counting of traffic.

The approach used in previous service forecasts as well as in this report employs a bounded top-level forecast. That is, a determination is made of a reasonable maximum level of demand, and all other service forecasts are calculated as a subset of that top-level number. In this manner, all service forecasts are assured of fitting within a reasonable frame of reference.

As shown in Figure 1.2, a total of nine service variables and their applicable states were considered. Figure 1.2 is repeated as Figure 2.1 below. Also shown in Figure 2.1 are the baseline location and subscriber profile variables considered in determining the subscription level for each service studied. These baseline assumptions are discussed further in Section 2.1.

Figure 2.1. Service analysis variables, variable states, and baseline profiles.




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Following are definitions and discussions of each of the baseline profiles, variables, and variable states shown in Figure 2.1.

## Baseline - Location Profile

For the traffic modelling in this report, the population and service profile of a representative Western European country was chosen as the baseline network[4]. Geography, demographics and propensity to buy services for a representative western European country were used in this analysis. A more detailed discussion of the location profile is found in Section 2.1.

[4] The demographic data comes from population data compiled by Telecompetition, Inc. from a number of respected and well—known demographic sources. These sources include the International Labour Organisation (ILO), US Census Bureau International Database, Rand McNally, EuroStat, and other country-specific statistical sources.

### Baseline – Subscriber Profile

The subscriber profile includes demographic factors such as age, income, occupation, and industry. The population counts by these demographic variables in the representative country help determine the number of subscriptions for each service. A more detailed discussion of the subscriber profile for the representative country is found in Section 2.1.

### Connectivity Types

Connectivity types consider whether the communication is between machines (machine-to-machine), people (people-to-people), or between machines and people (people-to-machines or machines-to-people.) The service category definition often includes the connectivity type. (Rich Voice, for example is entirely people-to-people, while Customised Infotainment, Mobile Internet Access, and Mobile Intranet / Extranet Access connect people with content (servers) and are therefore people-with-machines.)

### Media / Activity Types

Media and activity types include those services within a service category that have definable and distinct user features or characteristics. Rich Voice and Multimedia Messaging services are more easily defined by the type of media that is being utilised (e.g. text, graphics, photos, video, and audio). For each of the remaining service categories, specific activities were identified and analysed that represented the majority of expected traffic volume. Examples of activity types are web browsing, email, and mobile gaming. These activities differ for each service category. Media and activity types will also differ between market segments within service categories.

### Market Segment

Consumer users and business subscribers are the two market segments analysed. In some service categories, consumer and business segments were further split into sub-segments. A business subscriber using media for professional purposes will need higher quality than a consumer user, who is only exchanging pictures for social purposes. For example, a repairperson that needs a photo or diagram of the workings of an appliance will need it at much higher resolution than a consumer user who wants to send a quick holiday picture. The media quality will act as a multiplying factor for both the traffic volume and the asymmetry of a given media type.

### Network Cases (Origination and Termination)

This instance describes whether the user is engaged in a mobile-to-mobile[5] call, fixed to mobile or mobile to fixed. Traffic volumes and asymmetry are affected by network cases. For example, in the case of messaging services, if messages are sent from one mobile subscriber to another mobile subscriber then, on average, the number of uplink messages equals the number of downlink messages. However, if for example, a mobile subscriber sends a photo to a network server for later download from a home PC, the mobile traffic is primarily uplink. The propensity to use different network cases is also dependant on the market segment.

The proportion of traffic that stays within mobile networks, between mobile networks (i.e., international roaming) or between fixed and mobile networks is expected to change over time.[6] The deployment of SIP and IMS will enable greater interoperability between fixed and mobile networks, creating greater traffic between fixed and mobile networks.[7] International roaming traffic is growing, but is still less than

[5] Mobile to mobile includes traffic between mobile users or devices regardless of whether the users or devices are in the same or different operator's mobile networks.

[6] Studies by both Oftel (UK) and CTIA (US) indicate increasing percentage of traffic between mobile and fixed networks. Oftel, "Vodafone, O2, Orange T-Mobile Terminating Minutes", December 2002. CTIA, Wireless Industry Indices Report: Mid-Year 2001.

[7] See UMTS Forum Report 20 for more details on the impact of IMS (IP Multimedia Subsystem).

2% of total traffic.[8] From the mobile operator perspective, an international roaming call has the same traffic characteristics as a mobile to fixed call – the "receiver" portion of the call is to an "outside" network. The network case assumptions for each service take into consideration these industry trends, as well as the particular usage patterns for the service.

### Contact Types

Contact types mean whether the communication is one-to-one or one to many. This has an impact on spectrum, particularly for certain service categories. Contact types also significantly influence network cases and the market segment. For example, consumers will have a tendency to send messages from mobile-to-mobile. If they are at the same time, one-to many messages (such as might be sent to "buddy lists"), there will be many more downlink messages than uplink messages. On the other hand, if a business user (estate agent) is sending photographs of a property from his camera phone to several offices (in the fixed network), there is only one uplink message and no downlink.

### Terminal Types

The study considers two different categories of mobile terminal, which will influence traffic and symmetry. Professionals will tend to use terminals with high-resolution screens ("high complexity" terminals) such as laptops and high end PDAs for multimedia, where the accuracy and detail of the information is crucial. On the other hand, consumer subscribers will have more interest in small lightweight terminals, for which a high-resolution screen is not relevant. However, some exceptions are likely, when, for example, a consumer (with a small device) sends a photo to someone in the fixed network (e.g. as an e-mail attachment). Here, the recipient will have a high-resolution screen and printer and so will want the picture at high resolution. The size and resolution of the screen significantly affects the data volume of the picture or video media intended for it, so this usage factor will act as a multiplying factor for the associated traffic and asymmetry.

### Transmission Modes

Transmission modes means whether the communication is predominantly one-way or two-way. Service categories usage will determine the transmission mode. For example, certain types of multimedia communication may allow the transmission mode as an option. For design purposes, asymmetry at a cell level is important. So while subscribers may broadcast Multimedia Messaging Service (MMS) messages to a large number of friends or business associates, a smaller number remains within the same cell. This study has assumed that on average, a "one to many" call will transmit to an average of three other terminals.

### Service Levels

The expectation is that in many cases a user will be able to choose between restricted service quality and normal service quality. This will influence Quality of Service (QoS) parameters, such as latency, data rate and priority. In turn, this will affect network loading (hence spectrum demand), particularly at the busy hour. While this report does not explicitly calculate QoS effects, it does consider two levels of service – "normal" and "restricted"

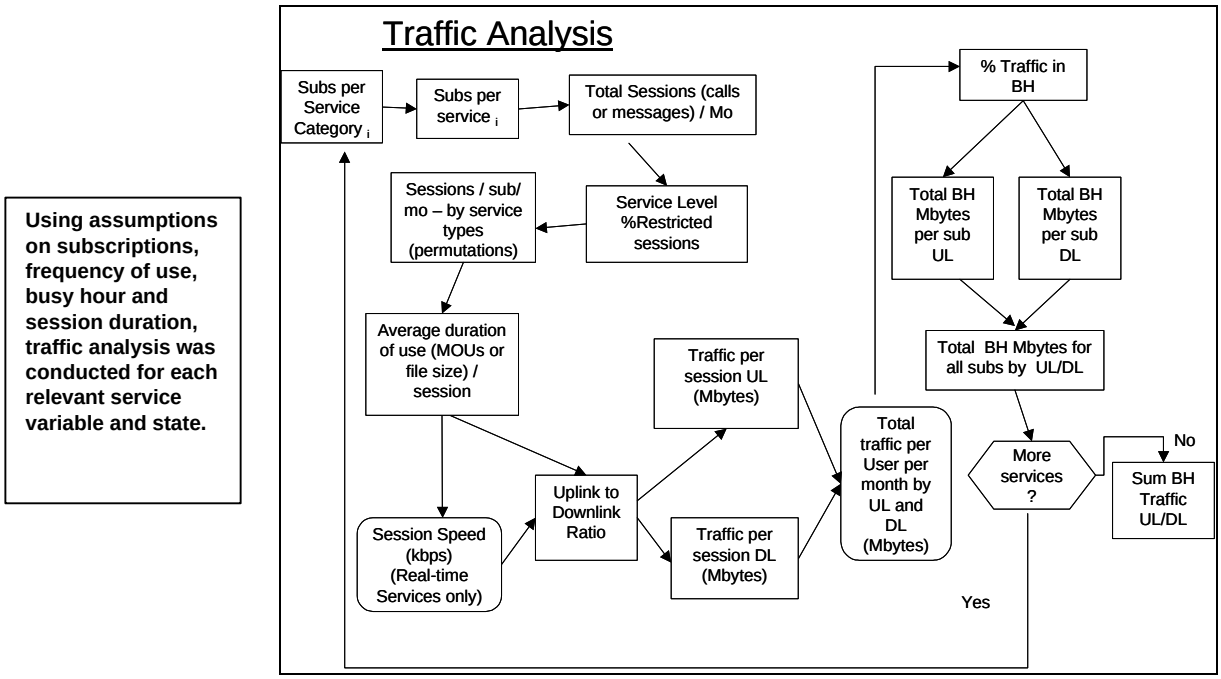
Service expectations for "normal" service levels vary by service and segment, and change over time. If one uses the fixed Internet as an anecdotal example, user expectations for data rate, latency, and priority will increase as usage increases and bandwidth is more available and less expensive. These future expectations of service level are considered in the calculations for this report.

The individual assumptions for the most traffic sensitive service variables are discussed under the respective service categories (Sections 4 and 5). For some services, some variable states were eliminated due to lack of any significant demand or impact on traffic calculation.

[8] Source: Communications Week and Strategy Analytics, September 1999.

For each service variable and state identified for analysis, busy hour and total traffic per subscription and per session is calculated. The basic calculation flow is shown in Figure 2.2. This framework is used for the calculations shown in later sections, with some variation for individual service differences. In the framework, monthly sessions or messages are used as subscribers are typically billed on a monthly basis. Daily traffic is estimated based on the number of days per month the service would be used. (Typically, consumer services assume 30 days per month while business services assume 22 days per month in use). The percentage of traffic in the busy hour is calculated based on the assumed percentage of traffic in the busy hour found in the traffic distributions in this report (for example Figure 4.9) applied to this daily traffic.

Figure 2.2. Traffic analysis framework.




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

## 2.1 Study Assumptions – Location Profile

This section highlights the key parameters of the baseline location profile using the representative country's geography, demographics, and propensity-to-buy demographics.

This country level aggregate view is important to begin to understand the overall offered traffic characteristics and service symmetry. However, practical RF design requires a much smaller geographic analysis, typically starting with a cell. While that type of analysis is not the focus of this study, subscriber traffic loads are presented for consumer and business subscribers to provide the reader with some ability to apply the data to this type of design.

The traffic characteristics and analysis in this report use the service subscription volumes as previously forecast for the chosen representative country in UMTS Forum Report 17 in year 2010. While individual countries will certainly have differences in demographics, the expectation is that the "representative country" will provide an adequate picture of traffic characteristics usable to any developed country. In addition, the traffic model is built in a way that will allow individual operators to use the model and to modify the service concentration or usage they believe more closely represents their individual situations.

The following geographic profile is the basis for the traffic model assumptions:

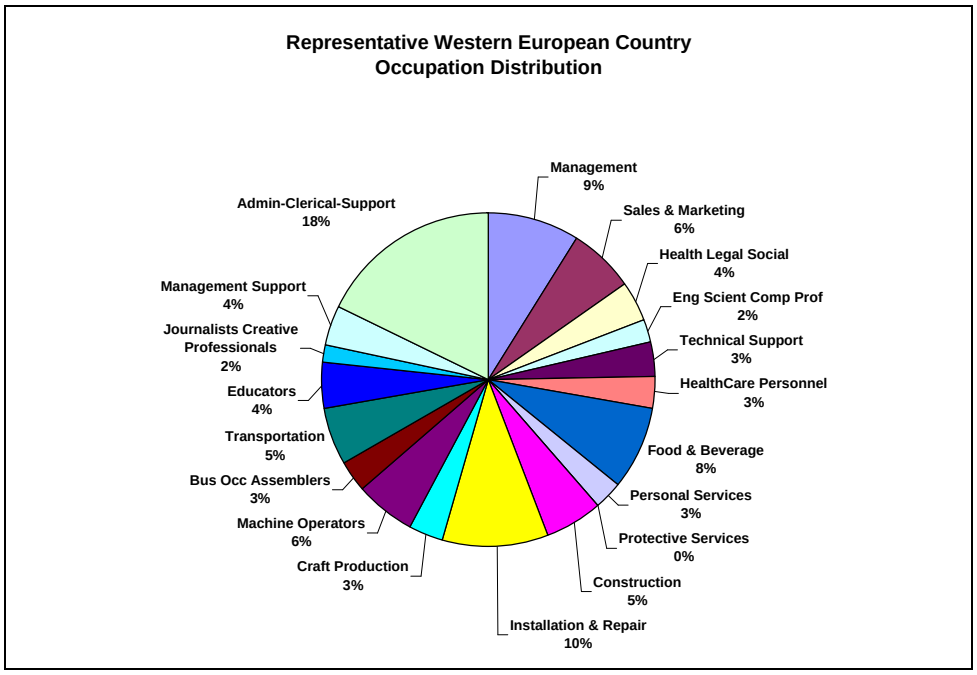
- Urban environment (where the majority of 3G traffic is expected to occur)
- Total Population: 60 Million

- Workforce Population: 30 Million

## Demographic Characteristics – Subscriber Profile

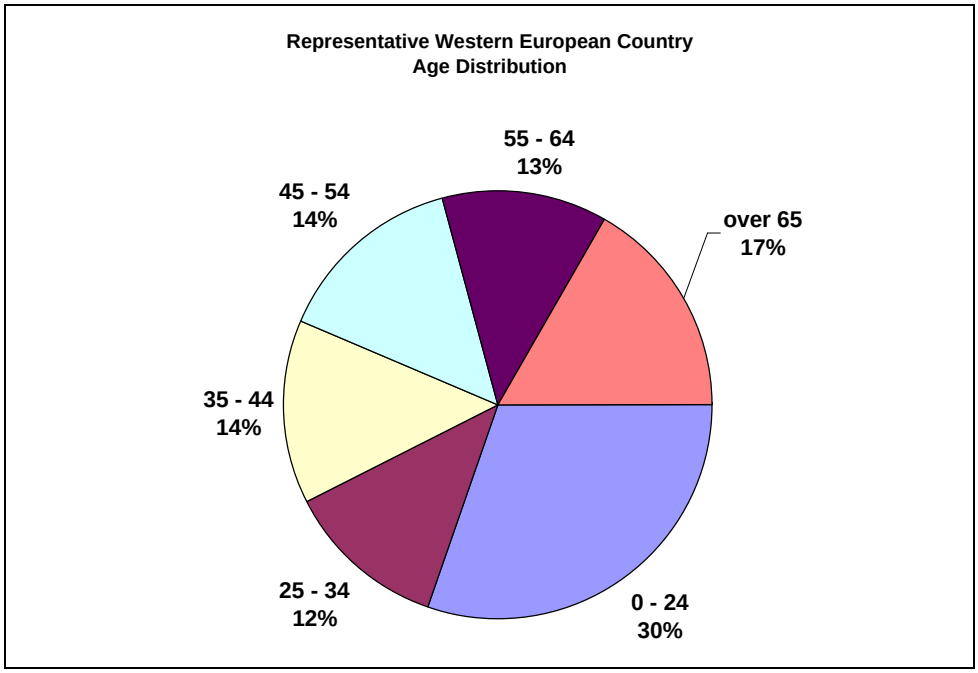
A Telecompetition proprietary forecasting tool that accommodates a wide range of demographic and other geographic variables was used to develop the service subscription forecasts. The tool uses demographic variables as a way to estimate the subscription levels for each country. The demographic population counts by industry, occupation, and income and the propensity-to-buy profiles (Section 3) for each service provide a basis for estimating subscription levels in each country. For example, sales and marketing professionals in an information industry are more likely to use mobile multimedia business conferencing. Therefore, a country that has a higher percentage of its population with those characteristics will have a higher concentration of service subscription. Figure 2.3– 2.6 summarise the representative country demographic profiles used to develop the subscription estimate for each service.

Figure 2.3. Occupational distribution used in service forecasts.



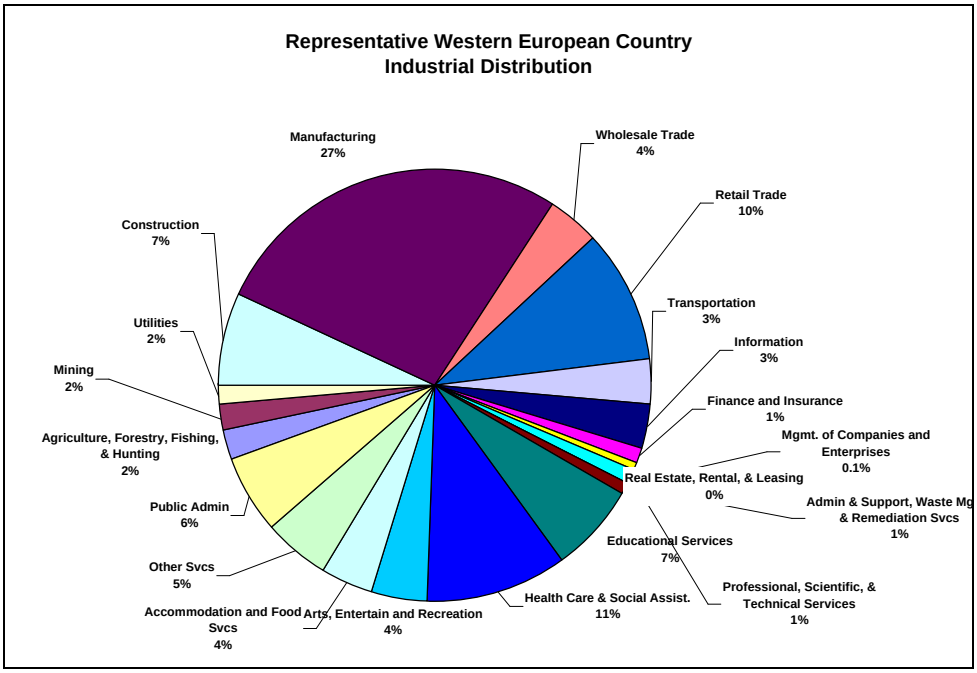

Source: International Labour Organisation

Figure 2.4. Age distribution used in service subscription forecast.



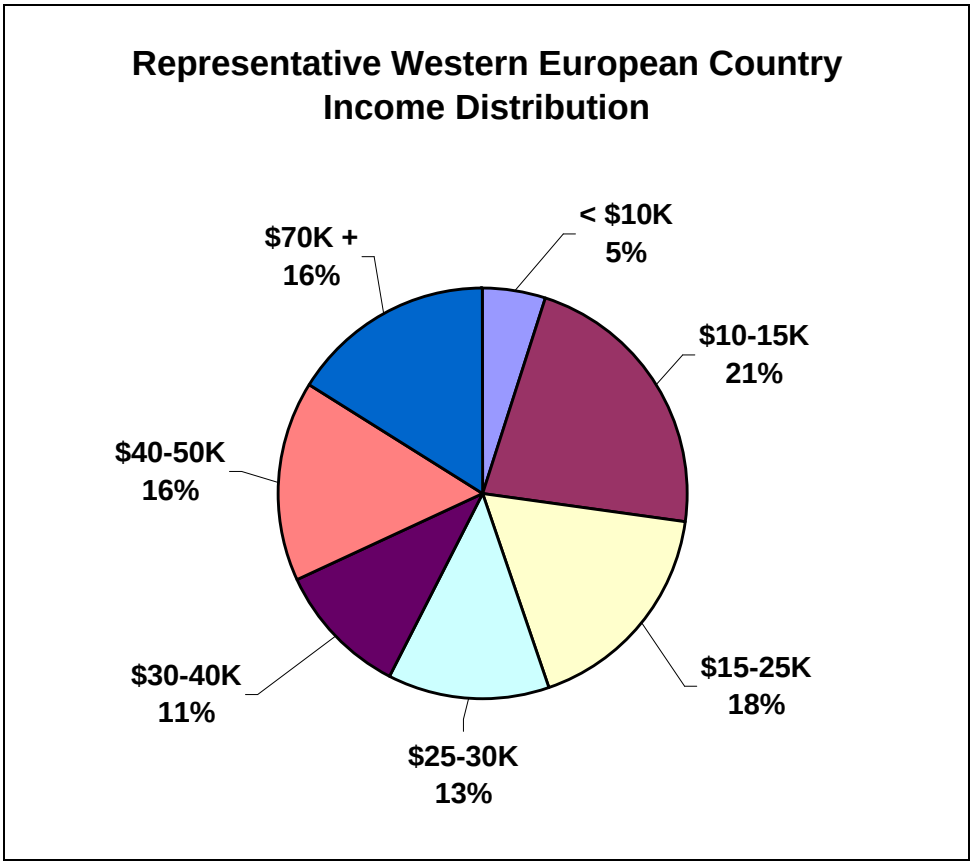

Source: International Labour Organisation

Figure 2.5. Industrial distribution used in service forecast.




Source: International Labour Organisation

Figure 2.6. Income distribution considered in traffic forecast.




Source: National Statistics, Department for Work and Pension, Family Resources Survey, 2000-01.

This demographic profile combined with the following assumptions result in a service forecast that is skewed towards an urban environment:

- Urban environments will have the concentration of 3G traffic.
- Population is concentrated in urban and dense urban environments.
- The propensity to buy profile (Section 3) is skewed towards occupations and industries more concentrated in urban rather than rural areas.

# 3 Service Assumptions

This report analyses all the service categories shown in Table 3.1. Table 3.1 provides the specific definitions of each service category.

Table 3.1 Service category descriptions.

| Service Category | Service Description | Market Segment Analysed |
|---|---|---|
| Mobile Intranet/Extranet Access | A business 3G service that provides secure mobile access to corporate Local Area Networks (LANs), Virtual Private Networks (VPNs), and the Internet. | Business |
| Customised Infotainment | A consumer 3G service that provides device-independent access to personalised content anywhere, anytime via structured-access mechanisms based on mobile portals. | Consumer |
| Multimedia Messaging Service (MMS) | A consumer or business 3G service, that offers non-real-time, multimedia messaging with always-on capabilities allowing the provision of instant messaging. Targeted at closed user groups that can be services provider- or user-defined. MMS also includes machine-to-machine telemetry services. | Consumer |
| Mobile Internet Access | A 3G service that offers mobile access to full fixed ISP services with near-wireline transmission quality and functionality. It includes full Web access to the Internet as well as file transfer, email, and streaming video/audio capability. | Consumer |
| Location-Based Services | A business and consumer 3G service that enables users to find other people, vehicles, resources, services or machines. It also enables others to find users, as well as enabling users to identify their own location via terminal or vehicle identification. | Consumer and Business |
| Simple Voice and Rich Voice | A 3G service that is real-time and two-way. Simple Voice provides traditional voice services including mobile voice features (such as operator services, directory assistance and roaming). Rich Voice provides advanced voice capabilities (such as voice over IP (VoIP), voice-activated net access, and Web-initiated voice calls, and mobile videophone and voice enriched with multimedia communications. | Consumer and Business |

Source: UMTS Forum Report 13

These service categories have very distinct definitions that are important considerations in analysing traffic. For example, MMS is non-real-time and one-way, while Rich Voice is real-time and two-way.

## 3.1 Mobile Penetration

The mobile traffic forecasts in this report are built upon a foundation of extensive market analysis of 3G service opportunities from UMTS Forum Report 17 and analyses from other reports. The underlying revenue, subscriber, and usage relationships are the starting point for the traffic analysis. The forecasts extend through year 2012, when it is expected that developed countries will have obtained maximum penetration and usage volumes of 3G services. Therefore, the following maximum usage assumptions for the representative country are the basis for the peak load and busy hour calculations in this report:

- Maximum mobile penetration is 90% of population.

- Maximum 3G data penetration is 60% of mobile subscribers.[9]

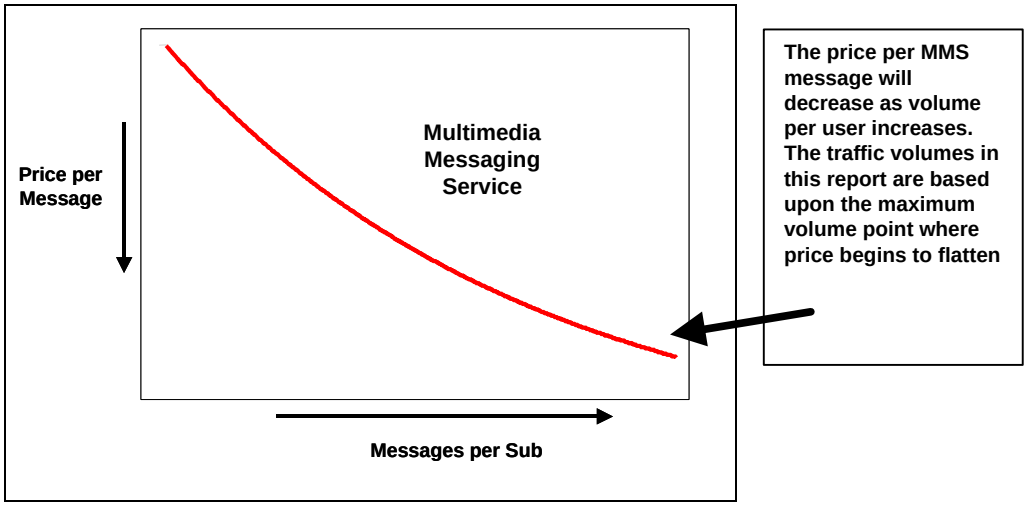
## 3.2 Mobile Usage

Service adoption and usage volume are highly influenced by service price. Typically the number of subscribers and the usage volume of those subscribers will increase as price decreases. There is, however, a limit on how much subscribers will use a service regardless of the price.

In the UMTS forecast analysis, conservative assumptions and reasonability governed the analysis process. At no time was it assumed that premium pricing or above-normal usage is attributed to 3G subscriptions. For example, price points used in the forecasts for MMS and Rich Voice represented a reasonable willingness to pay for existing services or substitute services. In general, volume usage for any service category was predicted to increase as per unit prices decreased. Reaching "maximum" penetration and usage levels described above, presumes a relatively low price level for mobile data services relative to current pricing.

Figures 3.2 and 3.3 illustrate the shape of the price demand curve for MMS and Rich Voice, and are representative of the analysis conducted for each service category

Figure 3.2. Price demand – MMS.

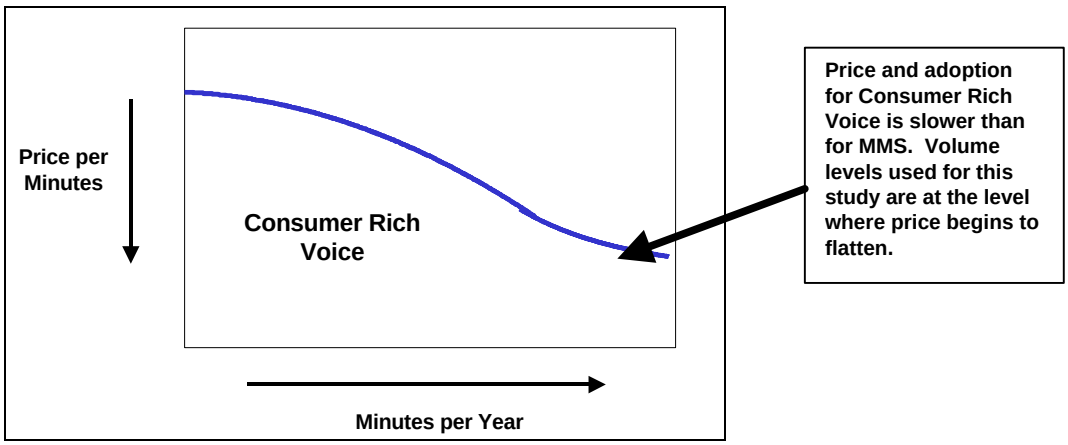



Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Because a full 3G Rich Voice enabled by IMS is a higher priced service, not commercially available for a few years, the adoption rate does not reach the same penetration levels as does MMS. Only 25% of 3G users will have subscribed to Rich Voice vs. almost 60% subscription levels for MMS. The shape of the curve for Rich Voice also shows service volume is less sensitive to changes in price than is MMS.

[9] 60% represents the bulk of 3G subscribers that generate traffic on a consistent basis. Also, the "maximum" 3G penetration is less than 100% of mobile subscribers to take into consideration geographic areas that may not be served by 3G networks (e.g., rural areas) and portions of the mobile population that do not use any 3G mobile data services (such as the very old, the very young, or economically disadvantaged people).

Figure 3.3. Price demand for Rich Voice.

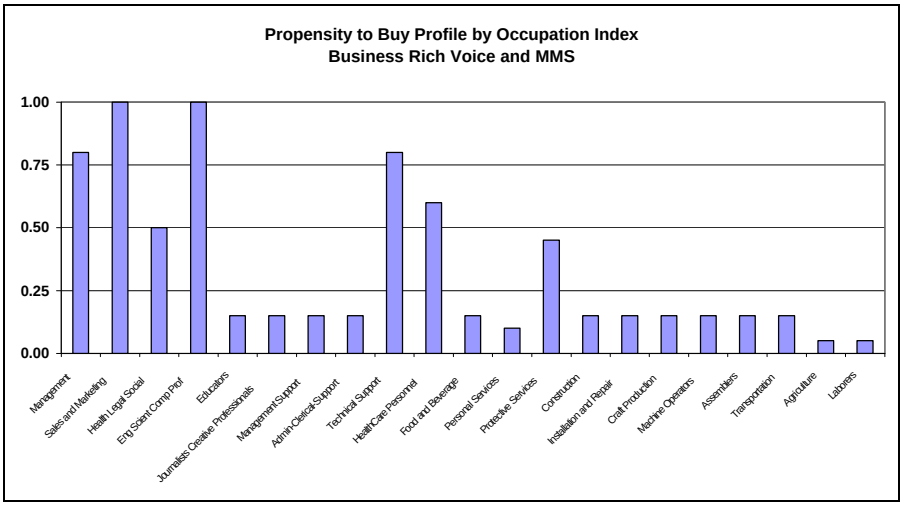



Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

## 3.3 Propensity to Buy Profiles

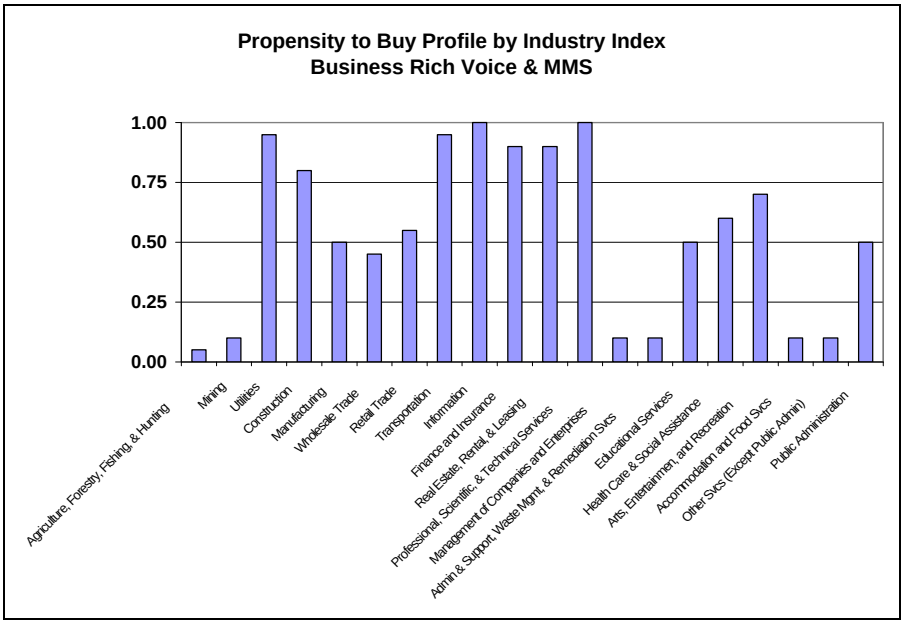
The forecast for each service category used in this analysis is based upon a service category profile that identifies the propensity to buy each service. Figures 3.4-3.7 for Rich Voice and MMS show the profiles as a relative index, are representative of profiles created for each service category. As illustrated in the Figures 3.4 and 3.5, workers in management, sales, marketing, engineering, and technical support occupations are more likely to use business Rich Voice and MMS than are workers in other occupations. Likewise, workers in the information and professional services industries are more likely to use business Rich Voice and MMS services than are workers in other industries. These indices are used as weighting factors against area population demographics to determine the number of subscribers for a service. These types of occupations are typically concentrated in urban rather than rural areas.

Figure 3.4. Relative propensity to buy Index by occupation – business Rich Voice and MMS




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

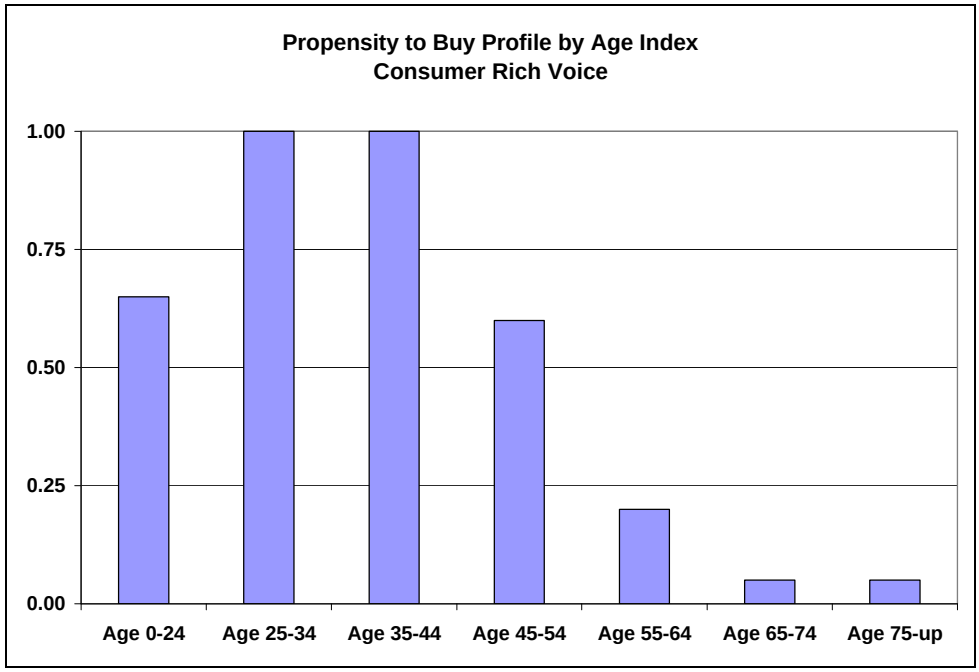
Figure 3.5. Relative propensity to Buy Index by industry – Business MMS and Rich Voice




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

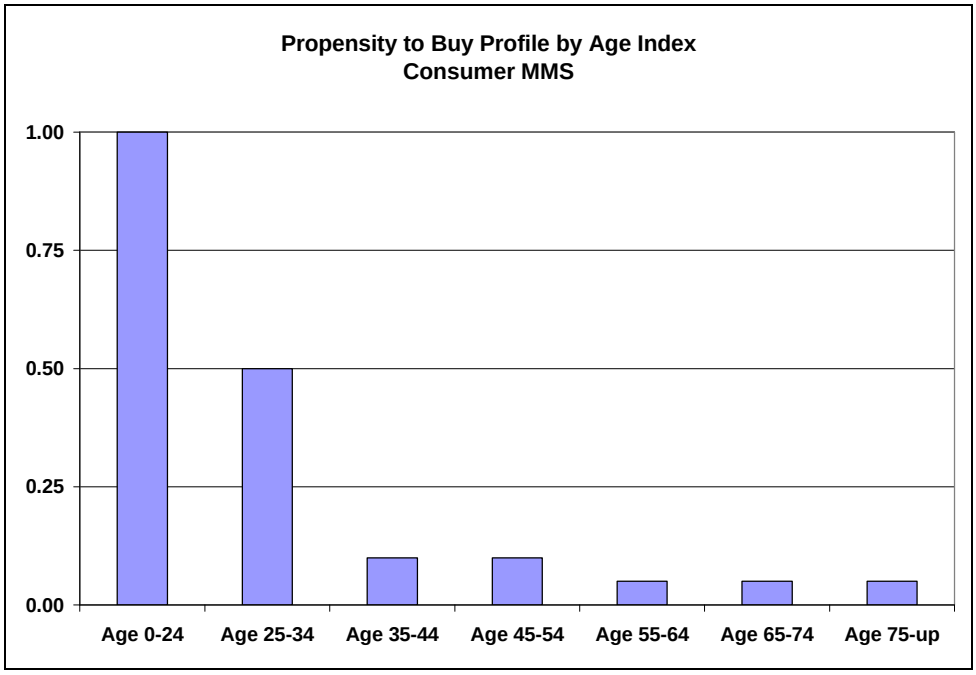
Figures 3.6 and 3.7 show the relative index for propensity to buy by age for consumer MMS and Rich Voice services. Consumer MMS is highly skewed to teenagers and very young adults, while Rich Voice is more skewed towards young adults to middle age.

Figure 3.6. Relative propensity to buy index by age – Consumer Rich Voice.




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Figure 3.7. Relative propensity to buy index by age – Consumer MMS.




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

# 4 Multimedia Messaging Service Assumptions and Offered Traffic

Analysis of MMS included business and consumer use and considers all the variables shown in Figure 1.2. The definition of MMS is repeated here for reader clarity:

> **Multimedia Messaging Service: A consumer or business 3G service that offers non-real-time, multimedia messaging with always-on capabilities allowing the provision of instant messaging. Targeted at closed user groups or business communities that are services provider- or user-defined. MMS includes messaging between people and also between machines (telemetry).**

For purposes of this analysis, Rich Voice and MMS services have very distinct differences even though both services can involve sending and receiving video and photos. The most important distinguishing difference is that MMS is non-real-time and one-way. In contrast, Rich Voice, (discussed in Section 5) is real-time and generally two-way.

From the end-user perspective, MMS service will look very much like existing SMS services, except that the user can include expanded and new media elements in addition to text. The MMS user will create the message and media (e.g., a mobile phone "camera), store it temporarily in the handset, then "send it" to other people or a network storage service.[10] The originator of the MMS message is either a mobile user or a fixed Internet PC user, sending the message to one or multiple parties. Therefore, MMS can include mobile-to-mobile, mobile to fixed, fixed to mobile as well as one-to-one and one-to-many variable states. Terminal device are a mobile handset, a PC, or a laptop / smart phone. By definition, MMS is one-way only, thus two-way transmission was not calculated. Three media types for both consumer and business are analysed in this report:

- People to People Messaging
  - Short video clips,
  - Photos,
  - Expanded text that may include some low-resolution graphics.

Analysis of MMS also includes business and consumer use of machine-to-machine telemetry services. Telemetry is defined as:
Machine-to-Machine Messaging

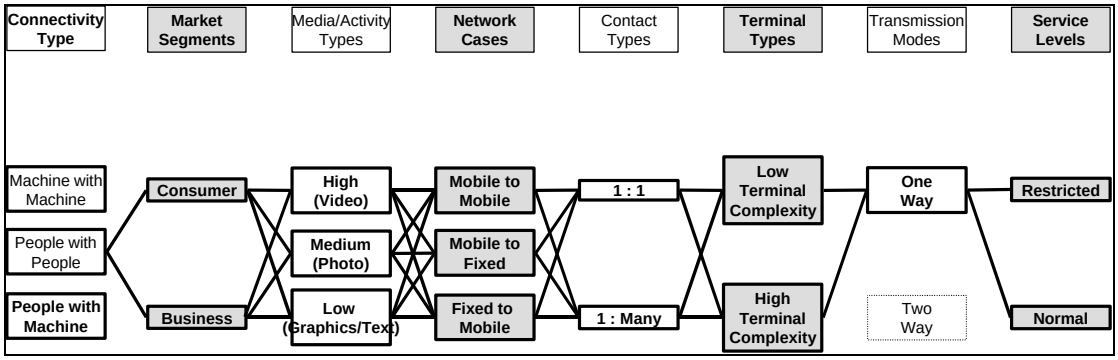
- Low bandwidth machine-to-machine initiated communications, monitoring or tracking of stationary objects.
- Telemetry does not include people and machines, (i.e., messaging or files that are transferred between servers, but initiated by people or files uploaded or downloaded by people to servers (e.g., Customised Infotainment)

These service variables are illustrated in Figure 4.1 and 4.2.

[10] It is also possible that the user could download content from a mobile Internet portal or web site, add a message, and then send it. However, the download portion of that transaction would actually be included under a different service category (e.g., Customised Infotainment)

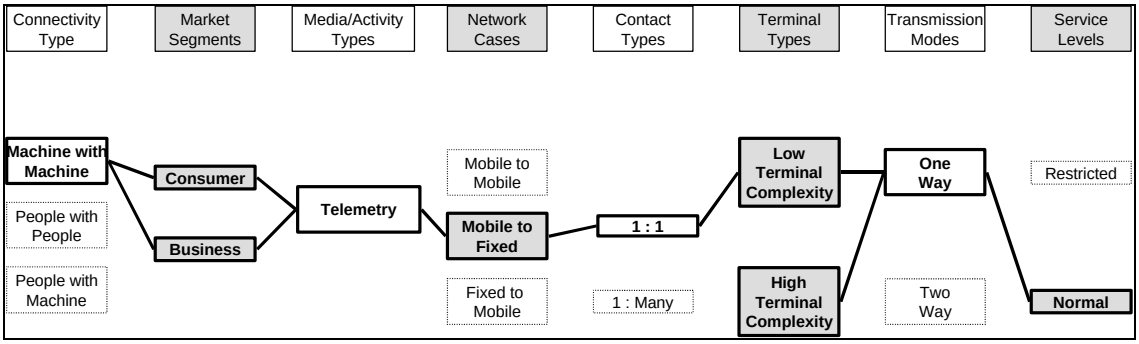
Figure 4.1. Service variables and states used for business and consumer MMS.

**In MMS, the "two-way" variable states were eliminated, as MMS, by definition, is one way.**




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Figure 4.2. Service variables and states used for machine-to-machine telemetry.




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

## 4.1 Usage and Traffic Assumptions

The number of MMS subscribers and their frequency and type of use (number of messages and type of media in message) was estimated based upon the representative country described earlier. MMS is viewed as a popular business service, used by nearly all business 3G subscribers as part of their daily activities. In the consumer market, MMS is heavily concentrated among teens and young adults. The analysis assumes that all messages include a text component, and a smaller number include video and or photo media. The major usage assumptions for MMS used in the offered traffic estimates for 2012 are as shown in Table 4.3.

Table 4.3 MMS usage assumptions.

| | |
|---|---|
| 3G Subscribers[11] | ▪ 31.9 M 3G Subscribers (53% of population)<br>▪ 20.4 M Consumer 3G Subscribers<br>▪ 11.5M Business 3G Subscribers |
| MMS Subscriptions | • 7.1 million consumer MMS Subscriptions (12% of population)<br>• 11.5 million business MMS Subscriptions (19% of population)<br>• 60 million telemetry subscriptions |
| Frequency of Use[12] | • Consumer – 11 messages per day<br>• Business – 5 messages per day<br>• Telemetry- 24 messages per day (every hour 24x7) |
| Media Type | • All MMS messages have text component,<br>• 66%% of messages are text and low graphics only<br>• 24% have a Photo media component,<br>• 10% have a video media component |
| Network Cases[13], Origination and Termination | • 32% mobile to mobile<br>• 40% mobile to fixed<br>• 28% fixed to mobile<br>• Telemetry is 100% mobile to fixed |
| Transmission Mode and Contact Type | • 80% one-to-one; 20% one-to-many<br>• All traffic is one-way |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

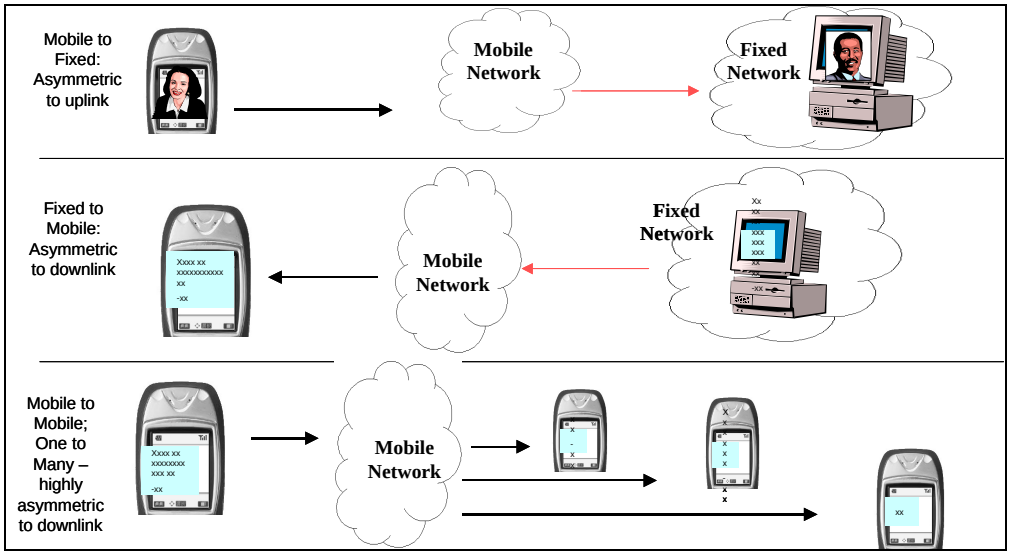
MMS service is one way. Therefore, the traffic symmetry of an individual session is defined by the network case (e.g., mobile-to-fixed) and whether the transmission is one to one or one to many. . The assumed symmetry of MMS is illustrated in Figure 4.4 and Telemetry in Figure 4.5, both further described in Table 4.6.

[11] Estimates of subscribers for 3G and MMS are based on UMTS Forum Report 17.

[12] Telecompetition estimate based on reported SMS messages and projected growth rates reported by GSM Association, IDC, EMC and other industry analysts.

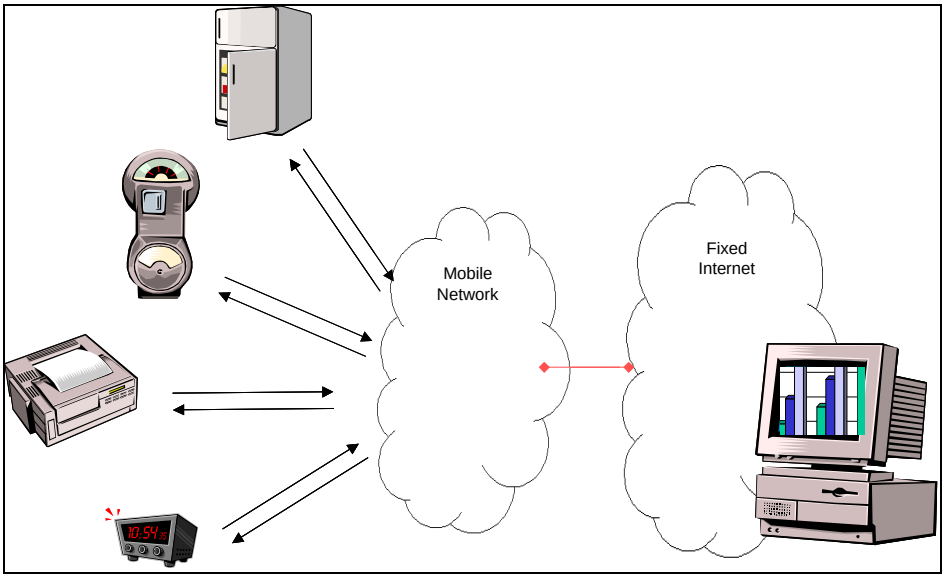
[13] Source: Telecompetition analysis of Oftel report on Vodafone, O2, Orange, and T-Mobile terminating minutes. Although mobile-to-mobile messaging is expected to increase in the future, it is also expected that this will be offset by an increase in messaging between fixed PCs and mobile users. Therefore, the relative proportion of future traffic between mobile and fixed networks is assumed to be similar to what exists today.

Figure 4.4. MMS symmetry for different service variables and states.




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Figure 4.5. Telemetry symmetry.




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Table 4.6. Assumed asymmetry of personal MMS services by contact type, transmission mode and network case.

| Contact Type<br>Transmission Mode | Network Case | Service Symmetry | Ratio UL: DL |
|---|---|---|---|
| One to One:<br>One Way | Mobile to mobile | Symmetric | 1:1 |
| | Mobile to Fixed | Asymmetric to Uplink | 1:0 |
| | Fixed to Mobile | Asymmetric to Downlink | 0:1 |
| One to Many:<br>One-Way | Mobile to mobile | Highly Asymmetric to Downlink | 1:3 |
| | Mobile to Fixed | Asymmetric to Uplink | 1:0 |
| | Fixed to Mobile | Highly Asymmetric to Downlink | 0:3 |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

The type of media used in an MMS message is an important factor in determining the file size. A range of file sizes is possible. The assumed message sizes for MMS in this analysis are summarised in Table 4.7.

Table 4.7 MMS – size of message[14]

| Terminal Type | Media / Activity Type | Message Size (kBytes) |
|---|---|---|
| Low Complexity Terminals | Text and/or low resolution graphics | 10 |
| | Photo | 30 |
| | Video | 100 |
| High Complexity Terminals | Text and/or low resolution graphics | 30 |
| | Photo | 100 |
| | Video | 150 |
| Low Complexity Terminals | Machine-to-Machine Telemetry | 0.01 |

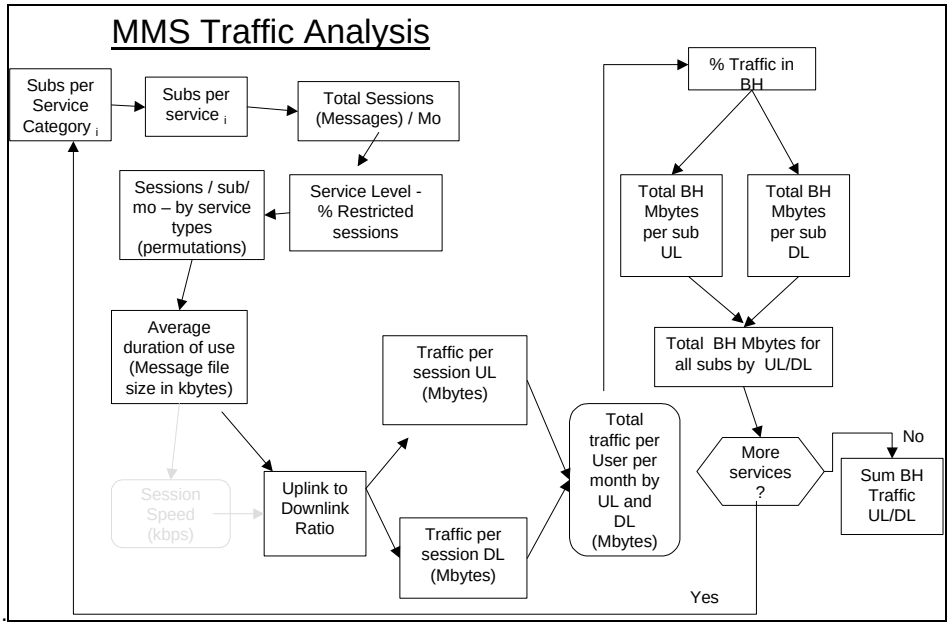
Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

## 4.2 Traffic Analysis and Results

The framework used for MMS traffic analysis follows the same flow as shown earlier in Figure 2.2. Since MMS is not a real-time service, “duration of use” and “session speed” is replaced by message file size. This is illustrated in Figure 4.8.

[14] Some of the Telecompetition estimates are based on file size capabilities of Nokia 7650, MMS enabled handsets per Nokia web site www.nokia.com.

Figure 4.8. MMS Traffic analysis framework.



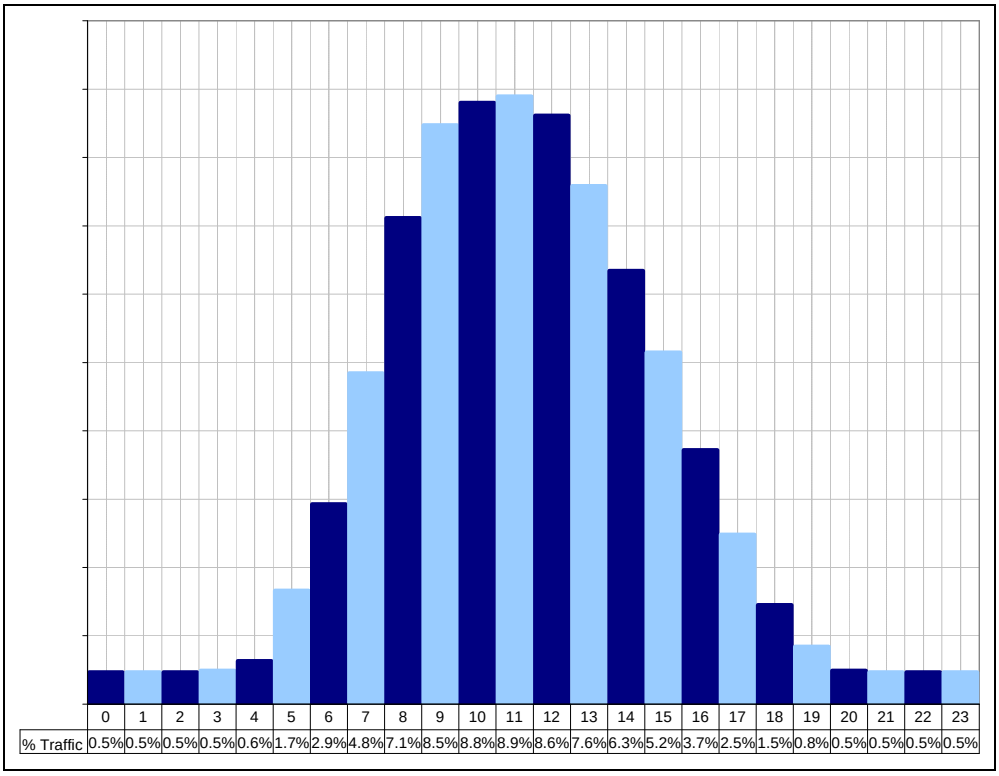

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

The busy hour distribution is shown in Figures 4.9, 4.10 and 4.11. The percent of traffic that occurs in the busy hour is 9.5% for consumers and 10.7% for business.

The traffic distribution is based on actual messaging traffic data from the UK operator O2 and on the following observations and rationale:

- Business use is concentrated from Monday through Friday, during the working hours of 0800 to 1800 (8 a.m. to 6 p.m.)
- Whilst business mobile voice traffic is often concentrated during commute hours, MMS users incorporate MMS into the routine business processes of a mobile employee so traffic is more evenly distributed throughout the day.
- Consumers use MMS more for recreational and personal interaction. Thus, consumer MMS traffic is more concentrated in the evenings than is business traffic.
- The traffic distribution as used in this study does not vary by the type of message, network, or terminal used. Subscribers use the service when they desire, using whatever terminal or network access is available to them at that time. The decision to send a photo or a video clip is based on the personal circumstances or situation of the subscriber, not on the hour of the day.

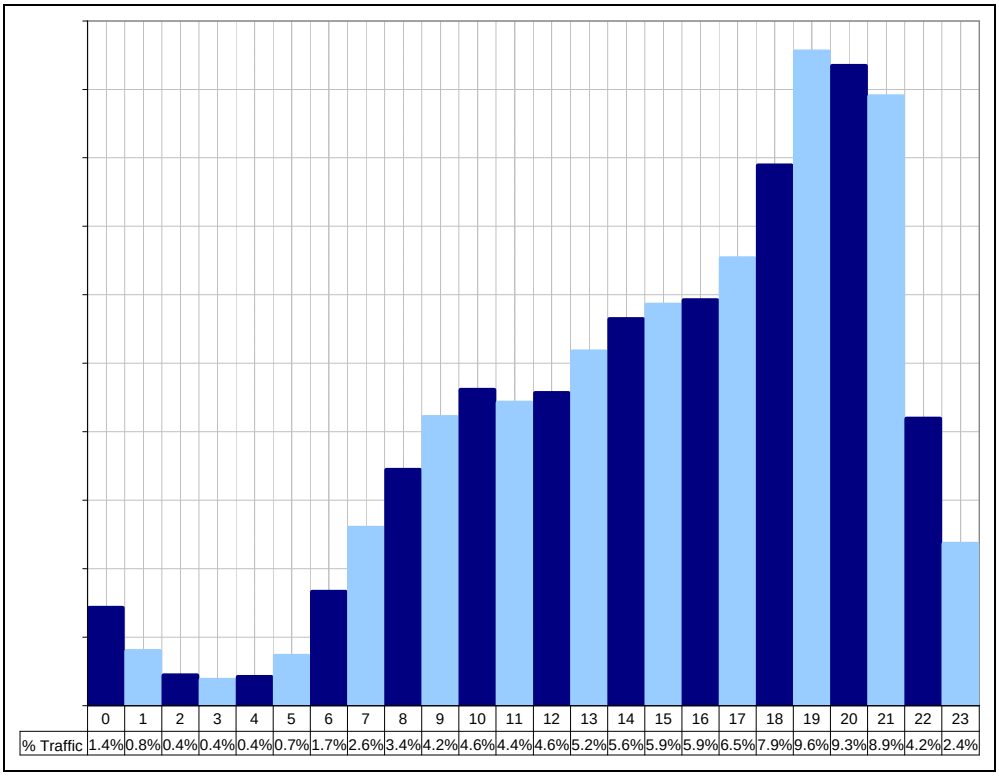
Figure 4.9. Diurnal traffic distribution – Business Multimedia Messaging Service.



| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % Traffic | 0.5% | 0.5% | 0.5% | 0.5% | 0.6% | 1.7% | 2.9% | 4.8% | 7.1% | 8.5% | 8.8% | 8.9% | 8.6% | 7.6% | 6.3% | 5.2% | 3.7% | 2.5% | 1.5% | 0.8% | 0.5% | 0.5% | 0.5% | 0.5% |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

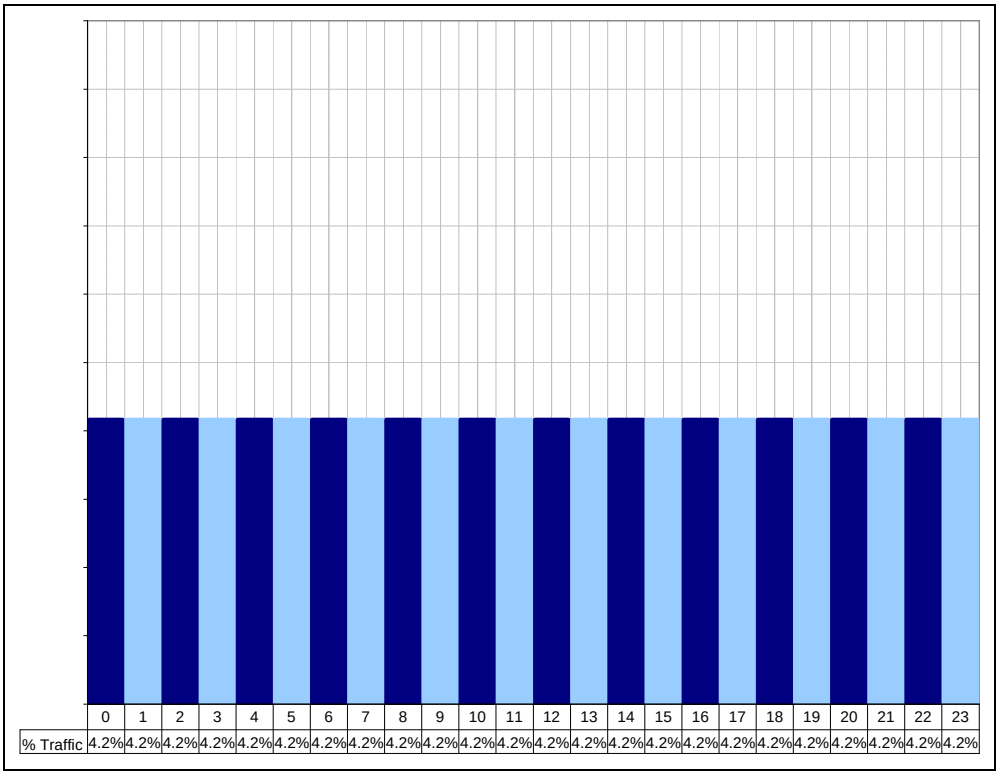
Figure 4.10. Diurnal traffic distribution – Consumer Multimedia Messaging Service.



| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % Traffic | 1.4% | 0.8% | 0.4% | 0.4% | 0.4% | 0.7% | 1.7% | 2.6% | 3.4% | 4.2% | 4.6% | 4.4% | 4.6% | 5.2% | 5.6% | 5.9% | 5.9% | 6.5% | 7.9% | 9.6% | 9.3% | 8.9% | 4.2% | 2.4% |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Figure 4.11. Diurnal traffic distribution – machine-to-machine telemetry.




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Based on the assumptions and analysis presented in this section, Table 4.12 and 4.13 summarise the offered traffic and traffic characteristics of MMS. This indicates MMS is slightly asymmetric to the downlink.

Table 4.12 MMS - offered busy hour traffic and asymmetry per country.

| Description | Busy Hour Traffic |
|---|---|
| **MMS Offered Traffic per country– Uplink** | **0.504 TBytes** |
| Business | 0.323 TBytes |
| Consumer | 0.180 TBytes |
| Telemetry | 0.001 TBytes |
| **MMS Offered Traffic per country – Downlink** | **0.511 TBytes** |
| Business | 0.350 TBytes |
| Consumer | 0.160 TBytes |
| Telemetry | 0.001 TBytes |
| **Overall Service Asymmetry - Uplink / Downlink** | **0.99** |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Table 4.13 MMS – Busy hour offered traffic per subscription.

| Description | Busy Hour Traffic |
|---|---|
| **Uplink traffic per MMS subscription** | |
| Per Business Subscription | 28.16 kBytes |
| Per Consumer Subscription | 25.17 kBytes |
| Telemetry | 0.02 kBytes |
| **Downlink traffic per MMS subscription** | |
| Per Business Subscription | 30.51 kBytes |
| Per Consumer Subscription | 22.46 kBytes |
| Telemetry | 0.02 kBytes |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

# 5 Rich Voice Assumptions and Offered Traffic

Analysis of Rich Voice services includes business and consumer usage, and considered all the variables shown in Figure 1.2. The definition of Rich Voice is repeated here for reader clarity:

> **Rich Voice: A 3G service that is real-time and two-way. It provides advanced voice capabilities (such as Voice over IP, voice-activated net access, and Web-initiated voice calls) as well as mobile videophone and multimedia communications.**

Rich Voice services are real-time and always include voice plus a multimedia element.

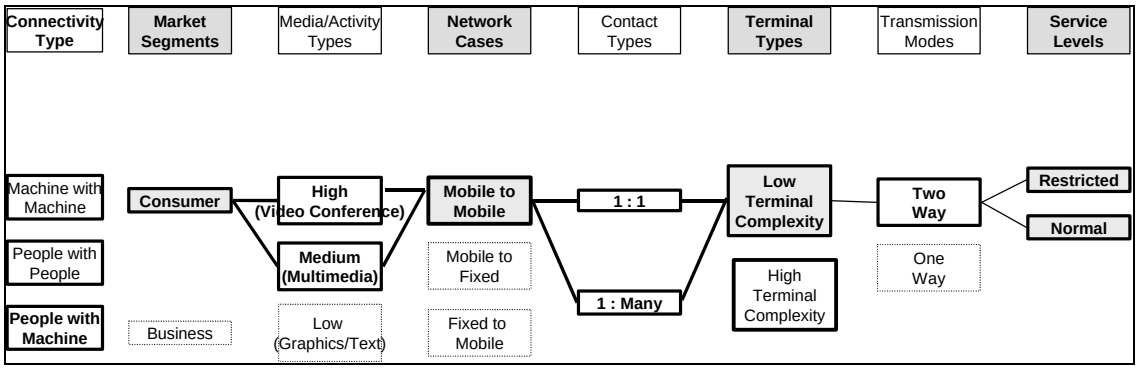
## 5.1 Usage and Traffic Assumptions

From the end-user perspective, Rich Voice will look much like a mobile substitute for desktop or other video conferencing service and/or a web conference that uses shared "whiteboard" and other multimedia elements (e.g., MS Net meeting). Some of the functionality of Rich Voice - talking while sharing other media - is closely emulated through a MMS message followed by a standard voice call once the message is received. However Rich Voice is a real time service, and as such the expectation is that a smaller number of 3G subscribers will pay a higher price for that real-time capability. Two levels of multimedia were analysed for both consumer and business segments:

- Low Resolution Video or multimedia (consumer)
- Video Only (consumer)
- Video Only (business)
- Multimedia Video Conference (business)

Some simplifying assumptions were made for the Rich Voice analysis. Rich Voice, by definition is real-time, two-way voice plus a real-time multimedia component. Therefore, as long as the communication is two-way, the service is, in aggregate, symmetrical. Although it is technically possible to use Rich Voice service as a one-way service and between fixed and mobile devices, in practical use, it would seem more likely that the service is real-time and used in an interactive conversation, not a one-way transmission. Also transmission of multimedia elements between mobile and fixed devices can occur in ways other than real time (e.g., MMS). The network variations do not make a difference in the symmetry or bandwidth required. Therefore, for consumer Rich Voice, all Rich Voice calls are two-way using low complexity terminals (e.g., mobile handsets). Figure 5.1 illustrates the service variables used for the traffic estimates in the consumer segment. Further discussion on traffic characteristics for consumer Rich Voice is found in Section 5.2.

Figure 5.1. Service variables and states used for consumer Rich Voice.

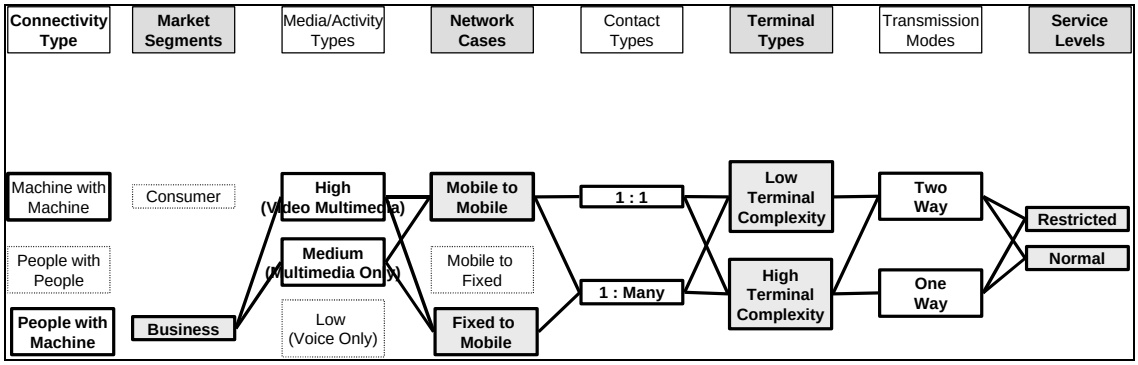



Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Service variables and states used for business Rich Voice calculations are shown in Figure 5.2. While any type of variation is possible, the analysis assumes that most multimedia conferences are conducted with both parties receiving and sending equal amounts of video or other multimedia real-time content. In most cases, differences in type of media, types of networks interoperating, terminal

complexity, or whether the transmission is one to one or one to many change the total bandwidth required, but not the symmetry. The one notable exception is business Rich Voice for hosted video and multimedia conferences where the host is typically a fixed terminal broadcasting video to remote and mobile locations.

Figure 5.2. Service variables and states used for Business Rich Voice.




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Table 5.3 summarises the usage assumptions for Rich Voice. It is important to remember that these usage assumptions only apply to the smaller portion of 3G subscribers that actually subscribe to Rich Voice service – not to the entire mobile or 3G-subscriber base. Anyone that subscribes to the service is a relatively heavy user. For example, consumer Rich Voice is envisioned as premium service used mostly for entertainment and personal communications purposes, to share special events (holidays, birthdays, vacations, etc) with other people. Consequently, only 10% of 3G subscribers use the service. Within this small subscriber base, the highest quality video Rich Voice is used infrequently (six times) during the year. More casual, lesser quality video or multimedia calls are made about two times a week for 15 minutes each time.

Compared to consumers, business subscribers of Rich Voice use the service less frequently, but for longer periods of time. Business subscribers of 3G services are expected to have 18 collaborative, mobile "conferences" per year – six of which include video plus multimedia. The remaining calls will look more like a Net Meeting conference with whiteboard and/or files shared and viewed in real-time. Each collaborative conference will last an hour on the average. Business usage includes one-way hosted conferences from a fixed host.

Table 5.3 Rich Voice usage assumptions.

| | |
|---|---|
| 3G Subscribers | • 31.9 M 3G Subscribers (53% of population)<br>• 20.4 M Consumer 3G Subscribers<br>• 11.5M Business 3G Subscribers |
| Rich Voice Subscriptions[15] | • 5.6M Consumer Subscriptions<br>• 5.9M Business Subscriptions |
| Frequency of Use | • 100 Consumer calls per year per subscription<br>• 18 Business calls per year per subscription |
| Media Type | • All Rich Voice calls include voice<br>• 33% of business Rich Voice are for multimedia video conference; 67% for multimedia only<br>• 2% of Consumer Rich Voice calls are video and 98% are for multimedia / Low Resolution Video |
| Network Case: Origination and Termination | • 100% of consumer Rich voice calls are mobile to mobile<br>• 70% of business Rich Voice calls are mobile to mobile<br>• 30% of business Rich Voice calls are fixed to mobile (hosted conferences) |
| Session Duration | • Consumer calls are either 5 or 15 minutes<br>• Business calls are either 15 or 60 minutes |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Most Rich Voice services are two-way and symmetric – all parties are sending and receiving the same type and quantity of information. Symmetry assumptions used in the analysis are shown in Table 5.4.

Table 5.4 Assumed asymmetry of Rich Voice service by contact type and network case.

| Contact Type | Network Case | Service Symmetry – per user | Ratio UL: DL |
|---|---|---|---|
| Two Way | Mobile to mobile | Symmetric | 1:1 |
| | Mobile to Fixed | Not Applicable | |
| | Fixed to Mobile | Not Applicable | |
| One Way | Mobile to mobile | Not Applicable | 1:1 |
| | Mobile to Fixed | Not Applicable | |
| | Fixed to Mobile | Asymmetric to Downlink (hosted conference) | 1:5 |

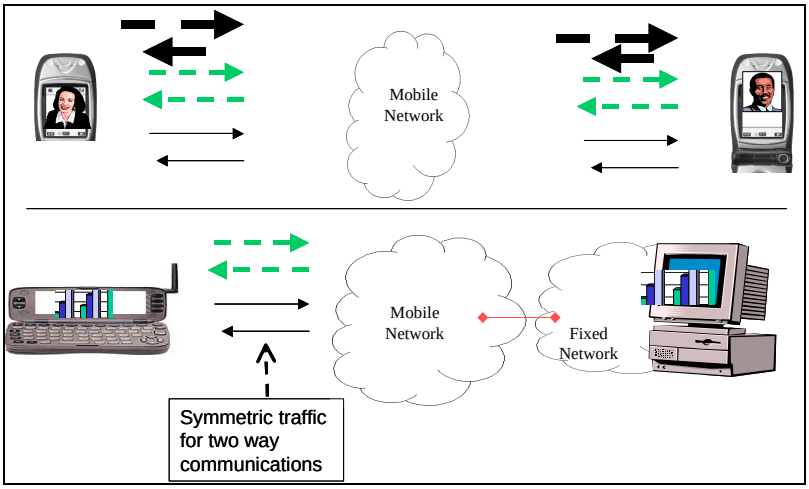
Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Figure 5.5 further illustrates the symmetry of most Rich Voice services. Regardless of the type of terminal used or whether the transmission is between mobile and/or fixed networks, the real-time Rich Voice services are almost always two-way and symmetric.

[15] Rich Voice subscriptions estimated by Telecompetition Inc. for UMTS Forum Report 17. The estimates considered historic digital camera adoption rates as reported by IDC ("Worldwide Digital Camera Market Forecast and Analysis", 2000) and growth in business conferencing services as reported by Wainhouse Research ("Teleconferencing Markets and Strategies", September 2000).

Figure 5.5. Symmetry of Rich Voice services.

As long as the multimedia transmission is two-way, Rich Voice service is symmetric.

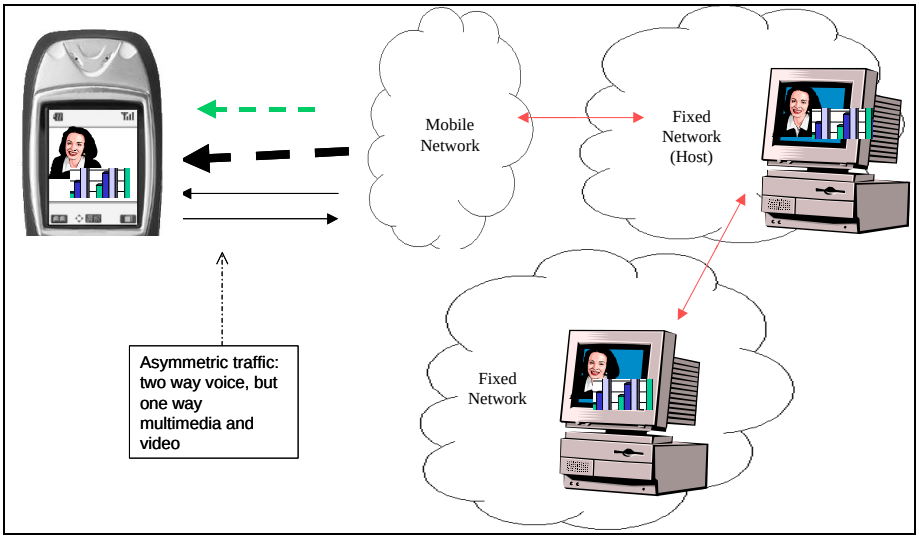



Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

The one clear exception to the Rich Voice symmetry is in the case of a hosted business conference where the host is in the fixed network. This typically would be a web cast, which is primarily one-way. The host transmits video, multimedia and voice, while the mobile participant would send only voice and possibly simple text to ask questions. This is illustrated in Figure 5.6

Figure 5.6. Rich Voice service example - hosted one-way conference for business.

**One-way multimedia transmission is possible, but in practical use is most likely limited to business-hosted conferences.**

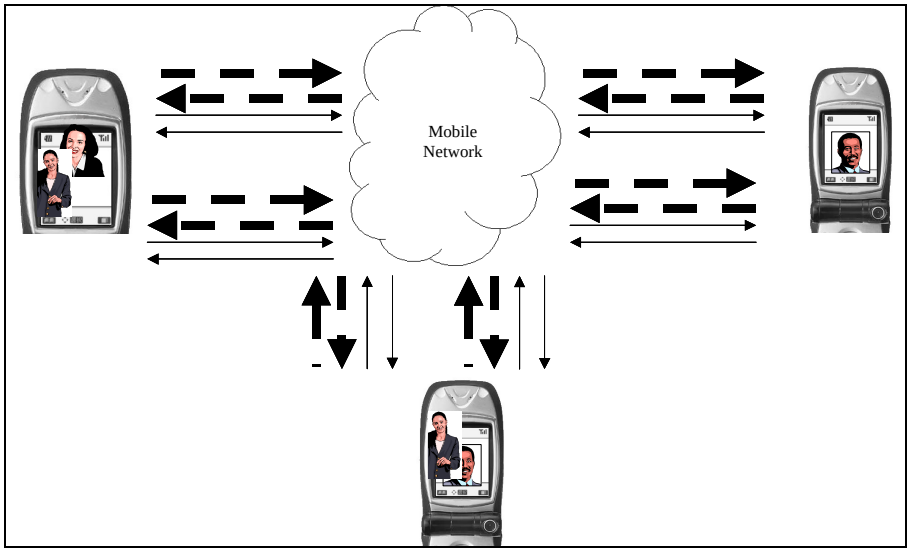



Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Multi-party conferences between Rich Voice subscribers are included in the calculations for total sessions. As shown in Figure 5.7, multi-party calls are still symmetric and two-way.

Figure 5.7. Rich Voice service example for number of sessions – one to many.

**The total number of sessions (calls) made by Rich Voice users is included in the total usage calculation regardless of whether they are calling each other or others on the fixed network. Therefore, a multi-party (one-to-many) call session impacts the traffic load during the busy hour, but not the symmetry.**




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Session speed and session duration assumptions are shown in Table 5.8. Business Rich Voice calls are longer than consumer calls.

Table 5.8 Range of Rich Voice session speed assumptions based on media type and terminal complexity.

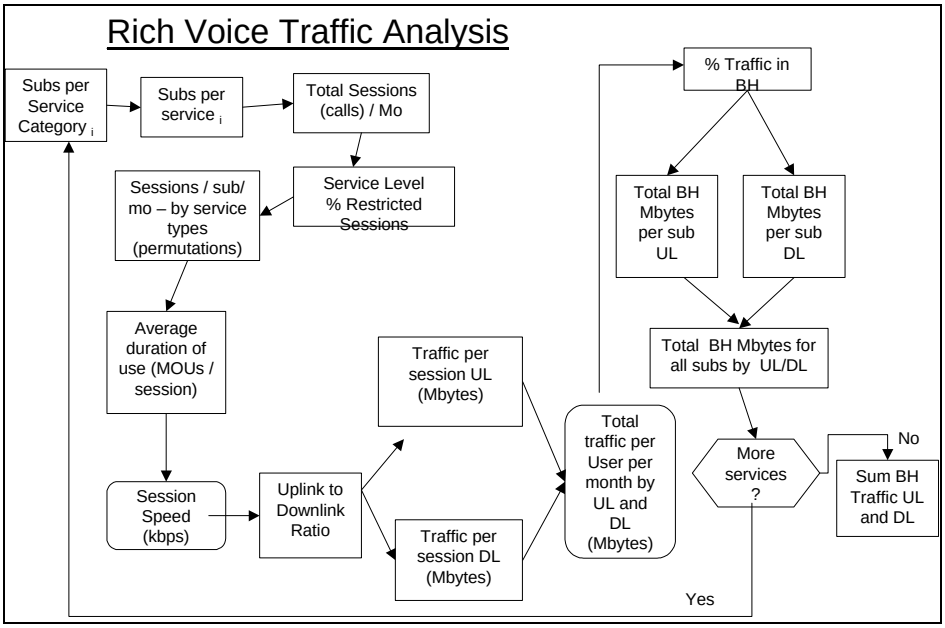
| Terminal Complexity | Media Type | Session Data Rate |
|---|---|---|
| Low | Voice plus text | 8 kbps |
| High | Voice plus multimedia | 38 kbps |
| High | Voice plus video plus multimedia | 192 kbps |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

## 5.2 Service Traffic Analysis and Results

The framework used for Rich Voice traffic analysis follows the same flow as shown earlier in Figure 2.2. Because Rich Voice is a real-time service, session speed and average duration of use (MOUs/session) are important variables in the analysis. This is illustrated in Figure 5.9.

Figure 5.9. Rich Voice traffic analysis framework.

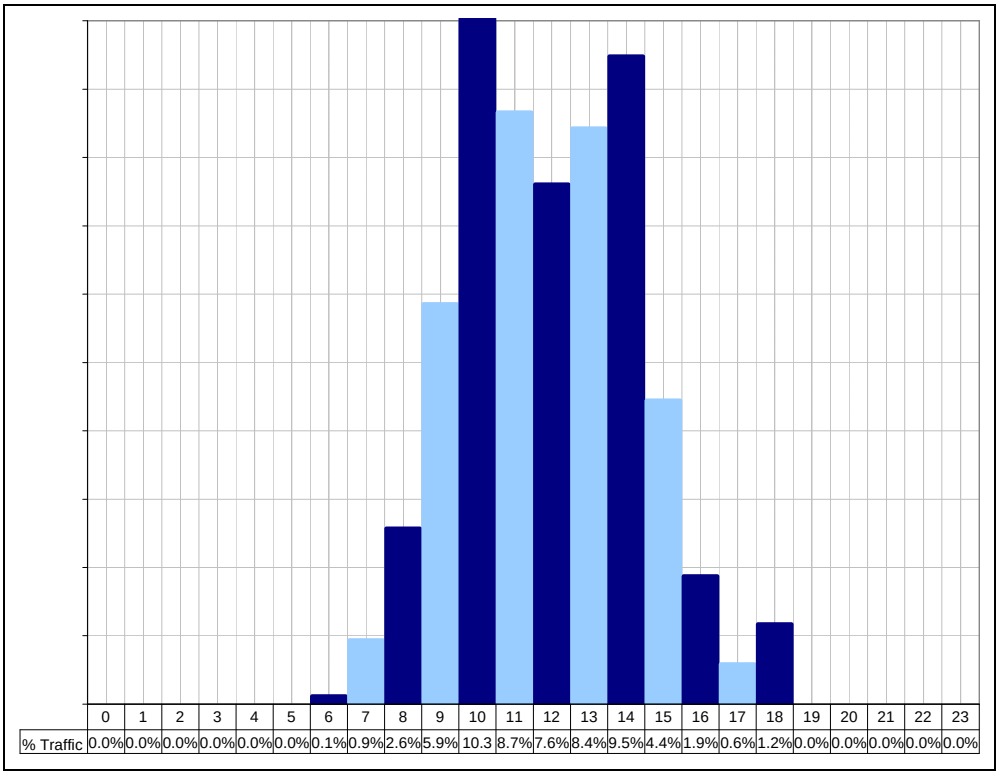



Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

The assumption is that 10.3% consumer and 16.6% business subscribers daily traffic occurs in the busy hour. The traffic distribution is illustrated in Figures 5.10 and 5.11, and is based on the following assumptions:

- Business use is concentrated from Monday through Friday, during the working hours of 0800 to 1800 (8 a.m. to 6 p.m.)
- While business mobile voice traffic is typically concentrated during commute hours, Rich Voice users incorporate Rich Voice into the routine business processes of a mobile employee so traffic is more evenly distributed throughout the day.
- Consumers use Rich Voice more for recreational and personal interaction. Thus, consumer Rich Voice traffic is more concentrated in the evenings.
- The busy hour does not vary by the type of message or network. Subscribers use the service when desired; using whatever terminal or network access is available to them at that time. The type of terminal capabilities and the needs of the situation determine whether the consumer will use a higher or lower resolution service.
- Business and consumer Rich Voice subscribers will have the ability to choose a restricted (lower speed) rather than a basic class of service for individual calls.
- Consumers use the service 30 days a month, while business subscribers use it for 21.2 days a month.

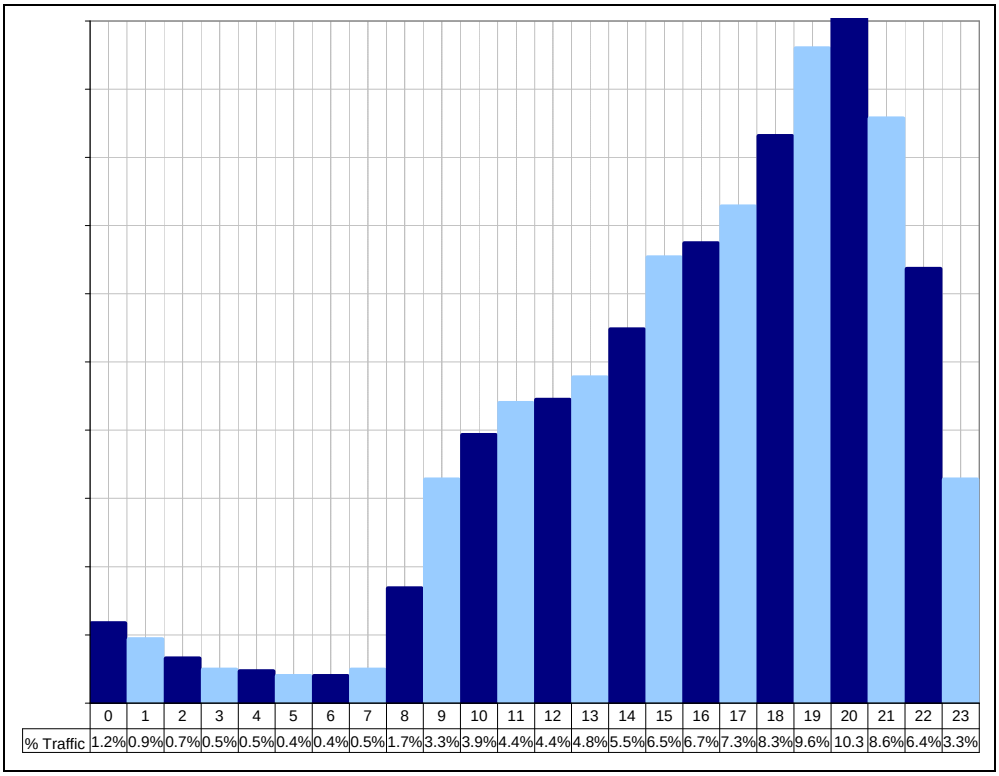
Table 5.10 Assumed diurnal traffic distribution – Business Rich Voice



| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % Traffic | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% | 0.1% | 0.9% | 2.6% | 5.9% | 10.3 | 8.7% | 7.6% | 8.4% | 9.5% | 4.4% | 1.9% | 0.6% | 1.2% | 0.0% | 0.0% | 0.0% | 0.0% | 0.0% |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Table 5.11 Assumed diurnal traffic distribution – Consumer Rich Voice



| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % Traffic | 1.2% | 0.9% | 0.7% | 0.5% | 0.5% | 0.4% | 0.4% | 0.5% | 1.7% | 3.3% | 3.9% | 4.4% | 4.4% | 4.8% | 5.5% | 6.5% | 6.7% | 7.3% | 8.3% | 9.6% | 10.3 | 8.6% | 6.4% | 3.3% |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Based on the assumptions and analysis presented in this section, Table 5.12 and Table 5.13 summarises the offered traffic and traffic characteristics of Rich Voice. This indicates Rich Voice is

asymmetric to the downlink. The asymmetry of Rich Voice is created by the existence of high bandwidth one-way hosted conferences for business users. All other Rich Voice services are two way and symmetric.

Table 5.12 Rich Voice – offered busy hour traffic and asymmetry per country.

| Description | Busy Hour Traffic |
|---|---|
| **Uplink - Rich Voice Offered traffic per country** | **2.06 TBytes** |
| Business | 2.03 TBytes |
| Consumer | 0.03 TBytes |
| **Downlink - Rich Voice Offered traffic per country** | **2.67 TBytes** |
| Business | 2.64 TBytes |
| Consumer | 0.03 TBytes |
| **Overall Service Asymmetry (UL /DL)** | **0.77** |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Table 5.13 Rich Voice – Offered busy hour traffic per subscription.

| Description | Busy Hour Traffic |
|---|---|
| **Uplink - Rich Voice traffic per Subscription** | |
| Per Business Subscription | 345.6 KBytes |
| Per Consumer Subscription | 7.5 KBytes |
| **Downlink - Rich Voice traffic per Subscription** | |
| Per Business Subscription | 450.7 KBytes |
| Per Consumer Subscription | 7.5 KBytes |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

# 6 Customised Infotainment Assumptions and Offered Traffic

Analysis of Customised Infotainment services includes business and consumer usage, and considered all the variables shown in Figure 1.2. The definition of Customised Infotainment is repeated here for reader clarity:

> **Customised Infotainment: A consumer 3G service that provides device-independent access to personalised content anywhere, anytime via structured-access mechanisms based on mobile portals.**

Customised Infotainment is a mass-market portal service that can include access to a wide variety of content and services. It is defined as a consumer-only service, paid for by an individual and used for entertainment, shopping, email, etc. A Customised Infotainment subscriber could also subscribe to other services such as MMS or Location-Based Services. Customised Infotainment is similar to Mobile Internet Access (Section 7) in the types of activities and segments included. Customised Infotainment differs from Mobile Internet Access in that it is a portal service, typically access via less complex mobile terminals, where the service provider is controlling the content and therefore the bandwidth/ file size available. Customised Infotainment subscribers are not as "Internet centric" as Mobile Internet Access subscribers and therefore access the service less frequently, for shorter periods of time. Personalisation of content and easy access to desired information is relatively more important than access speed.

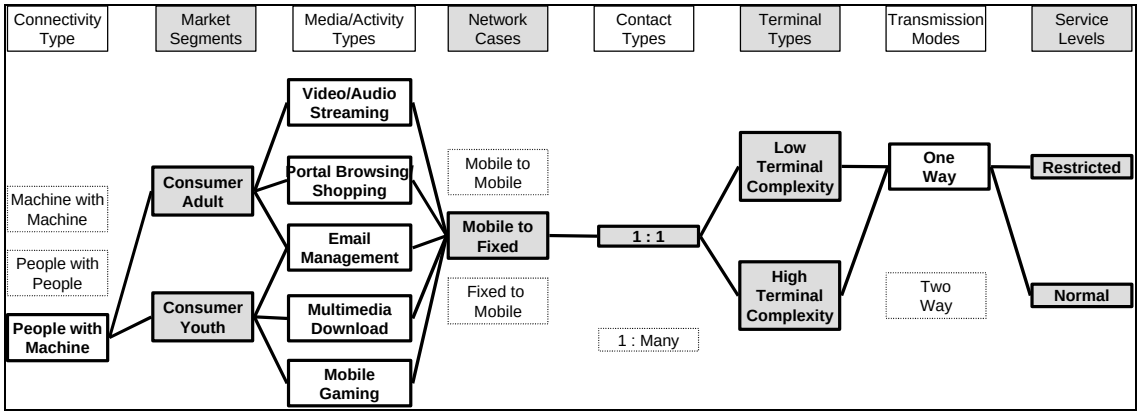
## 6.1 Usage and Traffic Assumptions

Three activity types were analysed for each of two consumer segments. While there are any number of activities and content that are potentially available through a Customised Infotainment service, the activity types chosen are represent the bulk of traffic volume and services with distinct traffic characteristics. Adult consumers and Youth were analysed separately to capture more accurately the entertainment services with higher usage patterns in a smaller group of subscribers.

- Adult Consumers
  - Email Management (includes both sending and receiving emails)
  - Video/Audio Streaming
  - Portal Browsing / Shopping
- Youth Consumers (teens)
  - Email Management (includes both sending and receiving emails)
  - Multimedia Download (i.e., music or video clips)
  - Mobile Games

The service variables and states for Customised Infotainment are shown in Figure 6.1. By definition, Customised Infotainment includes people accessing content hosted on network servers. (Person-to-person messaging and communications is part of MMS.) Thus all activities are considered one-way, mobile-to-fixed, and one-to-one communication.

Figure 6.1. Service variables and states used for Customised Infotainment.




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Subscribers of Customised Infotainment are expected to connect to their portal services once or twice a day and to perform multiple activity sessions each time they connect. For adult subscribers, the most popular activity is portal browsing and shopping (which includes financial transactions) followed by email. For Youth, mobile gaming is the most popular activity along with email. Table 6.2 summarises the specific usage assumptions for Customised Infotainment.

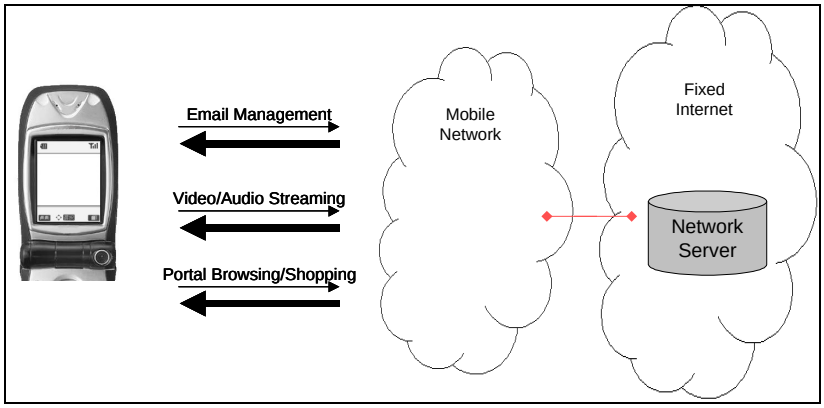
Table 6.2 Customised Infotainment usage assumptions.

| | |
|---|---|
| 3G Subscribers | • 31.9 M 3G Subscribers (53% of population)<br>• 20.4 M Consumer 3G Subscribers |
| Customised Infotainment Subscriptions | • 18.2 M Customised Infotainment Subscriptions<br>• 2.2 M Youth Subscriptions and 16M Adult Subscriptions |
| Frequency of Use | • 26 connections per month – combined activity types |
| Activity Type (sessions per month) | • Email Management: 20 sessions<br>• Video / Audio Streaming: 3 sessions<br>• Portal Browsing, Shopping: 25 sessions<br>• Mobile Gaming (Youth): 13 sessions<br>• Music or Video Download (Youth): 6 sessions |
| Network Case and Terminal Complexity | • 100% mobile to fixed<br>• 90% Low Complexity Terminals |
| Transmission Mode and Contact Type | • 100% one way<br>• 100% one-to-one |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

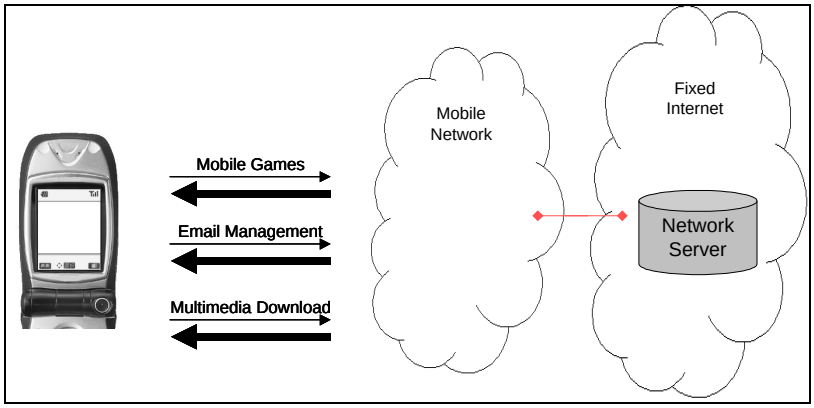
Figure 6.3 and 6.4 further illustrates the symmetry of most Customised Infotainment services.

Figure 6.3. Symmetry of Customised Infotainment - Adult Segment..




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Figure 6.4. Customised Infotainment – Youth Segment




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

File size assumptions for uplink and downlink are shown in Table 6.5. Customised Infotainment services are asymmetric to the downlink.

Table 6.5 Customised Infotainment – UL and DL file size by activity type – low complexity terminals.

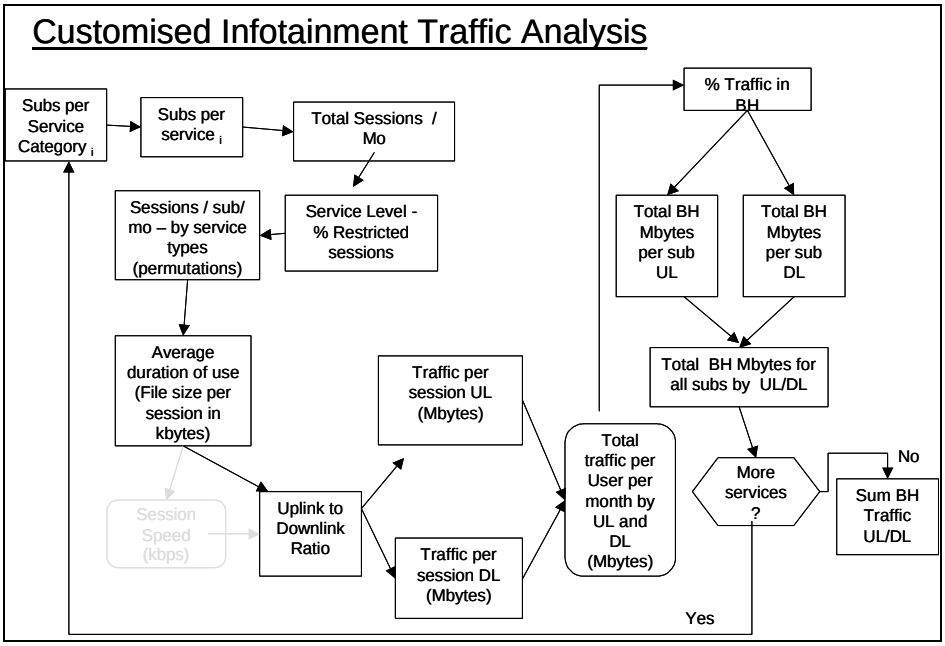
| Media / Activity Type | UL File Size (Kbytes) | DL File Size (Kbytes) | UL: DL Ratio |
|---|---|---|---|
| Email Management | 208 | 830 | 1:4 |
| Video/Audio Streaming | 90 | 2,250 | 1:25 |
| Portal Browsing / Shopping | 216 | 1,512 | 1:7 |
| MM Download | 90 | 2,250 | 1:25 |
| Mobile Games | 144 | 3,600 | 1:25 |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

## 6.2 Service Traffic Analysis and Results

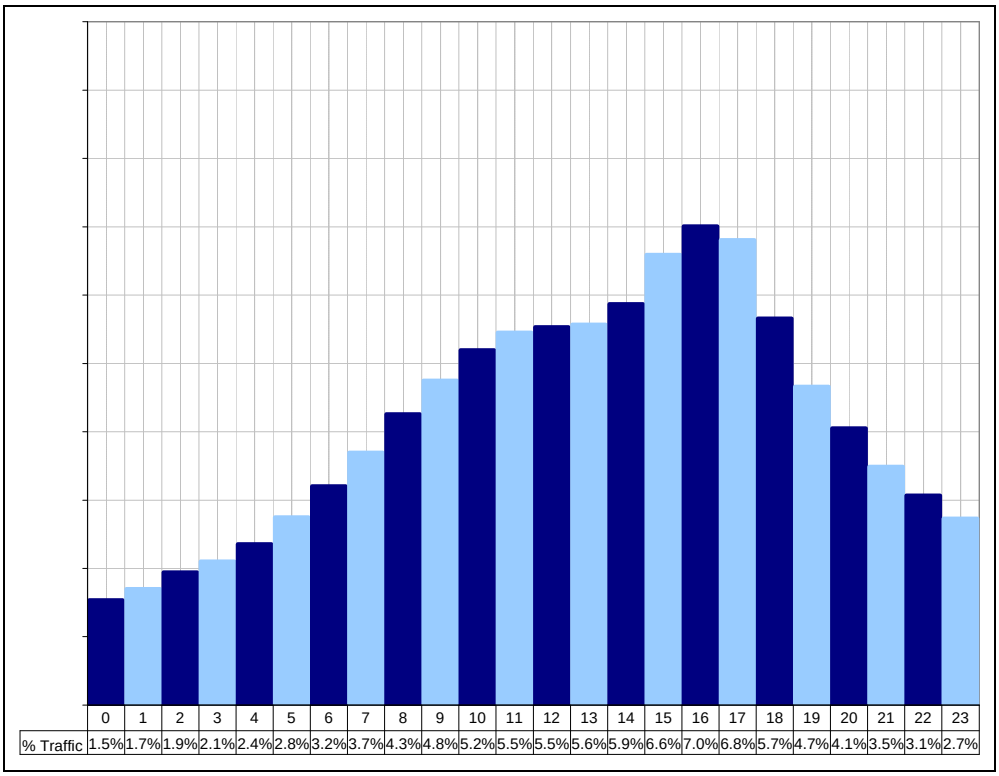
The framework used for Customised Infotainment traffic analysis follows the same flow as shown earlier in Figure 2.2 and is repeated in Figure 6.6. The busy hour distribution is shown in Figures 6.7. The percent of traffic that occurs in the busy hour is 7.0%.

Figure 6.6. Customised Infotainment traffic analysis framework.




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Figure 6.7. Assumed diurnal traffic distribution – Customised Infotainment




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Based on the assumptions and analysis presented in this section, Table 6.8 and Table 6.9 summarises the offered traffic and traffic characteristics of Customised Infotainment.

Table 6.8 Customised Infotainment – offered busy hour traffic and asymmetry per country.

| Description | Busy Hour Traffic |
|---|---|
| **Uplink - Customised Infotainment Offered traffic per country** | **0.38 TBytes** |
| Adult | 0.36 TBytes |
| Youth | 0.02 TBytes |
| **Downlink - Customised Infotainment Offered traffic per country** | **2.57 TBytes** |
| Adult | 2.22 TBytes |
| Youth | 0.35 TBytes |
| **Overall Service Asymmetry (UL /DL)** | **0.15** |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Table 6.9 Customised Infotainment – offered busy hour traffic per subscription.

| Description | Busy Hour Traffic |
|---|---|
| **Uplink - Customised Infotainment traffic per Subscription** | |
| Adult Subscription | 22.4 kBytes |
| Youth Subscription | 10.4 kBytes |
| **Downlink - Customised Infotainment traffic per Subscription** | |
| Adult Subscription | 138.3 kBytes |
| Youth Subscription | 159.9 kBytes |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

# 7 Mobile Internet Access Assumptions and Offered Traffic

Analysis of Mobile Internet Access services considered all the variables shown in Figure 1.2. The definition of Mobile Internet Access is repeated here for reader clarity:

> **Mobile Internet Access: A 3G consumer-only service that offers mobile access to full fixed ISP services with near-wireline transmission quality and functionality. It includes full Web access to the Internet as well as file transfer, email, and streaming video/audio capability.**

As stated in Section 6, the activity/media types considered for Mobile Internet Access are the same as those for Customised Infotainment. Like Customised Infotainment, Mobile Internet Access is a consumer-only service. However, Mobile internet Access subscribers prefer direct access to Internet services and content rather than using a portal service, go “on line” more frequently, and are more likely to use complex terminals. As a result, the bandwidth / file size requirements for the same activities is higher. Furthermore, Internet content is less likely to be optimised for mobile terminals than mobile portal content, pointing again to larger file sizes.

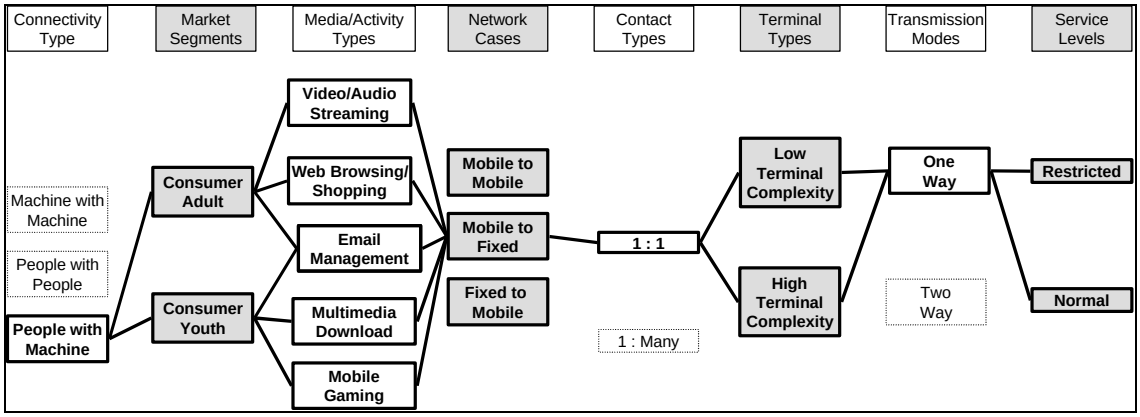
## 7.1 Usage and Traffic Assumptions

Three activity types were analysed for each of two consumer segments. While there are any number of activities and content that are potentially available through a Mobile Internet Access service, the activity types chosen are represent the bulk of traffic volume and services with distinct traffic characteristics. Adult consumers and Youth were analysed separately to capture more accurately the entertainment services with higher usage patterns in a smaller group of subscribers.

- Adult Consumers
  - Email Management
  - Video/Audio Streaming
  - Web Browsing / Shopping
- Youth (teens) Consumers
  - Email Management
  - Multimedia Download
  - Mobile Games (mobile access to server-based games)

The service variables and states for Mobile Internet Access are shown in Figure 7.1 and are identical to those shown for Customised Infotainment. By definition, Mobile Internet Access includes people accessing content hosted on network servers. (Person-to-person messaging and communications is part of MMS.) Thus all activities are considered one-way, mobile-to-fixed, and one-to-one communication.

Figure 7.1. Service variables and states used for Mobile Internet Access.




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Subscribers of Mobile Internet Access service are expected to connect "on-line" two or more times a day and to perform multiple activity sessions each time they connect. For adult subscribers, the most popular activity is portal browsing and shopping (which includes financial transactions) followed by email. For youth, mobile gaming is the most popular activity along with email. Table 7.2 summarises the usage assumptions for Mobile Internet Access.

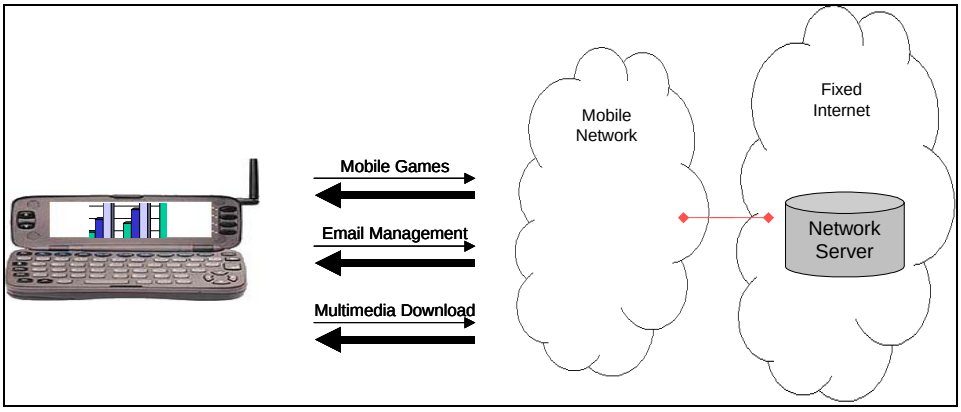
Table 7.2 Mobile Internet Access usage assumptions.

| | |
|---|---|
| 3G Subscribers | • 31.9 M 3G Subscribers (53% of population)<br>• 20.4 M Consumer 3G Subscribers |
| Mobile Internet Access Subscriptions | • 2.5 M Mobile Internet Access Subscriptions<br>• 0.3 M Youth Subscriptions and 2.2M Adult Subscriptions |
| Frequency of Use | • 52 connections per month – combined activity types |
| Activity Type (sessions per month) | • Email Management: 39 sessions<br>• Video / Audio Streaming: 5 sessions<br>• Portal Browsing, Shopping: 49 sessions<br>• Mobile Gaming (Youth): 26 sessions<br>• Music or Video Download (Youth): 12 sessions |
| Network Case and Terminal Complexity | • 100% mobile to fixed<br>• 70% High Complexity Terminals |
| Transmission Mode and Contact Type | • 100% one way<br>• 100% one-to-one |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

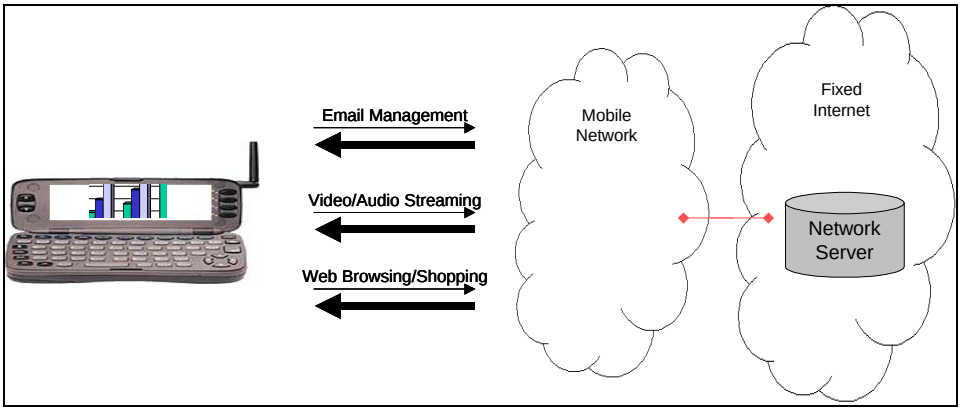
Figure 7.3 and 7.4 further illustrates the symmetry of most Mobile Internet Access services.

Figure 7.3. Mobile Internet Access – Youth Segment.




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Figure 7.4. Mobile Internet Access – Adult Segment




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

File size assumptions for uplink and downlink are shown in Table 7.5. Mobile Internet Access services are asymmetric to the downlink.

Table 7.5 Mobile Internet Access – UL and DL file size by activity type – high complexity terminals.

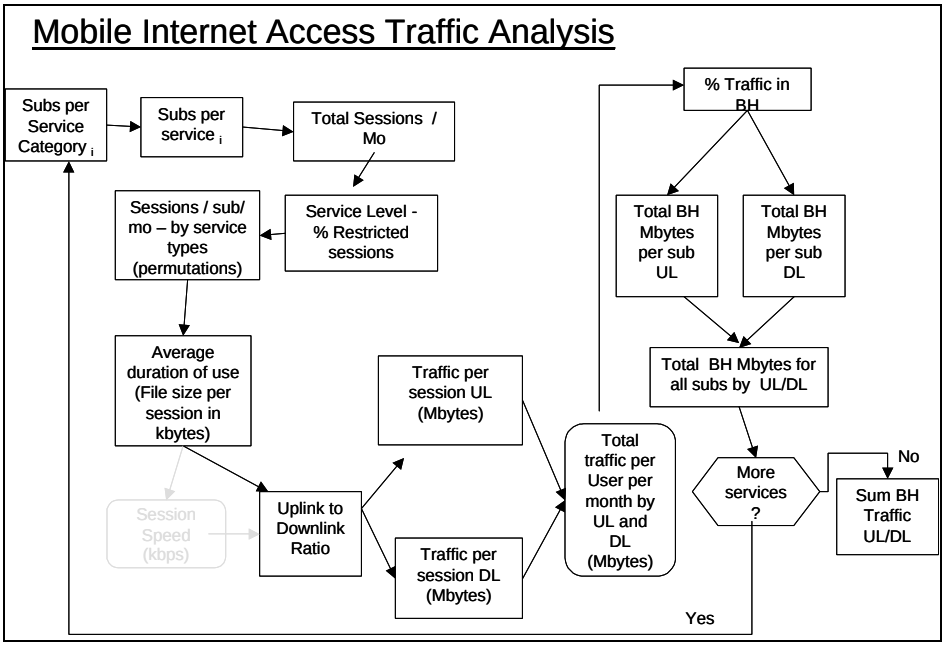
| Media / Activity Type | UL File Size (Kbytes) | DL File Size (Kbytes) | UL: DL Ratio |
|---|---|---|---|
| Email Management | 436 | 1,743 | 1:4 |
| Video/Audio Streaming | 189 | 4,725 | 1:25 |
| Web Browsing / Shopping | 454 | 3,175 | 1:7 |
| Multimedia Download | 189 | 4,725 | 1:25 |
| Mobile Games | 288 | 7,200 | 1:25 |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

## 7.2 Service Traffic Analysis and Results

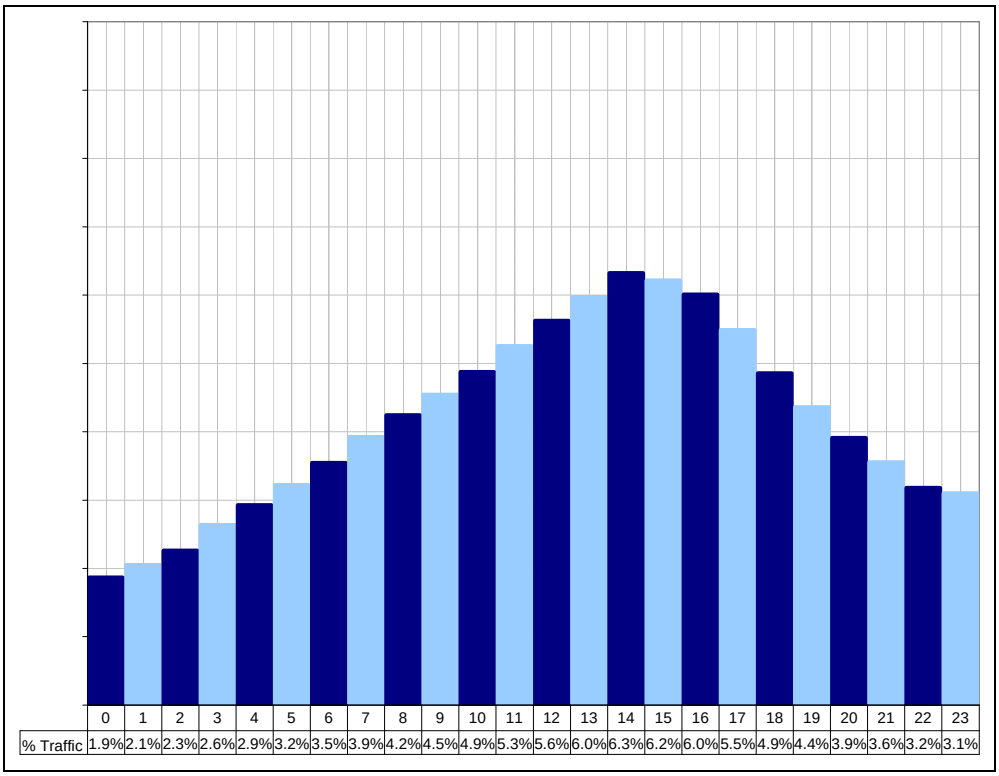
The framework used for Mobile Internet Access traffic analysis follows the same flow as shown earlier in Figure 2.2 and is repeated here in Figure 7.6. The assumed busy hour traffic distribution is illustrated in Figures 7.7. The percent of traffic that occurs in the busy hour is 6.33%.

Figure 7.6. Mobile Internet Access traffic analysis framework.




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Table 7.7 Assumed diurnal traffic distribution – Mobile Internet Access



| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % Traffic | 1.9% | 2.1% | 2.3% | 2.6% | 2.9% | 3.2% | 3.5% | 3.9% | 4.2% | 4.5% | 4.9% | 5.3% | 5.6% | 6.0% | 6.3% | 6.2% | 6.0% | 5.5% | 4.9% | 4.4% | 3.9% | 3.6% | 3.2% | 3.1% |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Based on the assumptions and analysis presented in this section, Table 7.8 and Table 7.9 summarises the offered traffic and traffic characteristics of Mobile Internet Access.

Table 7.8 Mobile Internet Access – offered busy hour traffic and asymmetry per country.

| Description | Busy Hour Traffic |
|---|---|
| **Uplink - Mobile Internet Access Offered traffic per country** | **0.15 TBytes** |
| Adult | 0.14 TBytes |
| Youth | 0.01 TBytes |
| **Downlink - Mobile Internet Access Offered traffic per country** | **0.98 TBytes** |
| Adult | 0.87 TBytes |
| Youth | 0.11 TBytes |
| **Overall Service Asymmetry (UL /DL)** | **0.15** |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Table 7.9. Mobile Internet Access – offered busy hour traffic per subscription.

| Description | Busy Hour Traffic |
|---|---|
| **Uplink - Mobile Internet Access traffic** | |
| Per Adult Subscription | 72.8 kBytes |
| Per Youth Subscription | 30.0 kBytes |
| **Downlink - Mobile Internet Access traffic** | |
| Per Adult Subscription | 449.6 kBytes |
| Per Youth Subscription | 420.1 kBytes |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

# 8 Mobile Intranet Extranet Access Assumptions and Offered Traffic

Analysis of Mobile Intranet Extranet Access services considered all the variables shown in Figure 1.2. The definition of Mobile Intranet Extranet Access is repeated here for reader clarity:

> **Mobile Intranet Extranet Access: A business 3G service that provides secure mobile access to corporate Local Area Networks (LANs), Virtual Private Networks (VPNs), and the Internet, including access to all messaging and email services.**

## 8.1 Usage and Traffic Assumptions

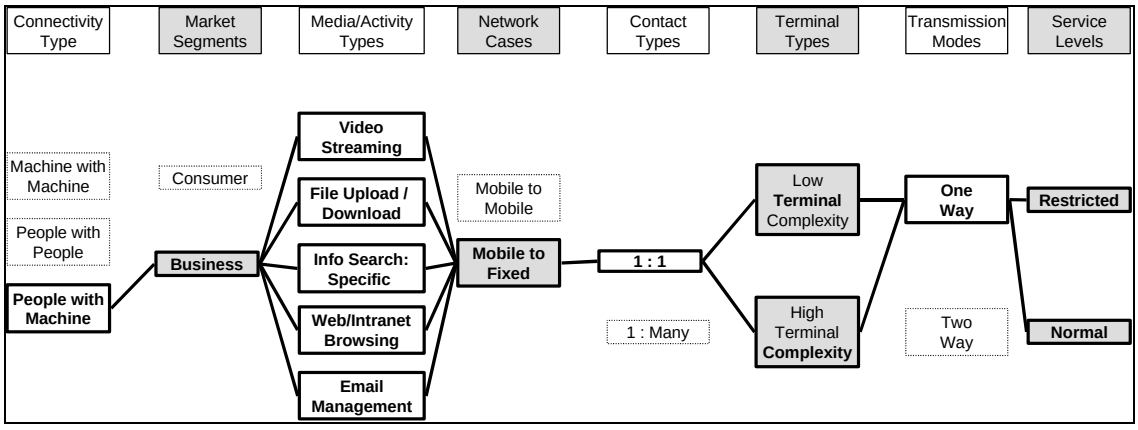
Analysis of Mobile Intranet Extranet Access includes two distinct business subscriber segments. The first segment, "Typically Mobile" includes field sales or technicians who are typically working away from the office and must regularly access corporate infrastructure on a daily basis to send and retrieve information. The second segment, "Occasionally Mobile", includes mobile executives and other professionals that typically work in an office, but must travel or are away from the office about 25% of the time. A total of six activity types were analysed for these two segments. While there are any number of activities and content that are potentially available, the activity types chosen are represent the bulk of traffic volume and services with distinct traffic characteristics or bandwidth requirements.

- Typically Mobile Workers
  - E-Mail Management (sending and receiving emails with attachments)
  - Video / Audio Streaming (e.g., corporate training clips or announcements)
  - Info Search: Specific (e.g., market or sales updates)
- Occasionally Mobile Workers
  - File Download / Upload
  - Intranet, Extranet, or Web Browsing
  - Email Management

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Service variables and states used for business Mobile Intranet Extranet Access calculations are shown in Figure 8.1. By definition, Mobile Intranet Extranet Access includes mobile workers accessing content hosted on network servers. (Person-to-person messaging and communications is part of MMS.) Thus all activities are considered one-way, mobile-to-fixed, and one-to-one communication.

Figure 8.1. Service variables and states used for Mobile Intranet Extranet Access.




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Typically Mobile Intranet Extranet Access subscribers connect about three times every workday. Occasionally Mobile workers connect about three times a day for the 25% of the work month away

from the office. Typically Mobile workers look for specific information, view streaming media (e.g. repair instruction videos) and check email. Occasionally Mobile workers browse for more general information on corporate servers or the Internet, check email, and download files, revise them, then upload. Table 8.2 summarises the usage assumptions for Mobile Intranet Extranet Access.

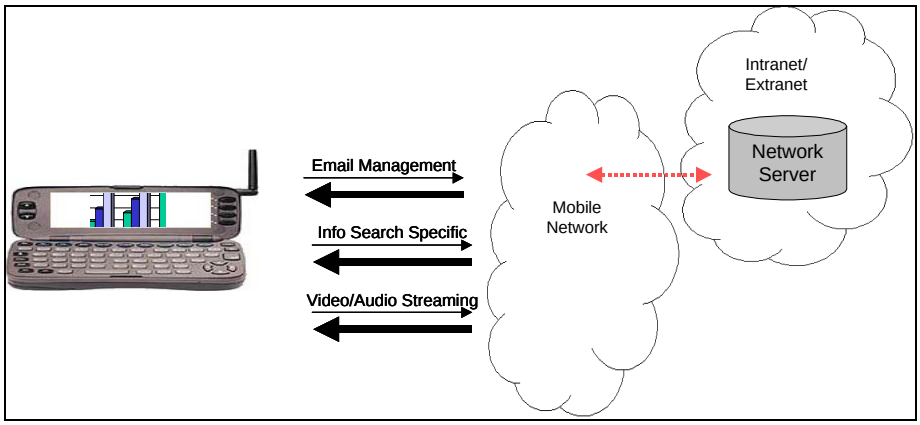
Table 8.2 Mobile Intranet Extranet Access usage assumptions.

| | |
|---|---|
| 3G Subscribers | • 31.9 M 3G Subscribers (53% of population) |
| Mobile Intranet Extranet Access Subscriptions | • 11.5 M Business Subscriptions<br>• 9.3 M "Typically Mobile"<br>• 1.8 M "Occasionally Mobile" |
| Frequency of Use | • 66 sessions per month – combined activity types; "Typically Mobile"<br>• 16 sessions per month – "Occasionally Mobile" |
| Activity Type (sessions / month) | • Email Management: 56 sessions<br>• Video Audio Streaming: 7 sessions<br>• Info Search – Specific: 47 sessions<br>• File Download / Upload: 8 sessions (Occasionally Mobile)<br>• Intra/Extra or Web Browsing: 16 sessions (Occasionally Mobile) |
| Network Case and Terminal Complexity | • 100% mobile to fixed<br>• 70% High Complexity Terminals |
| Transmission Mode and Contact Type | • 100% one way<br>• 100% one-to-one |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

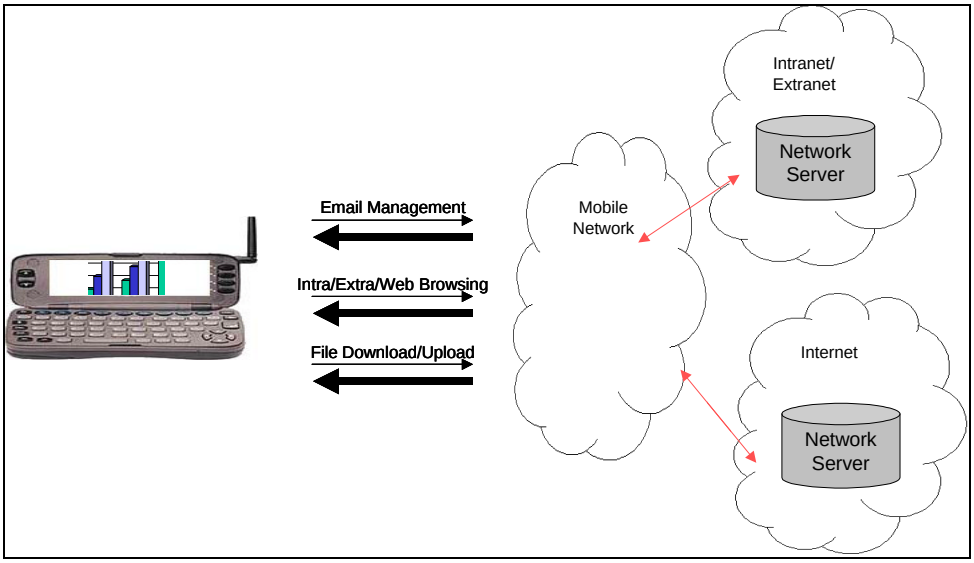
Figure 8.3 and 8.4 further illustrate the symmetry of most Mobile Intranet Extranet Access services.

Figure 8.3. Symmetry of Mobile Intranet Extranet Access – Typically Mobile Worker.




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Figure 8.4. Mobile Intranet Extranet Access - Occasionally Mobile Worker.




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

File size assumptions for uplink and downlink are shown in Table 8.5. Mobile Intranet Extranet Access services are asymmetric to the downlink.

Table 8.5 Mobile Intranet Extranet Access – UL and DL file size by activity type – high complexity terminals.

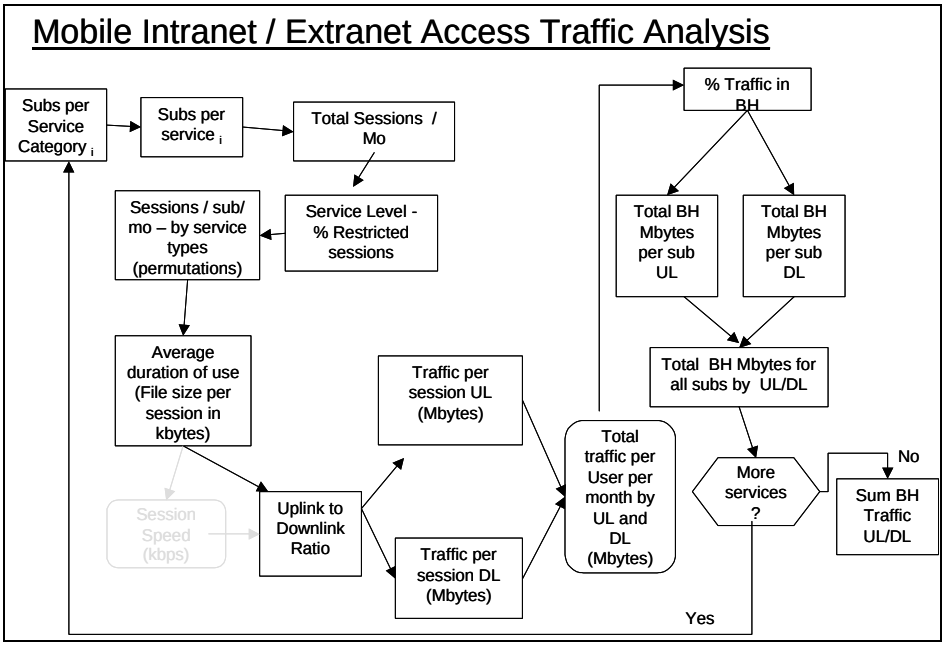
| Media / Activity Type | UL File Size (Kbytes) | DL File Size (Kbytes) | UL: DL Ratio |
|---|---|---|---|
| E-Mail Management | 436 | 1,743 | 1:4 |
| Video / Audio Streaming | 189 | 4,725 | 1:25 |
| Info Search – Specific | 88 | 617 | 1:7 |
| File Upload / Download | 987 | 1,036 | 1:1.1 |
| Intra/Extra or web browsing | 454 | 3,175 | 1:7 |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

## 8.2 Service Traffic Analysis and Results

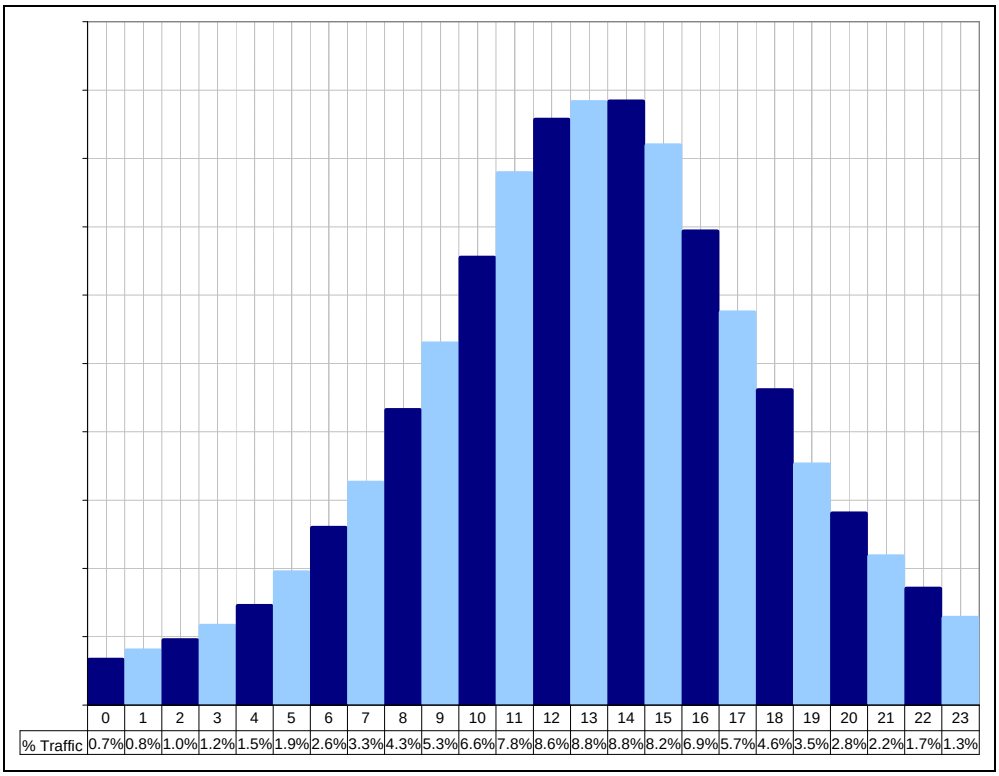
The framework used for Mobile Intranet Extranet Access traffic analysis follows the same flow as shown earlier in Figure 2.2 and repeated in Figure 8.6. The traffic distribution is illustrated in Figures 8.7. The percent of traffic that occurs in the busy hour is 8.57%.

Figure 8.6. Mobile Intranet / Extranet Access traffic analysis framework.




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Table 8.7 Assumed diurnal traffic distribution – Mobile Intranet Extranet Access



| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % Traffic | 0.7% | 0.8% | 1.0% | 1.2% | 1.5% | 1.9% | 2.6% | 3.3% | 4.3% | 5.3% | 6.6% | 7.8% | 8.6% | 8.8% | 8.8% | 8.2% | 6.9% | 5.7% | 4.6% | 3.5% | 2.8% | 2.2% | 1.7% | 1.3% |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Based on the assumptions and analysis presented in this section, Table 8.8 and Table 8.9 summarises the offered traffic and traffic characteristics of Mobile Intranet Extranet access.

Table 8.8. Mobile Intranet Extranet Access – offered busy hour traffic per country.

| Description | Busy Hour Traffic |
|---|---|
| **Uplink - Mobile Intranet Extranet Access Offered traffic per country** | **1.09 TBytes** |
| Typically Mobile | .96 TBytes |
| Occasionally Mobile | 0.13 TBytes |
| **Downlink - Mobile Intranet Extranet Access Offered traffic per country** | **5.61 TBytes** |
| Typically Mobile | 5.10 TBytes |
| Occasionally Mobile | 0.51 TBytes |
| **Overall Service Asymmetry (UL /DL)** | **0.20** |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Table 8.9. Mobile Intranet Extranet Access – offered busy hour traffic per subscription.

| Description | Busy Hour Traffic |
|---|---|
| **Uplink - Mobile Intranet Extranet Access traffic per Subscription** | |
| Typically Mobile | 103.2 kBytes |
| Occasionally Mobile | 73.9 kBytes |
| **Downlink - Mobile Intranet Extranet Access traffic per Subscription** | |
| Typically Mobile | 546.2 kBytes |
| Occasionally Mobile | 286.1 kBytes |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

# 9 Location-Based Services Assumptions and Offered Traffic

Analysis of Location-Based Services includes business and consumer usage, and considered all the variables shown in Figure 2.2. The definition of Location-Based Services is repeated here for reader clarity:

> **Location-Based Services: A business and consumer 3G service that enables users to find other people, vehicles, resources, services or machines. It also enables others to find users, as well as enabling users to identify their own location via terminal or vehicle identification.**

The distinguishing characteristic of Location-based Services is that the service requires data on the current location or position of a mobile object or person. Machine-to-machine devices that monitor stationary objects would be considered telemetry. Services that provide information about a future location (such as travel information) would fall under Customised Infotainment or Mobile Internet Access.

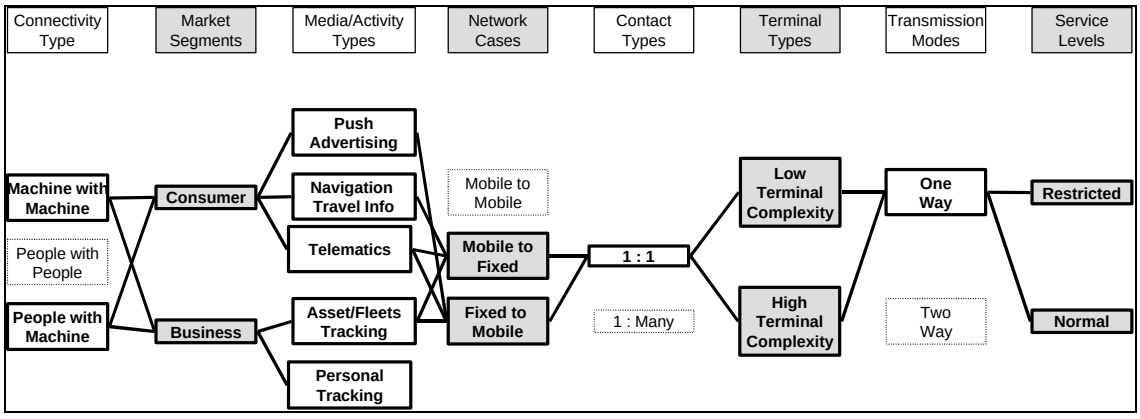
## 9.1 Usage and Traffic Assumptions

Future Location-based Services could include a wide variety of activities. For purposes of this report, five total activity types within consumer and business segments were analysed:

- Consumer Information Services
  - LBS Push Advertising ("Opt -in" only)
  - Navigation / Travel Information (Directions or area information based on current location of mobile user)
  - Telematics (Personal Vehicle (Navigation and direction information services such as OnStar, delivered via mobile networks.)
- Business Tracking Services
  - Personal Tracking (Continuous tracking of children, elderly, pets, etc.)
  - Fleet / Asset Tracking (Continuous tracking of mobile assets such as fleets or cargo)

Service variables and states used for business Location-Based Services calculations are shown in Figure 9.1

Figure 9.1. Service variables and states used for Location-Based Services.




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Location-based services include incremental activities access by 3G subscribers occasionally or by a small portion of users. Table 9.2 summarises the usage assumptions for Location-Based Services.

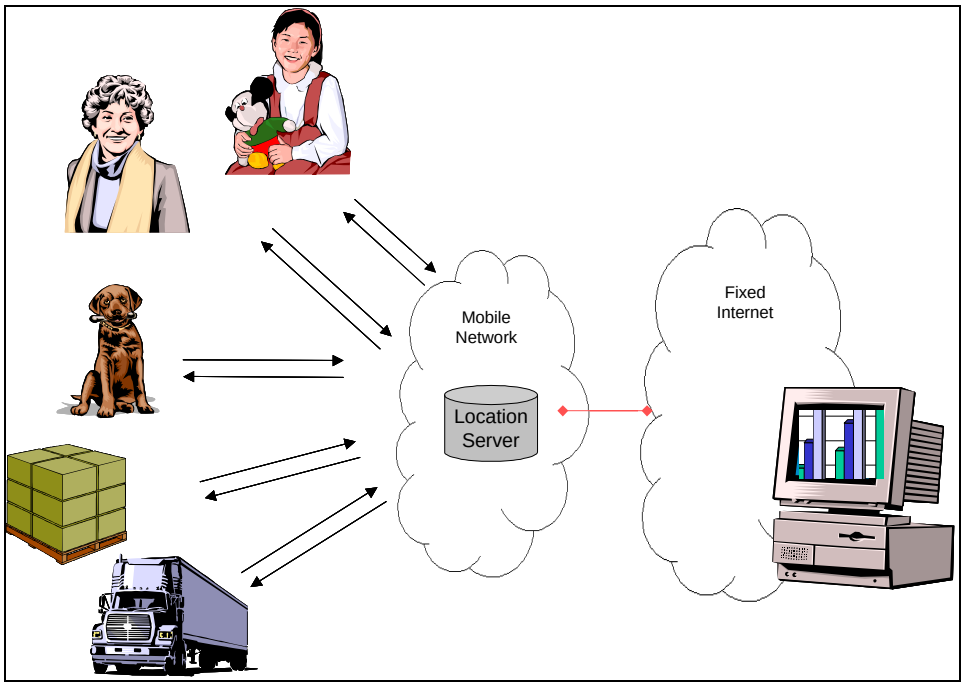
Table 9.2. Location-Based Services usage assumptions.

| | |
|---|---|
| 3G Subscribers | • 31.9 M 3G Subscribers (53% of population)<br>• 20.4 M Consumer 3G Subscribers |
| Subscriptions and Activity Type (sessions per month) | • LBS advertising: 25% of consumer subs access one session per day<br>• Navigation/Travel: 85% of consumer subs @ 8 sessions/ month<br>• Personal tracking: 1.3 3G subscribers use continuous (24x7) tracking<br>• Telematics: 1.8M 3G subscribers @ 1 session per week<br>• Fleet / Asset Tracking: 0.3M 3G subs with continuous tracking |
| Network Case and Terminal Complexity | • Mobile to fixed –varies by activity type<br>• 90% Low Complexity Terminals |
| Transmission Mode and Contact Type | • 100% one way<br>• 100% one-to-one |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

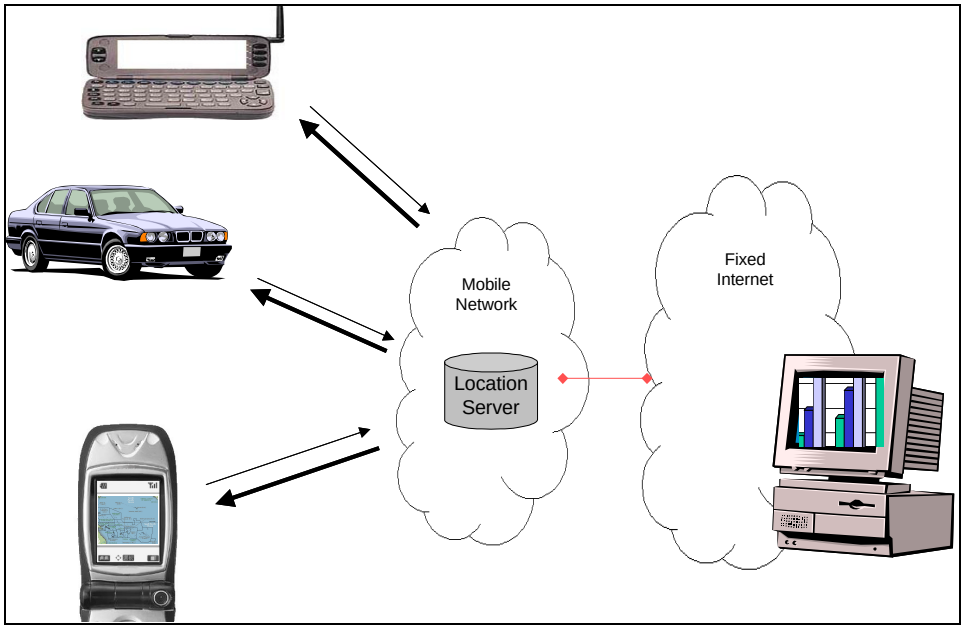
Figure 9.3 and 9.4 further illustrate the symmetry of most Location-Based Services.

Figure 9.3. Location-Based Services - continuous tracking services.




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Figure 9.4. Location-Based Services - Consumer.




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

File size assumptions for uplink and downlink are shown in Table 9.5. Location-Based Services are asymmetric to the downlink.

Table 9.5. Location-Based Services – UL and DL file size by activity type – low complexity terminals.

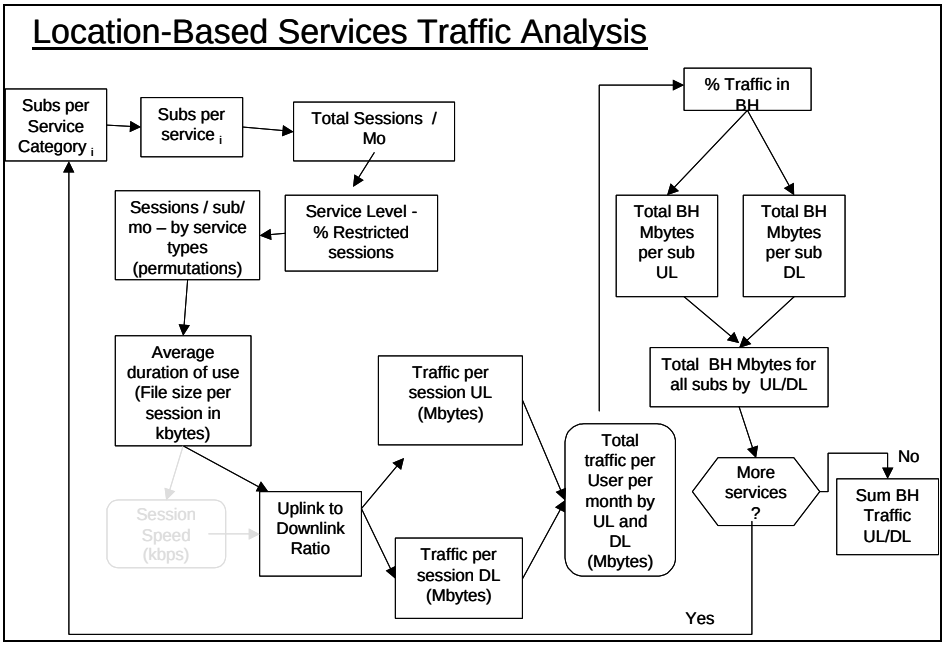
| Media / Activity Type | UL File Size (Kbytes) | DL File Size (Kbytes) | UL: DL Ratio |
|---|---|---|---|
| Push Advertising | 0 | 100 | 0: 1 |
| Navigation / Travel | 83 | 100 | 1: 1.2 |
| Personal Tracking | .01 | .01 | 1: 1 |
| Asset / Fleet Tracking | .01 | .01 | 1: 1 |
| Telematics | 83 | 166 | 1:2 |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

## 9.2 Service Traffic Analysis and Results

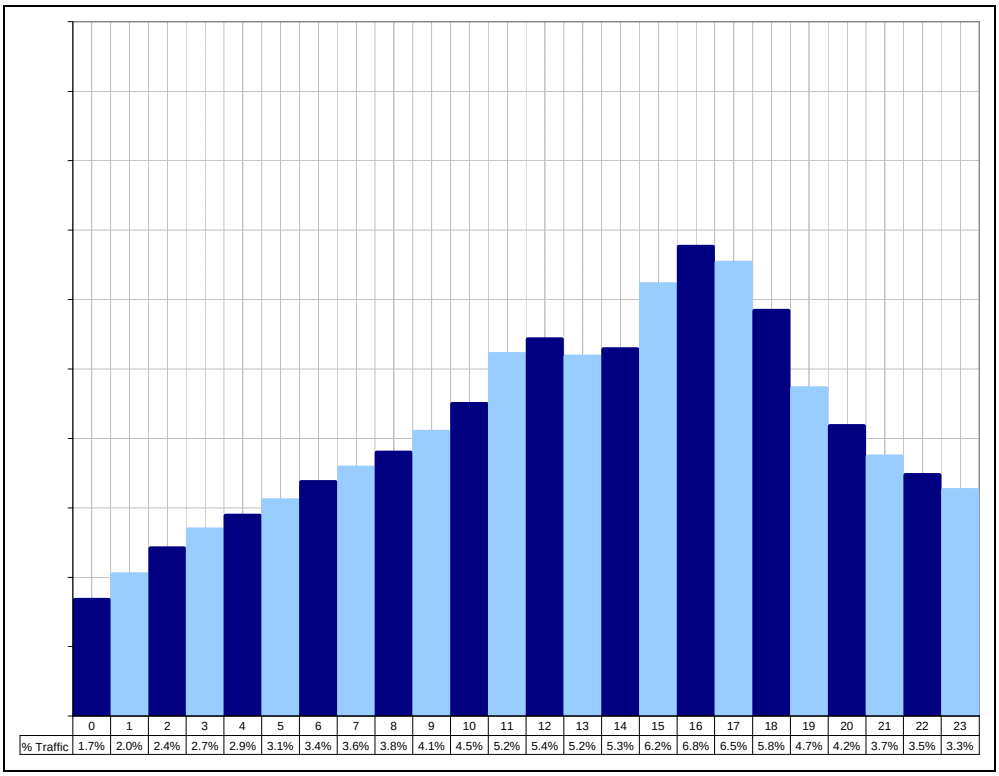
The framework used for Location-Based Services traffic analysis follows the same flow as shown earlier in Figure 2.2 and is repeated in Figure 9.6. The busy hour traffic distribution is illustrated in Figures 9.7 and 9.8. The percent of traffic that occurs in the busy hour is 6.76% for consumer and 4.17% for tracking services.

Figure 9.6. Location-Based Services traffic analysis framework.




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

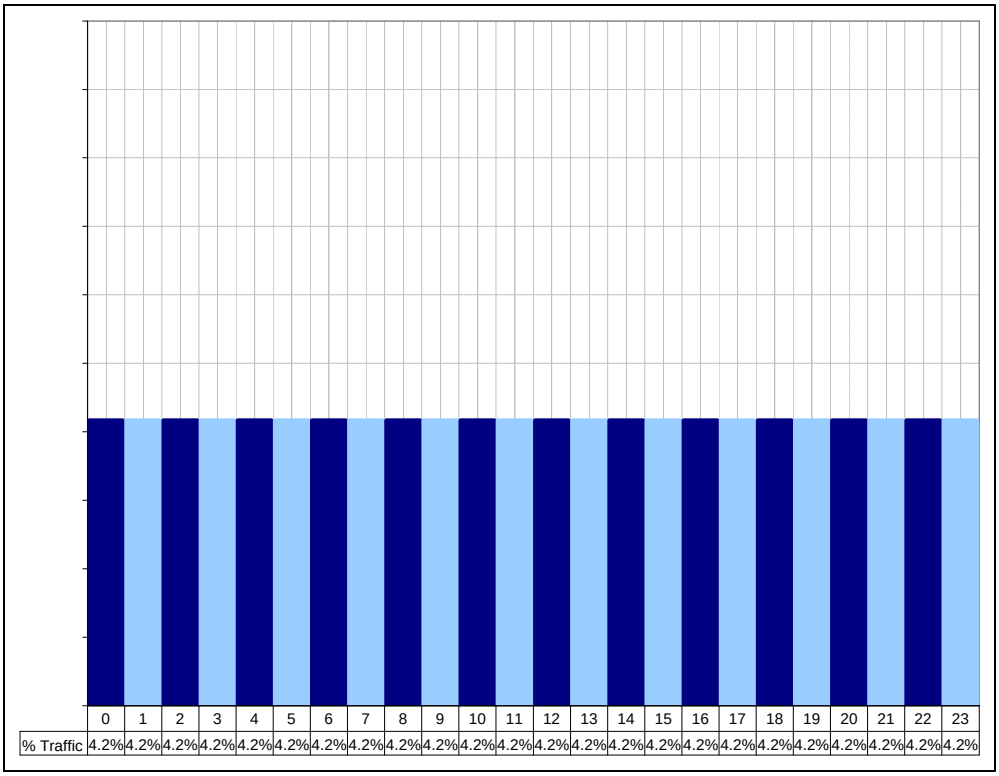
Table 9.7 Assumed diurnal traffic distribution – Location-Based Services



| | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % Traffic | 1.7% | 2.0% | 2.4% | 2.7% | 2.9% | 3.1% | 3.4% | 3.6% | 3.8% | 4.1% | 4.5% | 5.2% | 5.4% | 5.2% | 5.3% | 6.2% | 6.8% | 6.5% | 5.8% | 4.7% | 4.2% | 3.7% | 3.5% | 3.3% |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Table 9.8 Assumed diurnal traffic distribution – Location-Based Services - tracking services.




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Based on the assumptions and analysis presented in this section, Table 9.9 and Table 9.10 summarises the offered traffic and traffic characteristics of Location-Based services.

Table 9.9. Location-Based Services – offered busy hour traffic and asymmetry per country.

| Description | Busy Hour Traffic |
|---|---|
| **Uplink - Location-Based Services Offered traffic per country** | **0.024 TBytes** |
| Consumer | 0.023 TBytes |
| Continuous Tracking | 0.001 TBytes |
| **Downlink - Location-Based Services Offered traffic per country** | **0.061 TBytes** |
| Consumer | 0.060 TBytes |
| Continuous Tracking | 0.001 TBytes |
| **Overall Service Asymmetry (UL /DL)** | **0.402** |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Table 9.10. Location-Based Services – offered busy hour traffic per subscription.

| Description | Busy Hour Traffic |
|---|---|
| **Uplink - Location-Based Services traffic per Subscription** | |
| Consumer | 1.3 kBytes |
| Continuous Tracking | 0.1 kBytes |
| **Downlink - Location-Based Services traffic per Subscription** | |
| Consumer | 3.3 kBytes |
| Continuous Tracking | 0.1 kBytes |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

# 10 Simple Voice Assumptions and Offered Traffic

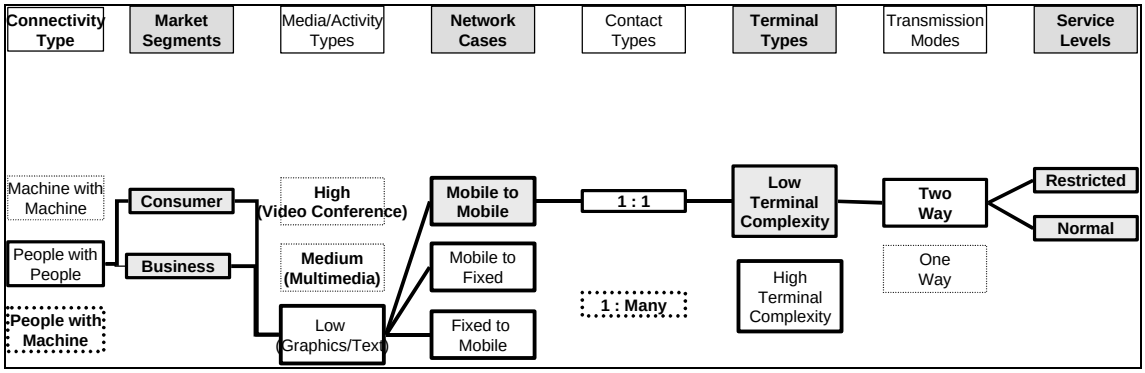
Analysis of Simple Voice includes business and consumer usage, and considered all the variables shown in Figure 2.2. The definition of Simple Voice is repeated here for reader clarity:

**Simple Voice: Two way, person-to-person real-time audio**

## 10.1 Usage and Traffic Assumptions

Service variables and states used for business Simple Voice calculations are shown in Figure 10.1

Figure 10.1. Service variables and states used for Simple Voice.




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Table 10.2 summarises the usage assumptions for Simple Voice

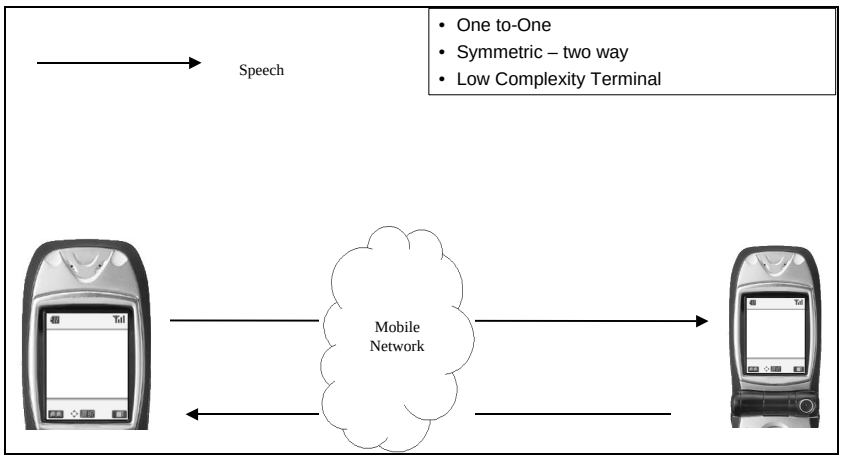
Table 10.2. Simple Voice usage assumptions.

| | |
|---|---|
| 3G Subscribers | • 31.9 M 3G Subscribers (53% of population)<br>• 20.4 M Consumer 3G Subscribers |
| Subscriptions and Activity Type (calls per month) | • Business Simple Voice: call duration of 3.0 minutes with 400 minutes per month<br>• Consumer Simple Voice: call duration of 3.5 minutes with 600 minutes per month |
| Network Case and Terminal Complexity | • Mobile to mobile: 32%<br>• Mobile to fixed: 40 %<br>• Fixed to mobile: 28%<br>• 100% Low Complexity Terminals |
| Transmission Mode and Contact Type | • 100% two way<br>• 100% one-to-one |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Figure 10.3 illustrates the symmetry of Simple Voice.

Figure 10.3. Simple Voice symmetry for mobile-to-mobile calls.

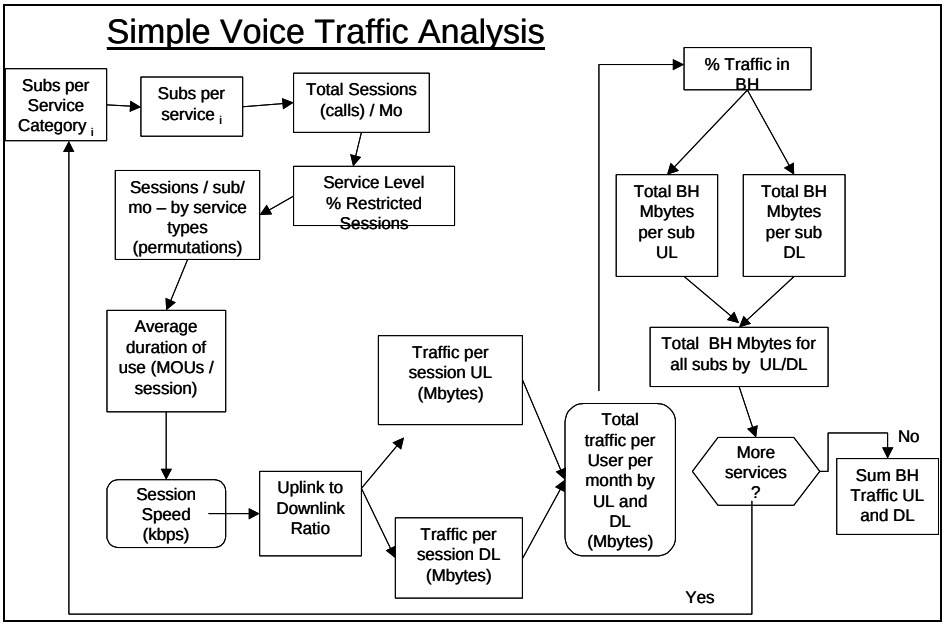



Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

## 10.2 Service Traffic Analysis and Results

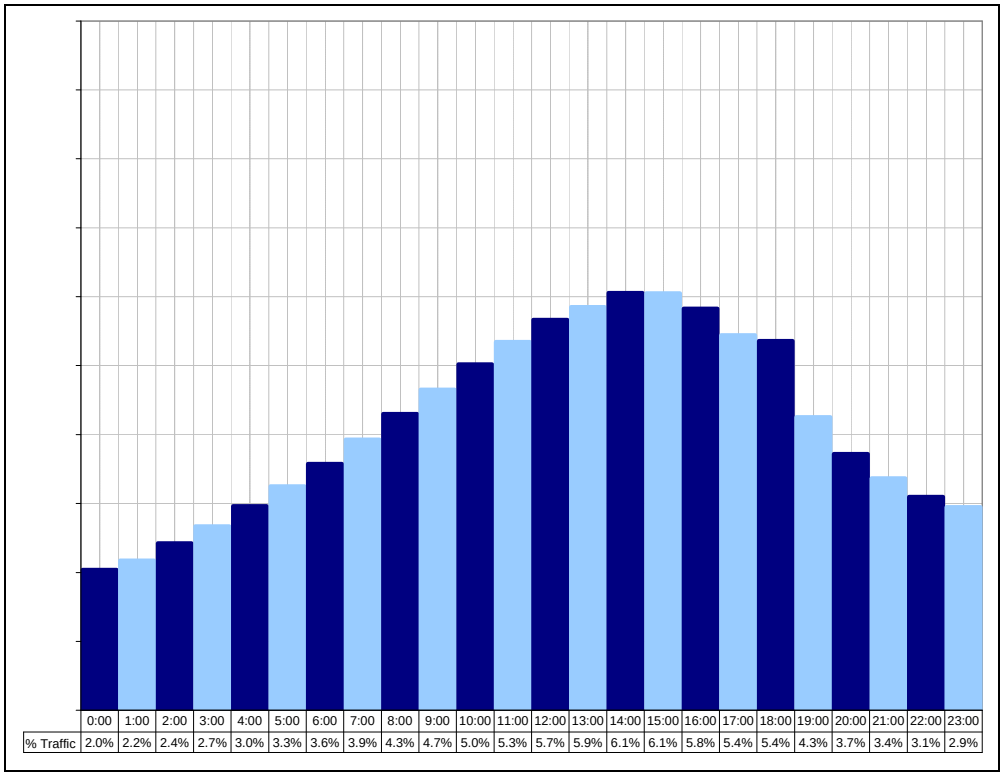
The framework used for Simple Voice traffic analysis follows the same flow as shown earlier in Figure 2.2 and is repeated in Figure 10.4. The busy hour traffic distribution is illustrated in Figures 10.5 and 10.6. The percent of traffic that occurs in the busy hour is 6.1% for consumer and 5.8% for business.

Table 10.4. Simple Voice traffic analysis framework.




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

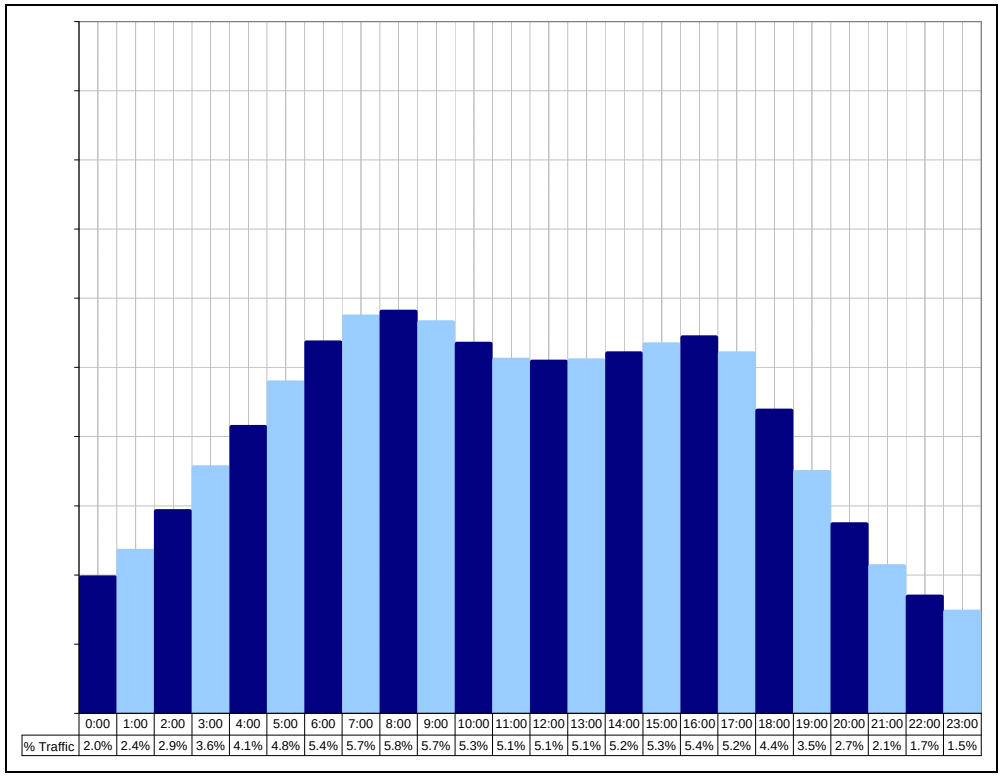
Table 10.5. Assumed diurnal traffic distribution – Simple Voice - Consumer.



| | 0:00 | 1:00 | 2:00 | 3:00 | 4:00 | 5:00 | 6:00 | 7:00 | 8:00 | 9:00 | 10:00 | 11:00 | 12:00 | 13:00 | 14:00 | 15:00 | 16:00 | 17:00 | 18:00 | 19:00 | 20:00 | 21:00 | 22:00 | 23:00 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % Traffic | 2.0% | 2.2% | 2.4% | 2.7% | 3.0% | 3.3% | 3.6% | 3.9% | 4.3% | 4.7% | 5.0% | 5.3% | 5.7% | 5.9% | 6.1% | 6.1% | 5.8% | 5.4% | 5.4% | 4.3% | 3.7% | 3.4% | 3.1% | 2.9% |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Table 10.6. Assumed diurnal traffic distribution – Simple Voice – Business.



| | 0:00 | 1:00 | 2:00 | 3:00 | 4:00 | 5:00 | 6:00 | 7:00 | 8:00 | 9:00 | 10:00 | 11:00 | 12:00 | 13:00 | 14:00 | 15:00 | 16:00 | 17:00 | 18:00 | 19:00 | 20:00 | 21:00 | 22:00 | 23:00 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| % Traffic | 2.0% | 2.4% | 2.9% | 3.6% | 4.1% | 4.8% | 5.4% | 5.7% | 5.8% | 5.7% | 5.3% | 5.1% | 5.1% | 5.1% | 5.2% | 5.3% | 5.4% | 5.2% | 4.4% | 3.5% | 2.7% | 2.1% | 1.7% | 1.5% |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Based on the assumptions and analysis presented in this section, Table 10.7 and Table 10.8 summarises the offered traffic and traffic characteristics of Simple Voice.

Table 10.7. Simple voice – offered busy hour traffic and asymmetry per country

| Description | Busy Hour Traffic |
|---|---|
| **Uplink – Simple Voice Offered traffic per country** | **2.13 TBytes** |
| Consumer | 1.41 TBytes |
| Business | .72 TBytes |
| **Downlink - Simple Voice Offered traffic per country** | **2.13 TBytes** |
| Consumer | 1.41 TBytes |
| Business | .72 TBytes |
| **Overall Service Asymmetry (UL /DL)** | **1.00** |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Table 10.8. Simple Voice – Offered busy hour traffic per subscriber.

| Description | Busy Hour Traffic |
|---|---|
| **Uplink – Simple Voice traffic per Subscriber** | |
| Consumer | 69.1 kBytes |
| Business | 62.4 kBytes |
| **Downlink – Simple Voice traffic per Subscriber** | |
| Consumer | 69.1 kBytes |
| Business | 62.4 kBytes |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

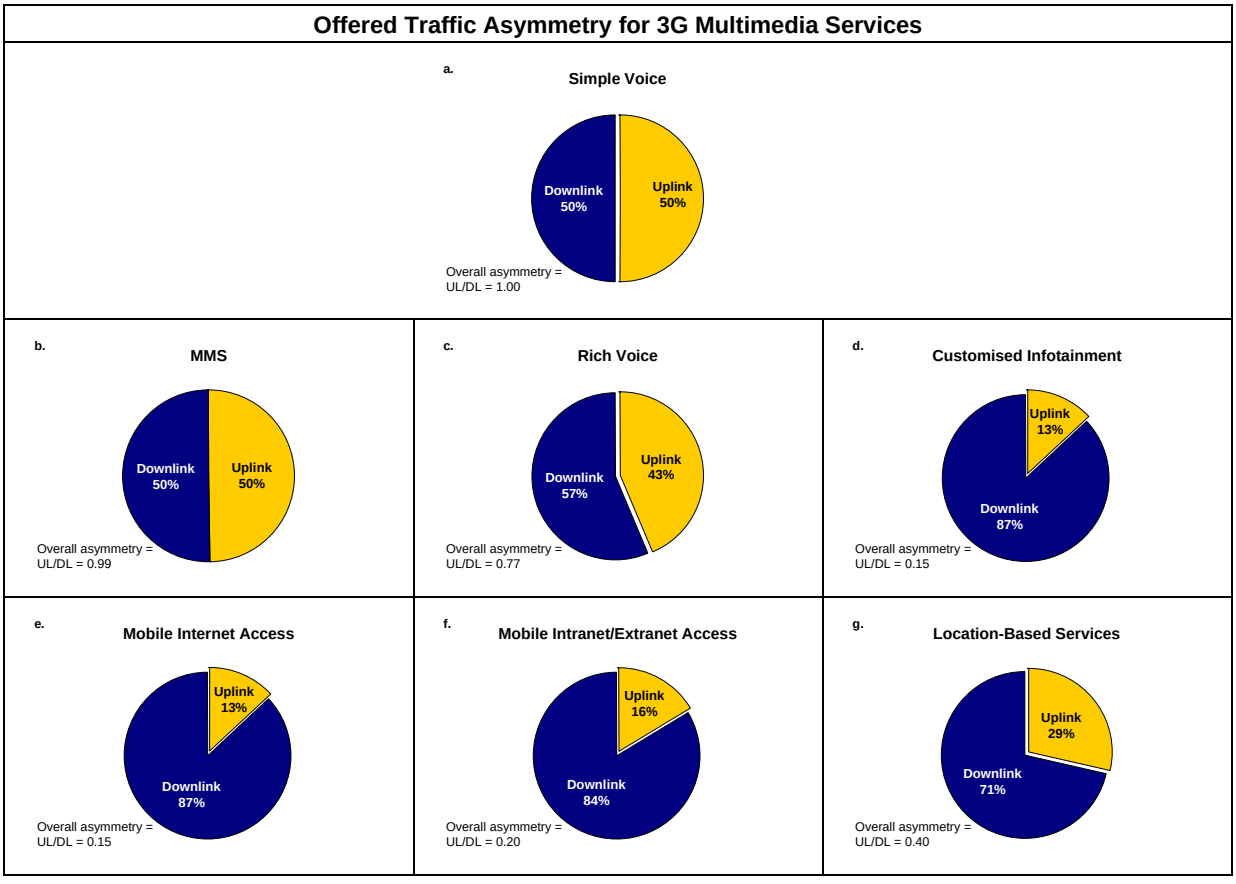
# 11 Results Summary

This section presents the summary results by Service Category from Sections 4 –10 so the reader can compare the traffic in aggregate and across Service Categories. The results are presented comparing Simple Voice to all other multimedia services. It should be noted that from a spectrum viewpoint, a more meaningful comparison is to compare all real time services to all non-real time services. Both Simple and Rich Voice are real time services and must be given special consideration in any spectrum calculation. Sufficient details about both types of services are contained in this report so that a comparison can be made. This comparison will be presented more fully in a later report.

## 11.1 Summary by Service Category

Figure 11.1 shows the offered traffic asymmetry for each service category. This asymmetry is calculated by dividing the total Service Category uplink traffic in its busy hour by the total Service Category downlink traffic is its busy hour. [16] The Service Category busy hour comes from the assumed traffic distribution charts found in the sections of this report applicable to each Service Category. For example, the assumed busy hour traffic for Customised Infotainment is shown in Table 6.7 as 0.38 TBytes over the uplink and 2.57 TBytes over the downlink. The resultant asymmetry is 0.38 divided by 2.57 or 0.15. This relationship is shown in Figure 11.1d.

Figure 11.1(a-g). A comparison of offered traffic asymmetry by service category.



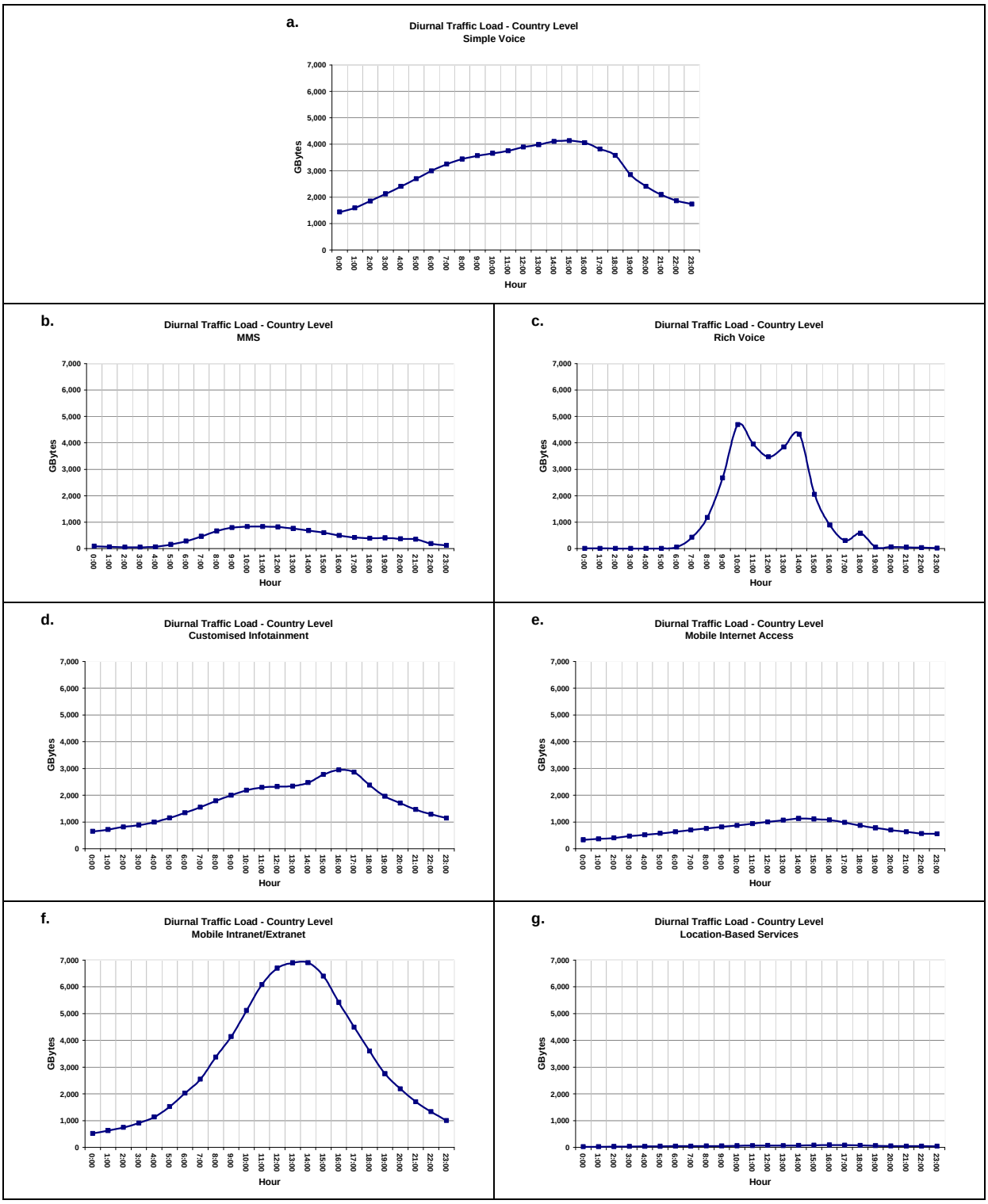

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Figure 11.2 shows the aggregate daily traffic load distribution for each Service Category. The distribution includes both uplink and downlink traffic. The vertical scale is the same for each of the charts in the figure, ranging from 0 to 7,000 GBytes. The horizontal axis is divided into 24 hours

[16] Busy hour varies by service category.

showing the traffic starting at midnight (0:00). The centre of each graph is midday (12:00). This figure represents the "typical" daily traffic for each Service Category. It is assumed that business traffic is only significant during business days (21.2 days per month), an assumption that tends to increase the busy hour traffic on business days.

Figure 11.2(a-g). Comparison of total diurnal traffic (UL + DL) by Service Category for representative country.




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Whilst Rich voice has a high traffic load during its busy hour, the total daily traffic for other services exceeds Rich Voice as shown in the following summary table.

Table 11.3. Daily total and busy hour traffic by service category.

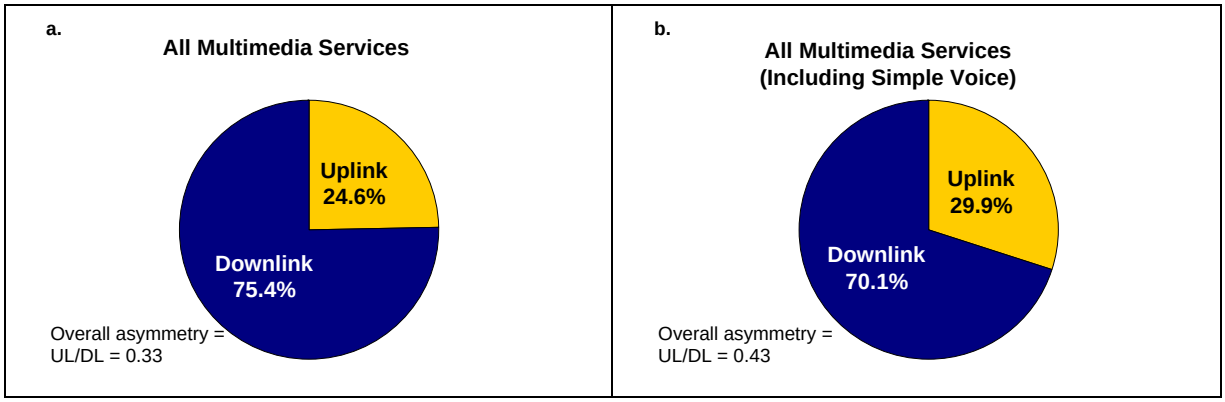
| Service Category | Total Daily Traffic for the Representative Country (TBytes) | Total Traffic in Service Category Busy Hour (TBytes) |
|---|---|---|
| **Multimedia Messaging Service** | 9.92 | 1.02 |
| **Rich Voice** | 28.66 | 4.73 |
| **Customised Infotainment** | 42.04 | 2.95 |
| **Mobile Internet Access** | 17.87 | 1.13 |
| **Mobile Intranet/Extranet Access** | 78.14 | 6.70 |
| **Location-Based Services** | 1.30 | 0.09 |
| **Simple Voice** | 71.28 | 4.26 |
| **Total** | 249.21 | 20.88 |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

## 11.2 Aggregate Traffic Results

Figure 11.4 shows the sum of the six service categories with and without Simple Voice. Most individual services are highly asymmetry, with the exception of Simple/Rich Voice and MMS, which are fairly symmetric. To calculate the aggregate asymmetry over all service categories, the sum of the total uplink traffic in the overall busy hour was divided by the total of the downlink traffic in the overall busy hour. An asymmetry of .43 was calculated when Simple Voice service, which is symmetric, was considered.

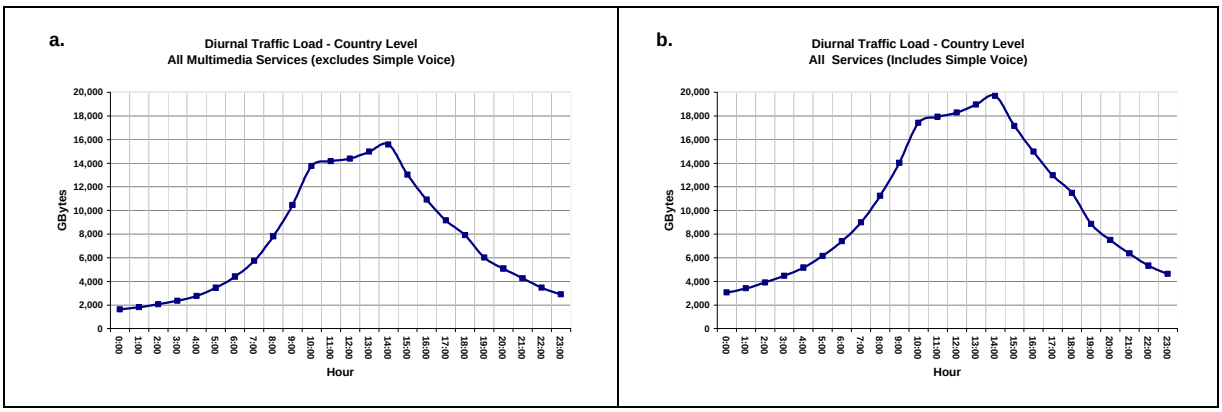
Figure 11.4 (a-b). Total offered traffic asymmetry during the aggregate busy hour.




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Figure 11.5 shows the combined traffic distribution with and without Simple Voice. The top of the vertical scale is 20,000 GBytes. As in Figure 11.2, the horizontal axis is divided into 24 hours showing the traffic starting at midnight (0:00).

Figure 11.5 (a-b). Total diurnal traffic distribution – aggregate busy hour.




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

## 11.3 Traffic Characteristics – Aggregate Busy Hour

As shown in Figure 11.5, the overall busy hour takes place in the 1400 hour. The aggregate busy hour is more representative of the actual traffic a network operator will experience. For this reason, the aggregate busy data is presented.

For network planning it is sometimes useful to have average traffic numbers that apply to the entire subscriber base served by the network. As not all subscribers in a network use every service such as MMS or Rich Voice, this section shows the busy hour traffic averaged over business or consumer 3G subscribers (not all of whom actually use these specific services) rather than service subscriptions (actual users of the service). This is provided as another aid to network planners in applying the data to their specific situations.

Table 11.6 shows the average busy hour traffic by consumer or business 3G subscribers and by total 3G subscribers. These numbers are different than the “per subscription” numbers presented for each service category, as the denominator is the total number of 3G subscribers, not the specific subscriptions to individual services.

Table 11.6. Total aggregate busy hour offered traffic.

| **Total Busy Hour Traffic** | | **Uplink** | **Downlink** |
|---|---|---|---|
| 3G Subscribers | 31.9 M | | |
| 3G Consumer Subscribers | 20.4 M | | |
| 3G Business Subscribers | 11.5 M | | |
| Total Busy Hour Traffic – per Country | | 5.89 TBytes | 13.80 TBytes |
| Business traffic | | 3.87TBytes | 9.11 TBytes |
| Consumer Traffic | | 2.02 TBytes | 4.70 TBytes |
| All Busy Hour Traffic – Average per all 3G Subscribers | | 184.4 kBytes | 432.4 kBytes |
| Business Segment - per Business 3G Subscriber | | 335.9 kBytes | 790.4 kBytes |
| Consumer Segment - per Consumer 3G Subscriber | | 98.9 kBytes | 230.2 kBytes |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

## 11.4 Worst Case Traffic Loads

The service level traffic distributions used in this reports were developed using historic voice and messaging traffic distributions and an assessment of user expectations, service pricing and other factors that may impact traffic patterns. Due to the normal market uncertainties for this type of analysis, a worst-case assessment is presented that shows the peak traffic load as if each service falls within the same exact hour of the day. Table 11.7 shows the country and subscriber level traffic loads under this worst case.

Table 11.7. Worst-case busy hour offered traffic per country – all service categories.

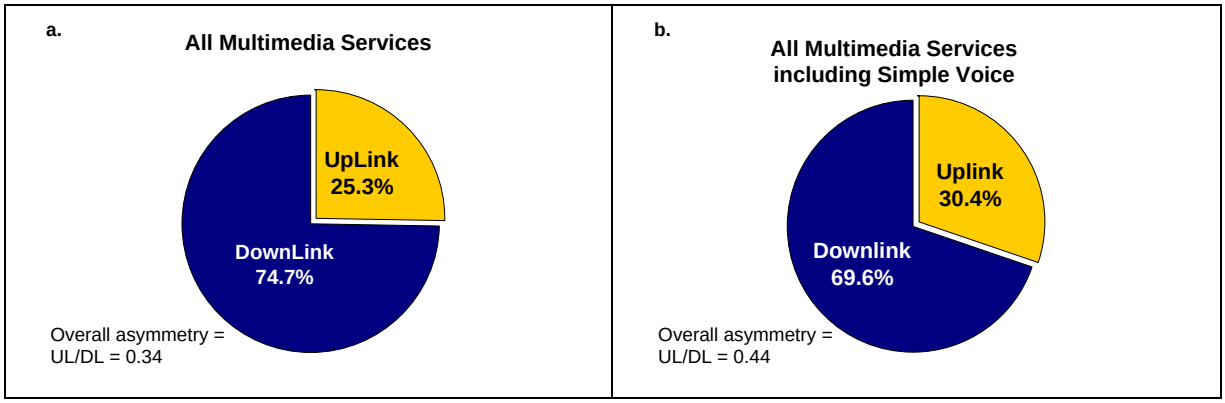
| Worst Case Busy Hour Traffic | | Uplink | Downlink |
|---|---|---|---|
| 3G Subscribers | 31.9 M | | |
| 3G Consumer Subscribers | 20.4 M | | |
| 3G Business Subscribers | 11.5 M | | |
| Worst Case Busy Hour Traffic – per Country | | 6.33 TBytes | 14.52 TBytes |
| Business | | 4.16 TBytes | 9.32 TBytes |
| Consumer | | 2.17 TBytes | 5.20 TBytes |
| Worst Case Busy Hour - Average per all 3G subscribers | | 198.4 kBytes | 454.9 kBytes |
| Business Segment – per Business 3B Subscriber | | 361.4 kBytes | 808.7 kBytes |
| Consumer Segment – per Consumer 3G Subscriber | | 106.4 kBytes | 255.1 kBytes |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

In this worst case, busy hour traffic is approximately 8% higher than the aggregate busy hour. This is based on a comparison of the total worst-case busy hour traffic of 20.85 TBytes to the aggregate busy traffic (uplink plus downlink) of 19.69 TBytes presented in Table 11.6. These results are highly dependent upon the traffic distributions assumed in this study.

Figure 11.8 shows the offered traffic assuming the worst-case scenario. The asymmetry is slightly different than the aggregate busy hour asymmetry shown in Figure 11.4.

Figure 11.8 (a-b). Worst-case total offered traffic asymmetry during the busy hour.




Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

# 12 Conclusions

This study presents an assessment of the offered traffic characteristics for future mobile data services based on end user demand. This is the unconstrained traffic offered to a 3G network. 2G and 2.5G traffic is not considered in this analysis, but could be added following the same methodology. Other factors may affect the actual network traffic characteristics – both technical (e.g., traffic shaping) and market-oriented (e.g., pricing plans).

The downlink traffic dominates the busy hour with the overall asymmetry of 0.43. In other words, on average, there is over twice (2.3) as much traffic flowing to the end-user as flows from the end-user back to the network. This overall asymmetry results from the service asymmetry assumptions made during this study. These assumptions are based on a number of field and lab measurements made using similar services on both 2.5G and fixed (wireline) networks. As 3G services develop and further data becomes available, these assumptions should be revisited. In addition, this overall asymmetry is based on a country-level service mix. The service mix in a local area, such as a cell, may vary significantly. The results per subscriber found in this report would then be needed to assess the local asymmetry in, for example, an area that is primarily used for business.

As fixed Internet traffic tends to be very asymmetric to the downlink (downloading content more than uploading), mobile access to Internet content follows the same pattern in this analysis. The possibility exists for mobile operators to change this asymmetric pattern through the pricing plans, traffic shaping and service definition. However, this study analysed the offered traffic based on how users currently prefer to interact.

This analysis represents an important step in better understanding the future traffic patterns for 3G networks. Further analysis should be done. Several additional areas have been identified for further work including:

- Obtaining more traffic distribution data from network operators and service providers.
- Varying the traffic distribution for each service.
- Adding the traffic from 2G and 2.5G services to this analysis.
- Adding traffic associated with network overhead for operations, administration, maintenance and provisioning to these offered traffic results.
- Completing further field measurements to validate the input assumptions made in this study.
- Updating the subscriber and subscription forecasts that are the basis of this analysis.
- Developing traffic scenarios at the cell level that have various mixes of consumer and business customers as an aid in the network planning process.

# 13 Service Forecasting Tool

The service forecasts that are the basis for this report with developed with a proprietary, adaptive forecasting technology called *ATIVA Research Tools*©. This technology performs sophisticated computations on both demand and supply side industry data to produce historic and forecasted revenues and other market size information at the regional, national and sub-national levels.

*ATIVA Research Tools*® uses algorithms to calculate product revenues to smaller geographic areas. Factors considered in the calculations include demographics, relative use by household income, age, industry characteristics, workforce population, propensity-to-buy profiles, deployment / service availability and other current market and technology drivers.

Figures 13.1 and 13.2 depict the *ATIVA Research Tools*®, system design and calculation process.

Figure 13.1 *ATIVA Research Tools*® system design.

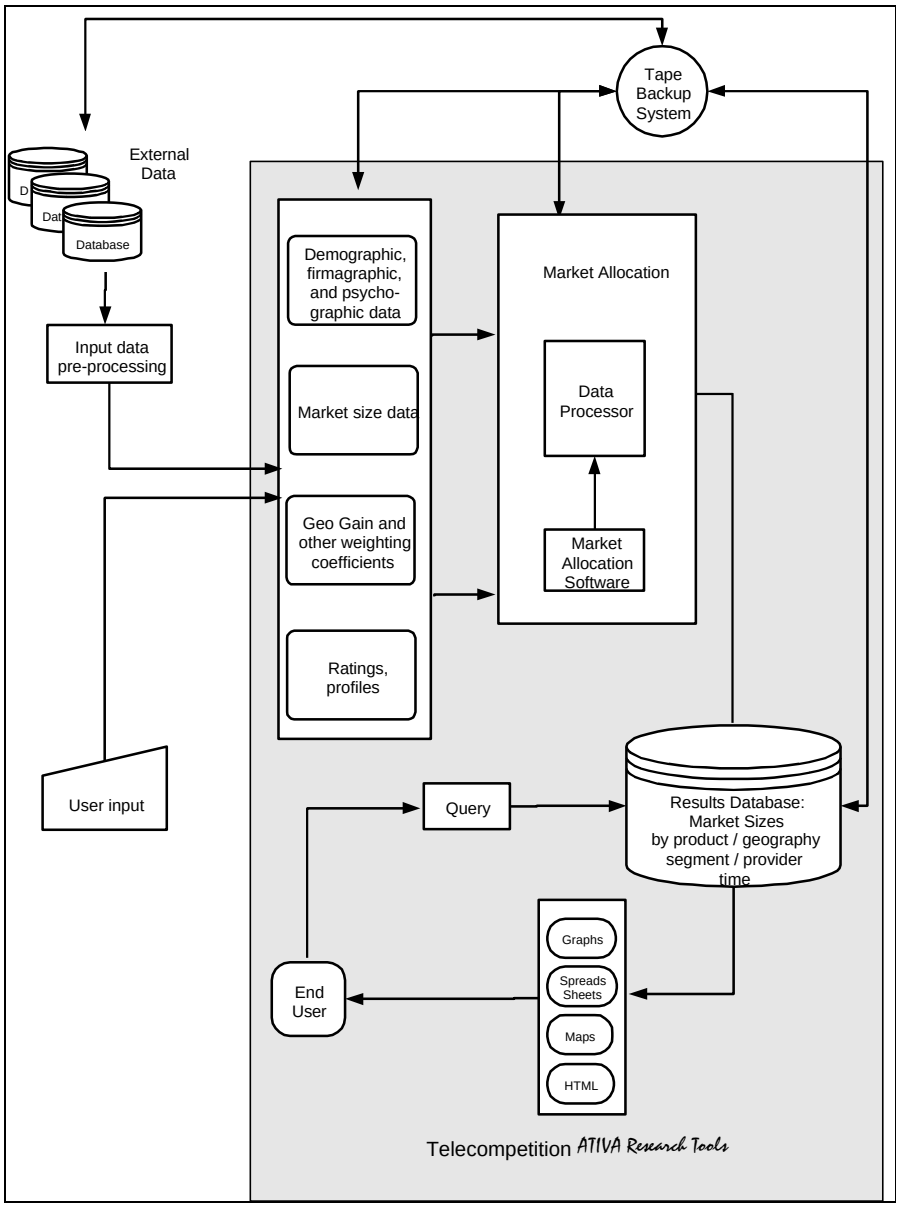
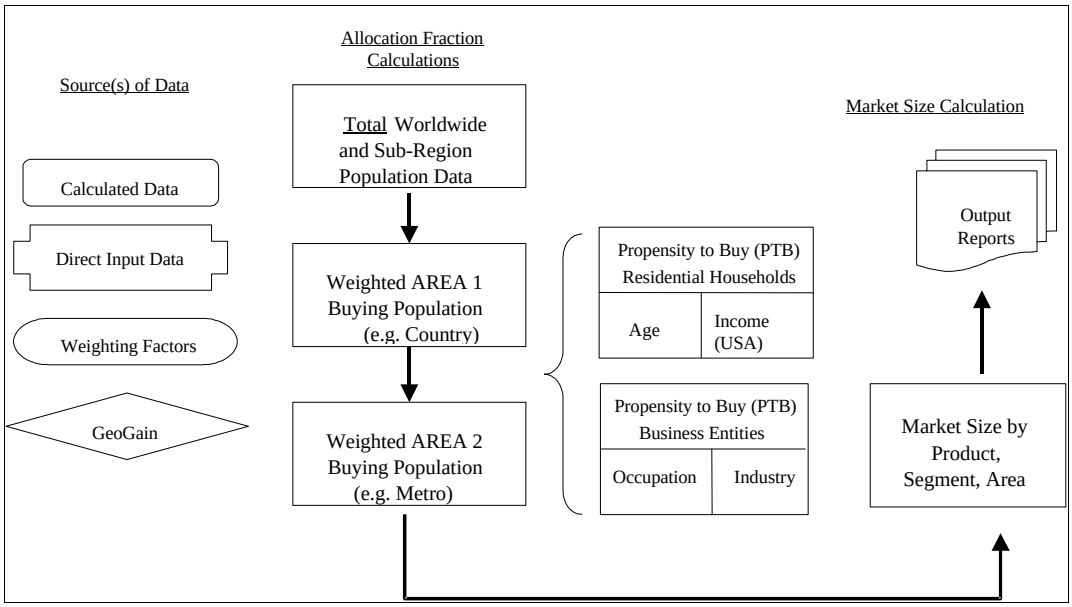


Figure 13.2 *ATIVA Research Tools®* calculation process flow.



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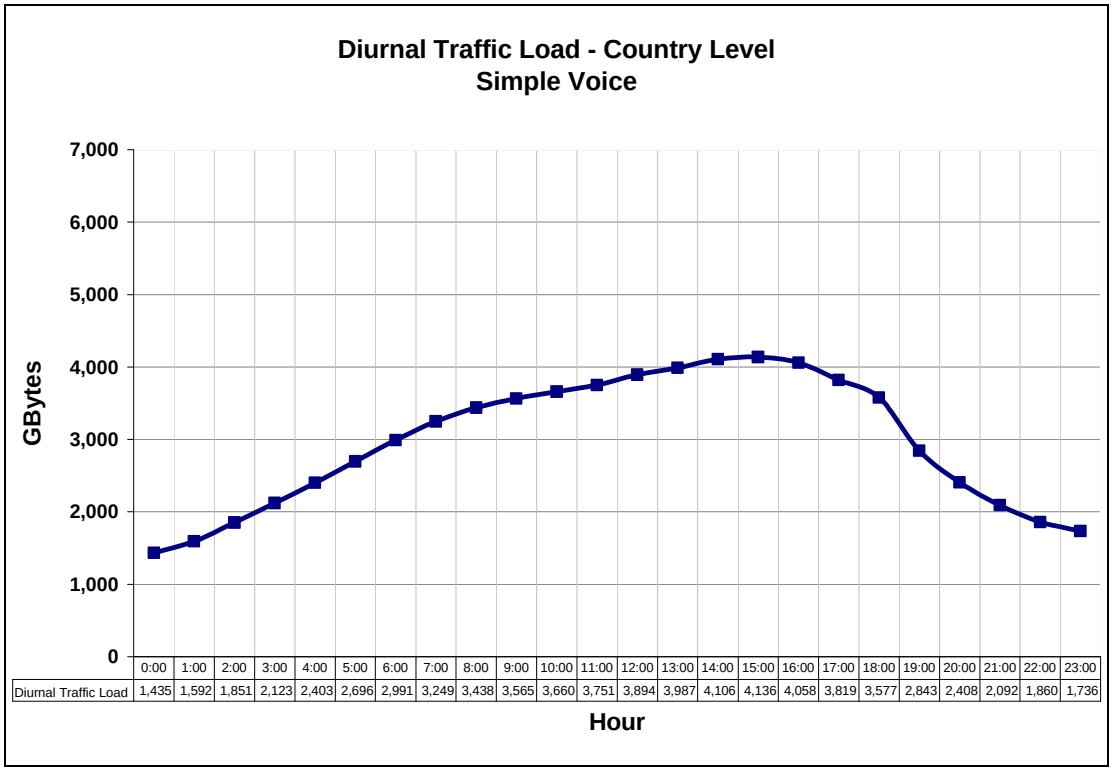
# 15 Appendix

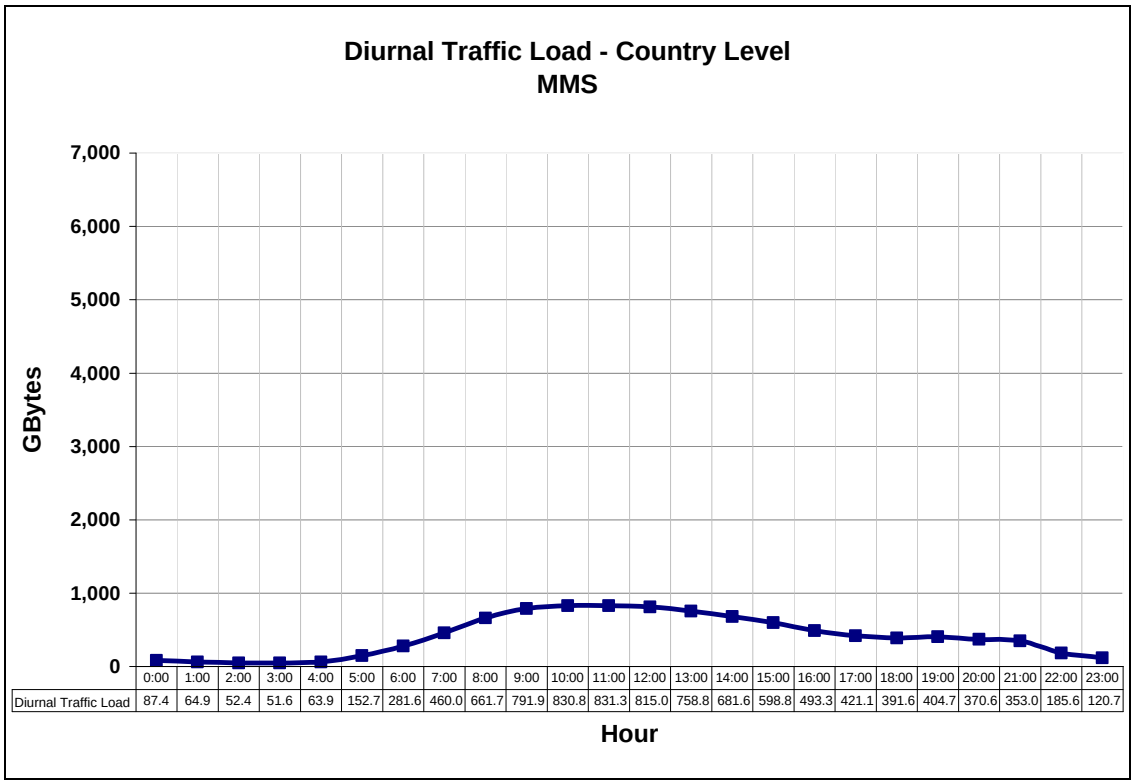
Figure 15.1 Offered traffic load for Simple Voice.




| | 0:00 | 1:00 | 2:00 | 3:00 | 4:00 | 5:00 | 6:00 | 7:00 | 8:00 | 9:00 | 10:00 | 11:00 | 12:00 | 13:00 | 14:00 | 15:00 | 16:00 | 17:00 | 18:00 | 19:00 | 20:00 | 21:00 | 22:00 | 23:00 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Diurnal Traffic Load | 1,435 | 1,592 | 1,851 | 2,123 | 2,403 | 2,696 | 2,991 | 3,249 | 3,438 | 3,565 | 3,660 | 3,751 | 3,894 | 3,987 | 4,106 | 4,136 | 4,058 | 3,819 | 3,577 | 2,843 | 2,408 | 2,092 | 1,860 | 1,736 |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

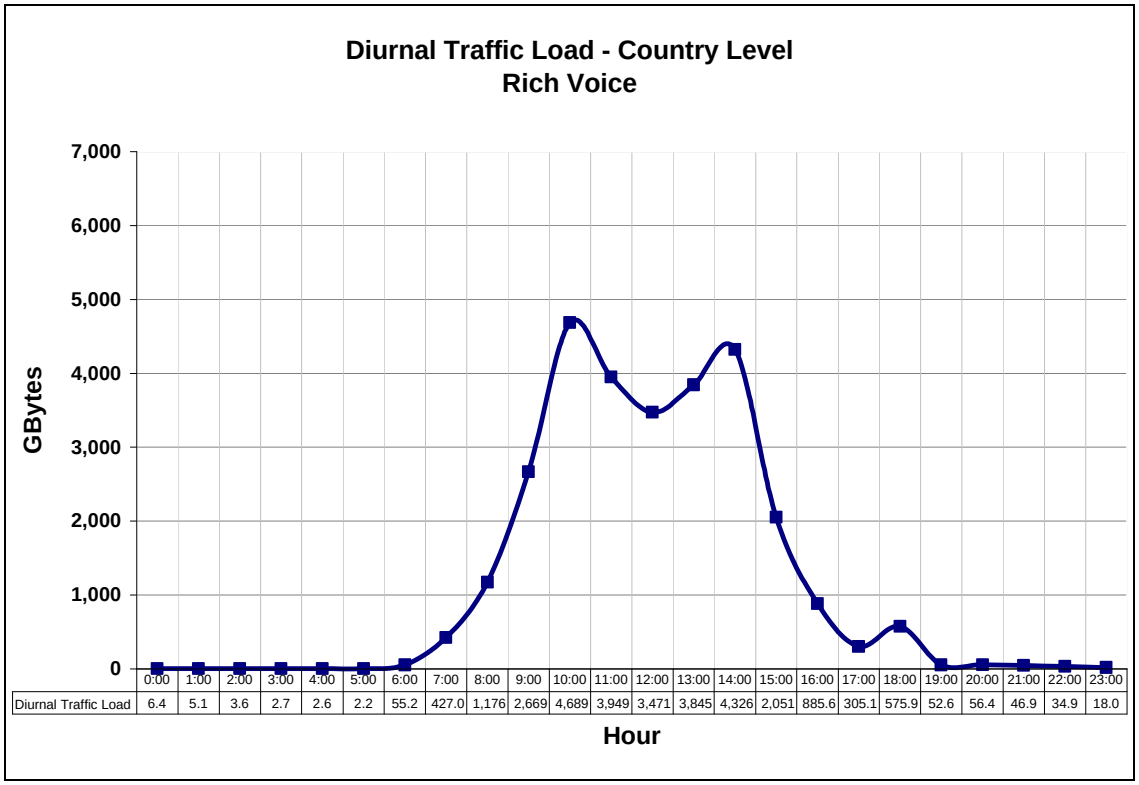
Figure 15.2 Offered traffic load for MMS.




| | 0:00 | 1:00 | 2:00 | 3:00 | 4:00 | 5:00 | 6:00 | 7:00 | 8:00 | 9:00 | 10:00 | 11:00 | 12:00 | 13:00 | 14:00 | 15:00 | 16:00 | 17:00 | 18:00 | 19:00 | 20:00 | 21:00 | 22:00 | 23:00 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Diurnal Traffic Load | 87.4 | 64.9 | 52.4 | 51.6 | 63.9 | 152.7 | 281.6 | 460.0 | 661.7 | 791.9 | 830.8 | 831.3 | 815.0 | 758.8 | 681.6 | 598.8 | 493.3 | 421.1 | 391.6 | 404.7 | 370.6 | 353.0 | 185.6 | 120.7 |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

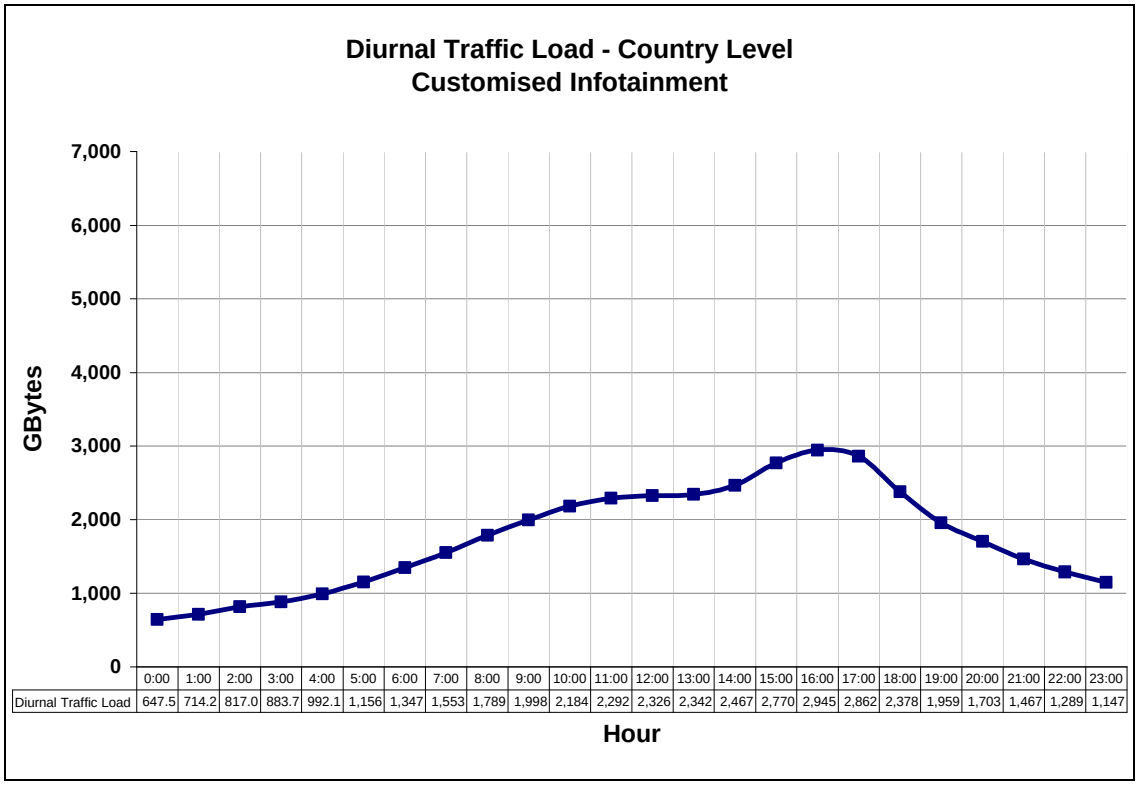
Figure 15.3 Offered traffic load for Rich Voice.




| | 0:00 | 1:00 | 2:00 | 3:00 | 4:00 | 5:00 | 6:00 | 7:00 | 8:00 | 9:00 | 10:00 | 11:00 | 12:00 | 13:00 | 14:00 | 15:00 | 16:00 | 17:00 | 18:00 | 19:00 | 20:00 | 21:00 | 22:00 | 23:00 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Diurnal Traffic Load | 6.4 | 5.1 | 3.6 | 2.7 | 2.6 | 2.2 | 55.2 | 427.0 | 1,176 | 2,669 | 4,689 | 3,949 | 3,471 | 3,845 | 4,326 | 2,051 | 885.6 | 305.1 | 575.9 | 52.6 | 56.4 | 46.9 | 34.9 | 18.0 |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

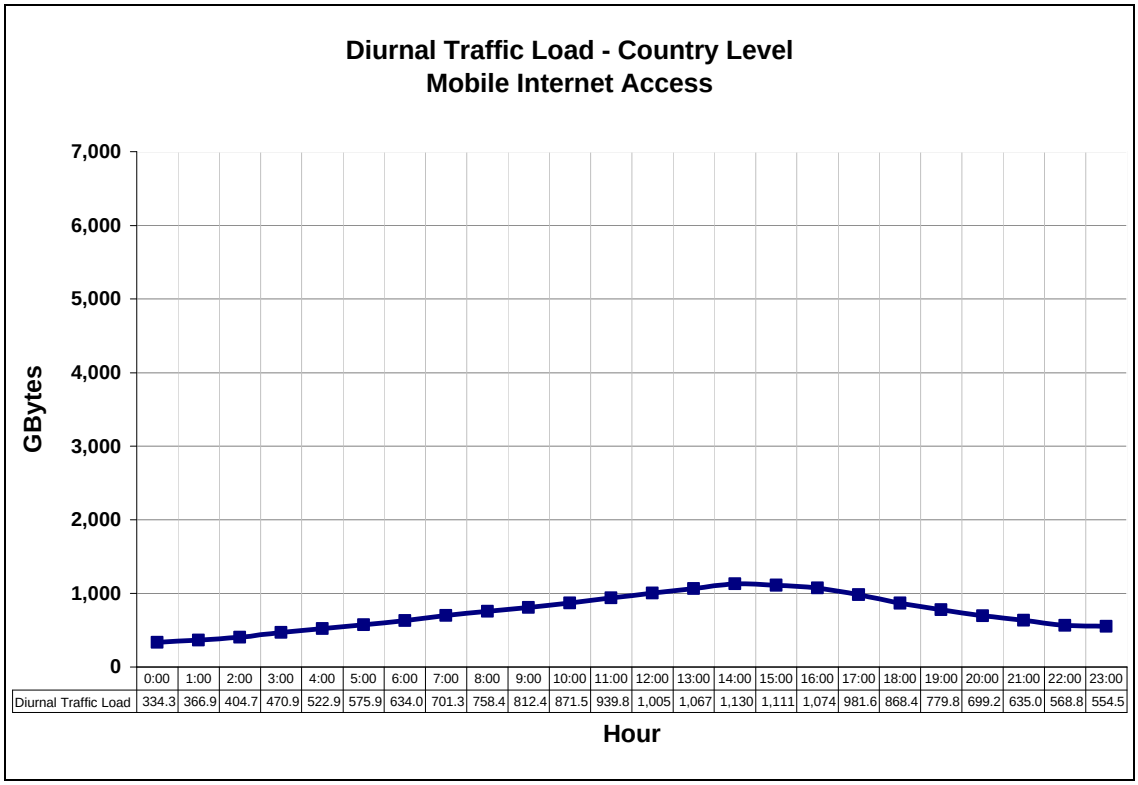
Figure 15.4 Offered traffic load for Customised Infotainment.




| | 0:00 | 1:00 | 2:00 | 3:00 | 4:00 | 5:00 | 6:00 | 7:00 | 8:00 | 9:00 | 10:00 | 11:00 | 12:00 | 13:00 | 14:00 | 15:00 | 16:00 | 17:00 | 18:00 | 19:00 | 20:00 | 21:00 | 22:00 | 23:00 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Diurnal Traffic Load | 647.5 | 714.2 | 817.0 | 883.7 | 992.1 | 1,156 | 1,347 | 1,553 | 1,789 | 1,998 | 2,184 | 2,292 | 2,326 | 2,342 | 2,467 | 2,770 | 2,945 | 2,862 | 2,378 | 1,959 | 1,703 | 1,467 | 1,289 | 1,147 |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

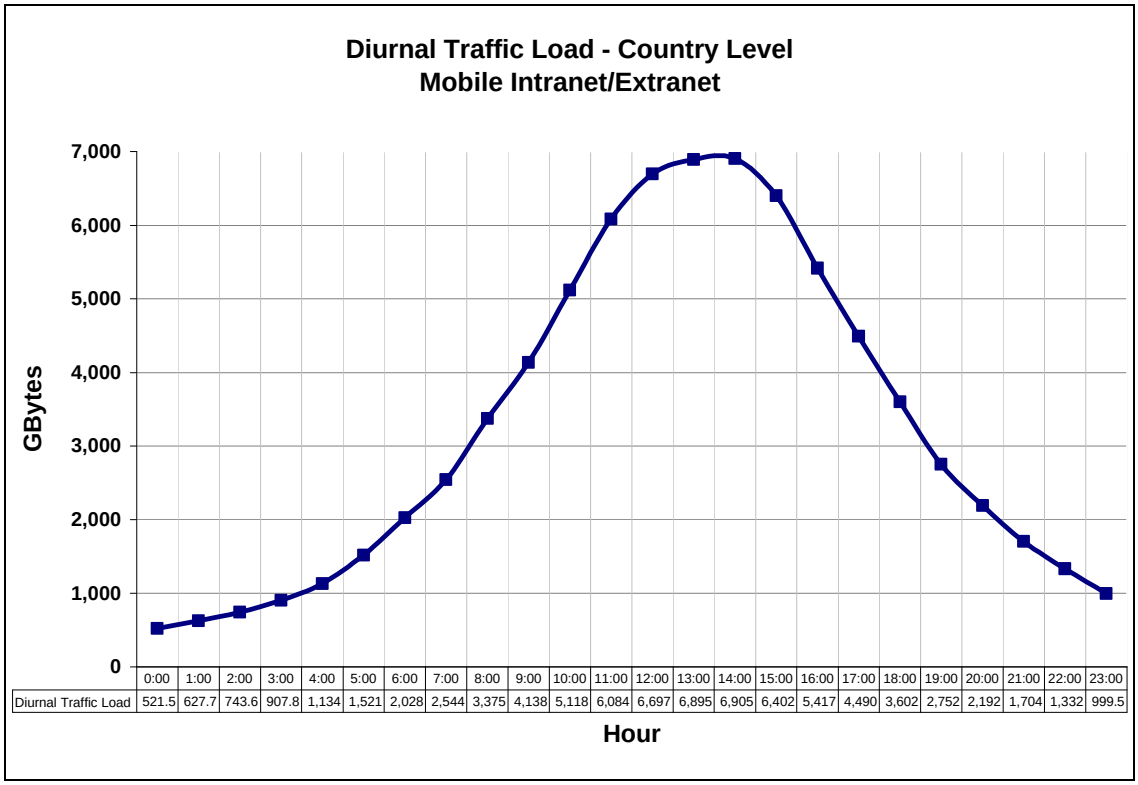
Figure 15.5 Offered traffic load for Mobile Internet Access.




| | 0:00 | 1:00 | 2:00 | 3:00 | 4:00 | 5:00 | 6:00 | 7:00 | 8:00 | 9:00 | 10:00 | 11:00 | 12:00 | 13:00 | 14:00 | 15:00 | 16:00 | 17:00 | 18:00 | 19:00 | 20:00 | 21:00 | 22:00 | 23:00 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Diurnal Traffic Load | 334.3 | 366.9 | 404.7 | 470.9 | 522.9 | 575.9 | 634.0 | 701.3 | 758.4 | 812.4 | 871.5 | 939.8 | 1,005 | 1,067 | 1,130 | 1,111 | 1,074 | 981.6 | 868.4 | 779.8 | 699.2 | 635.0 | 568.8 | 554.5 |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

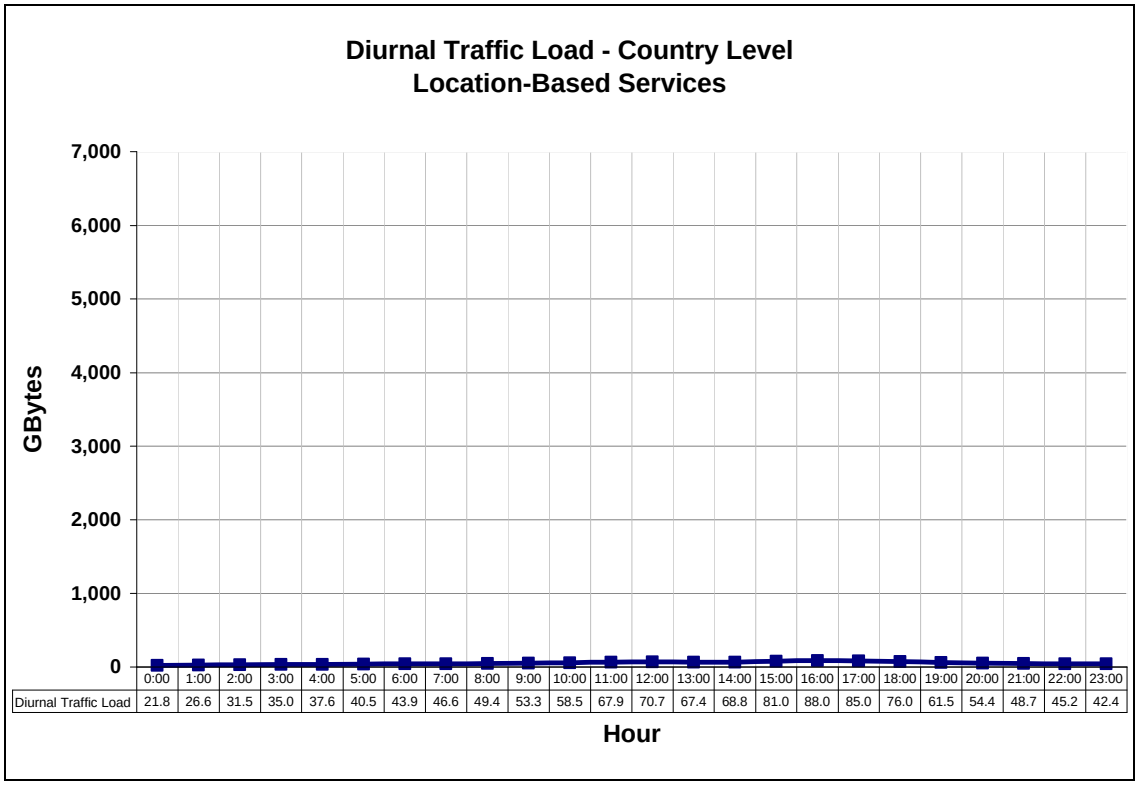
Figure 15.6 Offered traffic load for Mobile Intranet/Extranet.




| | 0:00 | 1:00 | 2:00 | 3:00 | 4:00 | 5:00 | 6:00 | 7:00 | 8:00 | 9:00 | 10:00 | 11:00 | 12:00 | 13:00 | 14:00 | 15:00 | 16:00 | 17:00 | 18:00 | 19:00 | 20:00 | 21:00 | 22:00 | 23:00 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Diurnal Traffic Load | 521.5 | 627.7 | 743.6 | 907.8 | 1,134 | 1,521 | 2,028 | 2,544 | 3,375 | 4,138 | 5,118 | 6,084 | 6,697 | 6,895 | 6,905 | 6,402 | 5,417 | 4,490 | 3,602 | 2,752 | 2,192 | 1,704 | 1,332 | 999.5 |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

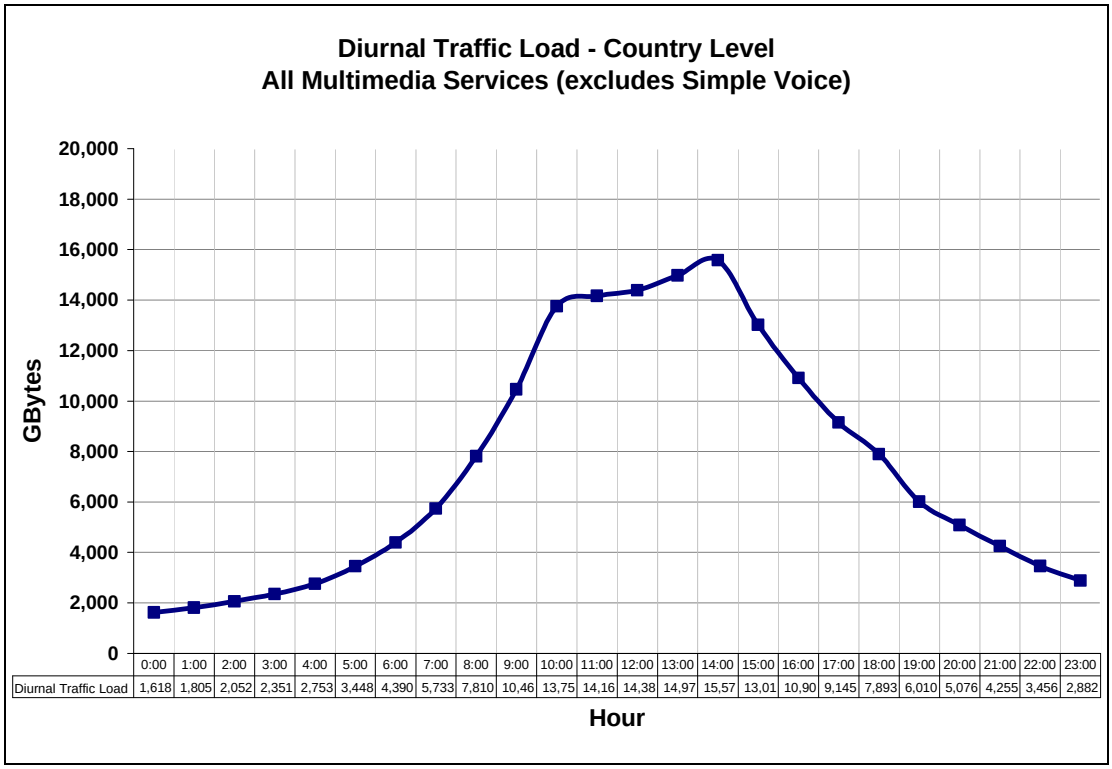
Figure 15.7 Offered traffic load for Location-Based Services.




| | 0:00 | 1:00 | 2:00 | 3:00 | 4:00 | 5:00 | 6:00 | 7:00 | 8:00 | 9:00 | 10:00 | 11:00 | 12:00 | 13:00 | 14:00 | 15:00 | 16:00 | 17:00 | 18:00 | 19:00 | 20:00 | 21:00 | 22:00 | 23:00 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Diurnal Traffic Load | 21.8 | 26.6 | 31.5 | 35.0 | 37.6 | 40.5 | 43.9 | 46.6 | 49.4 | 53.3 | 58.5 | 67.9 | 70.7 | 67.4 | 68.8 | 81.0 | 88.0 | 85.0 | 76.0 | 61.5 | 54.4 | 48.7 | 45.2 | 42.4 |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

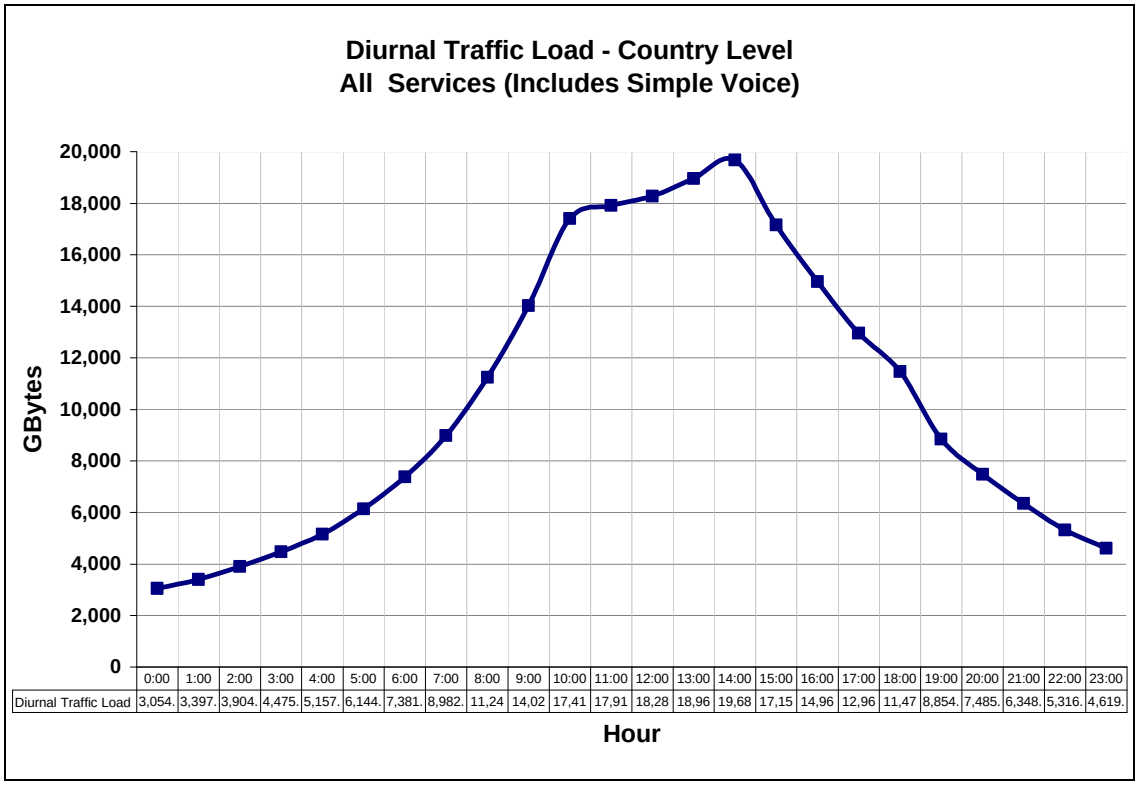
Figure 15.8 Offered traffic load for All Multimedia Services (excludes Simple Voice).




| | 0:00 | 1:00 | 2:00 | 3:00 | 4:00 | 5:00 | 6:00 | 7:00 | 8:00 | 9:00 | 10:00 | 11:00 | 12:00 | 13:00 | 14:00 | 15:00 | 16:00 | 17:00 | 18:00 | 19:00 | 20:00 | 21:00 | 22:00 | 23:00 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Diurnal Traffic Load | 1,618 | 1,805 | 2,052 | 2,351 | 2,753 | 3,448 | 4,390 | 5,733 | 7,810 | 10,46 | 13,75 | 14,16 | 14,38 | 14,97 | 15,57 | 13,01 | 10,90 | 9,145 | 7,893 | 6,010 | 5,076 | 4,255 | 3,456 | 2,882 |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.

Figure 15.9 Offered traffic load for All Services (Includes Simple Voice).




| | 0:00 | 1:00 | 2:00 | 3:00 | 4:00 | 5:00 | 6:00 | 7:00 | 8:00 | 9:00 | 10:00 | 11:00 | 12:00 | 13:00 | 14:00 | 15:00 | 16:00 | 17:00 | 18:00 | 19:00 | 20:00 | 21:00 | 22:00 | 23:00 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Diurnal Traffic Load | 3,054. | 3,397. | 3,904. | 4,475. | 5,157. | 6,144. | 7,381. | 8,982. | 11,24 | 14,02 | 17,41 | 17,91 | 18,28 | 18,96 | 19,68 | 17,15 | 14,96 | 12,96 | 11,47 | 8,854. | 7,485. | 6,348. | 5,316. | 4,619. |

Source: Telecompetition, Inc., prepared for the UMTS Forum, October 2003.