Emerging Smartphone Trends & Evolving Data Subscriber Demands

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Executive Summary

Recent smartphone launches herald a new breed of data subscriber. The demands of prior smartphone subscribers are formidable and well known in the industry, especially with regards to iPhone 3G data volumes and numbers of data calls. However, recent Tier-1 market data comparing newer smartphones with the iPhone 3G reveal that the new breed of subscriber has an even more insatiable demand for data on a per-subscriber basis, including upwards of:

- 250% increase in total data call time
- 130% increase in data calls
- 130% increase in uplink data volumes
- 40% increase in downlink data volumes

As expected, different devices exhibit different per-subscriber demands on the network. These comparative differences have been observed whilst working alongside a number of operators around the globe and are shown to be helpful in trending future aggregate demand.

The combination of more data calls, longer data call times and greater data transfers constitutes the next level in exploding data demand that network operators need to prepare for through an intense focus on this new breed of data subscribers: where they are located, what their demands are, where and how their needs are not being met.

Introduction

Recent smartphone launches herald a new breed of data subscriber. The demands of prior smartphone subscribers are formidable and well known in the industry, especially with regards to iPhone 3G data volumes and numbers of data calls. However, the introduction of new data-intense features on recent smartphones (such as HD video, 5-Megapixel cameras, and multitasking to increase user efficiency on the iPhone 4), raises the expectation that the users of these new smartphones will be even more intense data consumers. The purpose of this paper is to quantify this step-change in behaviour as seen in a variety of popular smartphones.

According to recent RNC-level data spanning a single, 24-hour weekday in an urban Tier-1 network, over 440,000 distinct subscribers made over 22 million voice and data calls (the latter involving the transfer of 3.7 TBytes of data). The comparative analysis in this paper focuses on popular devices which were represented by at least 1000 subscribers (note that the most popular devices were represented by well over 10,000 subscribers). While any device could be used as a point of reference, the iPhone 3G is chosen due to its historical significance (since it constituted a recent pinnacle in user network demand). Therefore, increases in demand over the iPhone 3G constitute a new standard for subscriber behavior that network operators must prepare for.

The remainder of this paper is broken into two parts: subscriber demand and network operator response.

Part I: Subscriber Demand

Comparative results

The per-subscriber demand of twelve smartphones are compared to the iPhone 3G in Table 1 below. The devices are organized by manufacturer and then by release date. Non-voice devices (such as a collection of 3G modems and the iPad) are also compared. The results were normalized in each category so that the iPhone 3G score would be 100%. The highest smartphone score in each category is high-lighted in red (note that there is a tie for the downlink data volume). Non-voice device scores of interest are also high-lighted in red.

Device	Release Date	Data MoU/sub	Data calls/sub	UL Data Volume (kbits/sub)	DL Data Volume (kbits/sub)	Voice calls/sub
iPhone 3G	Jun-08	100%	100%	100%	100%	100%
iPhone 4	Jun-10	167%	144%	145%	141%	93%
Blackberry 9000	May-08	55%	59%	11%	11%	73%
Blackberry 9500	Nov-08	81%	61%	19%	24%	107%
Blackberry 9700	Nov-09	101%	69%	21%	25%	98%
HTC Magic	May-09	163%	212%	84%	89%	68%
HTC Google Nexus One	Jan-10	194%	234%	170%	137%	61%
HTC Desire	Mar-10	128%	135%	136%	141%	70%
Nokia E71	Jul-08	27%	12%	21%	15%	134%
Nokia E72	Jun-09	64%	40%	57%	24%	136%
Nokia N900	Nov-09	20%	8%	18%	12%	138%
SonyEricsson Xperia	Mar-10	351%	95%	144%	138%	113%
Samsung Galaxy	Jun-10	283%	150%	226%	122%	82%
3G Modems	(various)	377%	11%	3537%	2676%	0%
iPad	Apr-10	125%	96%	322%	137%	0%

Table 1: Comparative Results by device

Total data call time per subscriber increased by up to 250%

The average Sony Ericsson Xperia subscriber was connected to the network in data calls 3.5 times more than the average iPhone 3G subscriber as evidenced by the Data Minutes of Use (MoU) per subscriber column. This corresponds to increased consumption of network resources by the average Xperia subscriber and needs to be taken into account in network planning and network optimization activities. For example, if the rates of purchase of Xperia devices are forecasted to increase (e.g., due to marketing and sales targets) then the impact of these future devices can be estimated using the information in Table 1. In a more general example, the network impact of an arbitrary mix of network devices can be similarly estimated.

Advanced multitasking features of the Android and iPhone operating systems are likely to be important contributors to the increase in total data call time. The user inactivity timeout associated with the termination of most data calls may not occur as often when the user is able to swiftly change from application to application. This is because a data download for a newly started application could easily be required before the timer expires after the last data is received for the prior application (which would still be running in the background).

Data calls per subscriber increased by up to 130%

The number of data calls per subscriber is 130% higher for the HTC Google Nexus One than for the iPhone 3G. By way of comparison, the iPhone 4 shows an increase of 40%. Part of this increase may be due to the relative novelty of the iPhone 4, but this can also be consistent with the greater ease-of-use of the iPhone 4 over the iPhone 3G. Similar ease-of-use arguments may apply to the Google Nexus One. The applications predominantly used on the Google Nexus One and the iPhone 4 (especially automated applications) may also contribute to this increase and remains a topic for future study.

Uplink data volumes per subscriber increased by up to 130%

The Samsung Galaxy revealed a dramatic 130% increase in uplink data volumes per subscriber compared to the iPhone 3G. Several other smartphones (including the HTC Google Nexus One and the iPhone 4) also showed substantial gains in this category. While subscribers with these newer smartphones are generally still a minority compared to iPhone 3G subscribers, their relative numbers are going up each day and it is only a matter of time before they are responsible for greater aggregate uplink data volumes than all iPhone 3G users combined.

Increases in uplink data volumes are largely expected to be due to corresponding increases in user generated content. HD video recorders and 5-Megapixel cameras are common features in the smartphones showing gains in uplink data volumes. The use of image and video editing applications will also result in larger amounts of uplink data volume to be transmitted by the subscriber to the network. It should still be noted, however, that each smartphone in this study still consumed more downlink data than it generated uplink data.

Downlink data volumes per subscriber increased by up to 40%

The iPhone 4 and the HTC Desire both showed an increase of 40% in downlink data volumes over the iPhone 3G. Since the downlink-to-uplink data volume ratio was in excess of 7-to-1 on average for the smartphones under study, this downlink increase of 40% corresponds to a larger total volume of data than a 130% uplink increase (discussed in the last section). As noted earlier regarding the increases in total data call times and total numbers of data calls, it remains a topic for further study to characterize the root cause of this downlink data volume increase. But regardless of the cause, quantifying this increase is still important for purposes of network planning and optimization (including forecast trending).

Quantifying the evolving data explosion

The uplink and downlink data volume demands per subscriber versus release date of the more demanding smartphone devices (made by Apple, HTC, Samsung & Sony Ericsson) are shown in Figure 1 below.

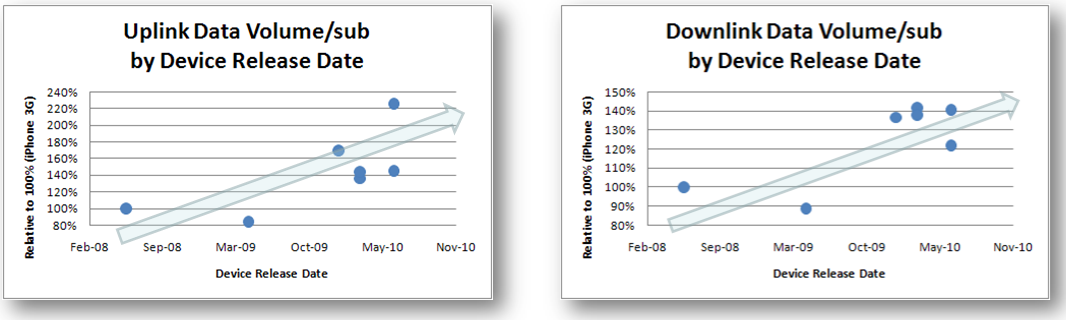

Figure 1: Uplink & downlink data volume/sub vs. device release date

While the data demands of the HTC Magic (released in May 2009) are 80-90% that of the iPhone 3G (released nearly a year earlier), the next generation of devices starting from January 2010 show a clear unit step in behaviour. While constituting a new breed of data subscriber using the network in considerable volumes today, they also point to how future waves of smartphone users may make even greater demands.

Smartphones are generally not bought to make voice calls…

As seen in Figure 2, trending of the number of voice calls per subscriber was found to be fairly flat across the release dates of all of the smartphones reported on in Table 1.

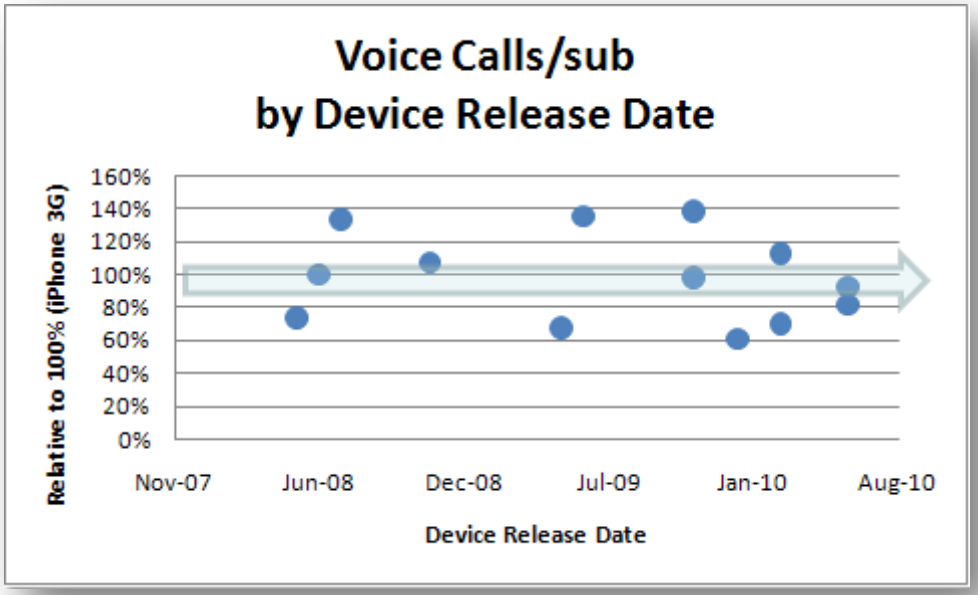

Figure 2: Uplink & downlink data volume/sub vs. device release date

This is not surprising given the popular smartphone emphasis on data communications as opposed to voice communications. We also see that some smartphones (such as the Nokia N900) are much more likely to be used to place voice calls.

Finally, it is interesting to note that the flat trending in Figure 2 implicitly responds to the question of how data transfers impact the nature of verbal communications. For example, it is easy to think of situations where one might place a phone call in response to some data exchange (such as an e-mail or an SMS or a Facebook entry). However, these situations would appear to be exceedingly rare based on the data in Figures 1 and 2 (where data volumes increased dramatically while voice calls remained flat). These findings support the familiar view that subscribers overwhelmingly tend to respond "in kind" (e.g., an e-mail response to an incoming e-mail or a Facebook comment in response to another Facebook comment)

Is the iPad a big smartphone or a small PC?

The 3G modems in a network are generally noteworthy for two aspects: 1) their relatively low volumes of subscribers (compared to smartphones and other devices) and 2) their remarkably high volumes of data per subscriber. The product of these two items result in the aggregate data volume across all 3G modems and is typically competitive with (and sometimes in excess of) the aggregate data volume across all smartphones. Table 1 shows a staggering 26-to-34 times increase in the data volume per 3G modem subscriber over the iPhone 3G reference. This is achieved by making nearly one-tenth the number of data calls and only a 2.8-fold increase in the total data call time.

In contrast, the typically more numerous iPads reveal per-subscriber scores in Table 1 that are almost always in the range of the smartphone scores for each category. The only exception is the uplink data volume which shows a 220% increase over the iPhone 3G (the most aggressive smartphone reveals a 120% increase), but this is still more than an order of magnitude less than the corresponding 3G modem increase. Based on this analysis, the iPad appears to have much more in common with smartphones than with 3G modems from a network demand perspective.

Part II: Network Operator Response

Response overview

The new breed of data subscribers has been shown in Part I of this paper to be incredibly data hungry, much more so than the previous iPhone 3G subscriber. Over the coming months it is expected that the already-pressured Tier-1 network operators will not only continue to struggle with the existing data demand but also to become increasingly more challenged with the demand from newer, more advanced smartphones.

The question then must be: How does the network operator best respond to these increased pressures?

It is well-known that network capacity is best-placed at the center of the demand. This minimizes the distance from cell-sites to subscribers, which in turn reduces the RF pathloss, reduces the requisite transmit powers and maximizes throughput, overall capacity and network efficiency.

There are today a number of solutions which offer network operators the opportunity to quickly put network capacity in the right place, including:

- Femto-cells – Femto-cells are now available commercially from a number of Tier-1 operators. They are essentially a home base-station with a very limited footprint, designed for in-building enhancement. Femto-cells use a fixed broadband infrastructure to provide backhaul to the core network.

- Micro/Pico Cells – Micro and Pico cells are deployed by the operator for traffic offload. Micro-cells are typically low-powered units, mounted at street level to provide coverage over a 200-300m radius. Pico-cells are usually even lower-powered with a radius of 100m or less. Both solutions are aimed at very localized offload – but in an outdoor environment (in contrast to the femto-cell). Examples of microcell deployments can be found in train stations, busy shopping intersections or similar.

- Distributed Antenna Systems (DAS) – A DAS solution usually involves multiple antennas connected to a single base-station. The difference over a typical macro site is that there may be ten or more antennas connected to single base-station, all transmitting low power, at street level, but spanning an entire street. A good example of this is Oxford Street in London where DAS antennas are mounted on streetlamps along the entire

length of the road. Again the aim is to offload traffic from the macro network onto the highly-localized DAS solution.

- In-buillding Solutions – In-building solutions have traditionally been deployed in large conference centers, in airports and in similar locations. In this case, the in-building solution can be quite well isolated from the macro network but again aims to provide a highly localized, high-capacity solution.

There are a number of benefits from the solutions described above, not least that they typically are less time consuming to deploy than a new macro network site (which can take more than 2 years to pass through planning and construction in most western countries). As previously noted, they are also more effective at serving localized traffic than a macro network site due to their proximity to where the traffic is actually located.

Picking the best locations

It has been observed that these localized solutions are best and most cost effective when they are located exactly where the traffic demand is located. On the other hand, if an in-building solution is deployed in the incorrect building or a microcell is located on the wrong street corner then this could result in an expensive mistake.

Using traditional techniques, most mobile operators will not be able to pinpoint traffic locations with sufficient accuracy to make sure that they get the best return on their infrastructure investment. The traditional techniques are reliant on the experience of a local engineering team, including their estimation of where traffic is likely to be located within a cell footprint. This estimation is often driven by knowledge of where the key shopping areas are and where the big corporate customers are located, in concert with traffic statistics obtained from cell-level counters. But this technique suffers from the inability to objectively quantify the relative importance of one building compared to another, both within a particular corporate or commercial area as well as spanning the entire cell footprint. Also, the engineering team is unlikely to have walk-tested each individual building to quantify what the existing in-building network performance is in order to justify the deployment of an in-building solution which can have a total cost in the range of millions of dollars.

The selection of the most appropriate locations is greatly helped by the use of a location-aware and subscriber-centric product like ariesoGEO. The ariesoGEO product processes every call made in the network under study in a 24x7 manner. Analysis of every call (including device

types, data volumes and coverage-related measurements) can provide network operations with the locations of traffic hotspots to building-level accuracy. This is critically important due to the intense demand that the new breed of data user will place on the network (as discussed in Part I of this paper).

The ariesoGEO product has been recently used to determine the best locations for microcells and in-building solutions. Figure 3 below shows part of an urban downtown area highlighting specific data traffic hotspots (where in-building solutions would potentially be justified).

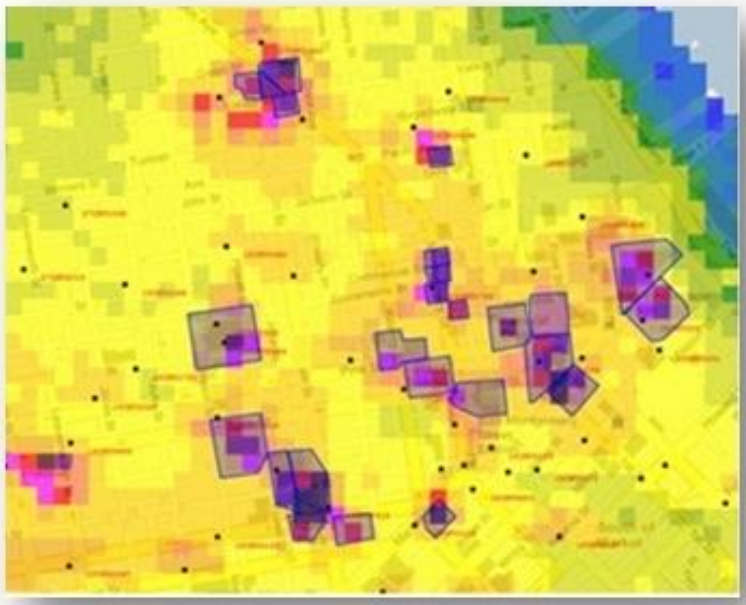

Figure 3: Urban data traffic hotspot maps

Figure 4 shows an example where a microcell had been deployed in the center of the image, but the majority of the traffic (shown as red in the overlay thematic map) is approximately 100m to the west. Clearly the impact of this microcell is now limited: the traffic is relatively far away from the site location and the RF pathloss between the traffic and the microcell will be much larger than if the site was located in the midst of the hotspot. As a result, the return on this microcell investment is considerably limited by its sub-optimal placement.

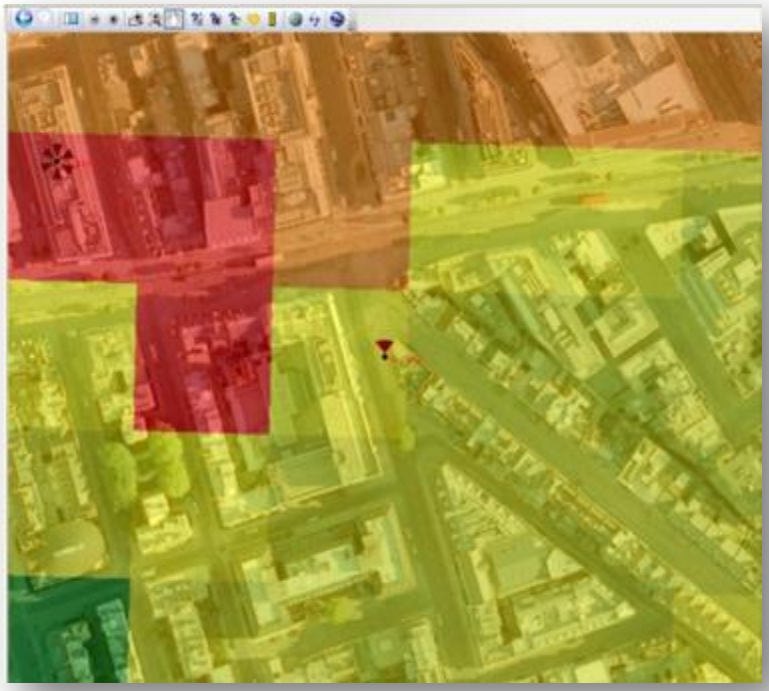

Figure 4: Microcell in sub-optimal location

Justifying the business case

The business case for deployment of microcells and in-building solutions can have many justifications, including:

1) Deferment of capacity adds in macro network: If in-building or micro-solutions were not pursued, the operator would have to spend upwards of $100,000 to deploy a second, third or fourth carrier to provide even a limited portion of the capacity an in-building solution would provide. This also assumes that the operator has enough spectrum in order to deploy new carriers. In Europe, where most operators only have two carriers, this may quickly become a significant issue.

2) Increase in quality offered to the macro network: By off-loading to localized solutions, the utilization of existing macro sites will decrease. This has a positive impact on the amount of interference they generate to the wider network and consequently network quality. From a subscriber perspective, this means fewer dropped/dropped calls and higher data throughputs. It is expected that this will favorably impact subscriber churn.

3) Increase in carried traffic: Linked to the reduction in network blocking the network now has improved capacity. Consequently, users are likely to talk longer and download more (since they suffer fewer instances of frustrating call drops and slow download speeds) which are expected to result in an increase in revenue.

Summary

A new breed of data subscriber can be characterized by measured demands that newer smartphones make on actual networks. Compared to iPhone 3G users, this new breed is the next level in the evolving data explosion by virtue of their even more insatiable demand for data, on the uplink as well as the downlink, including upwards of:

- 250% increase in total data call time
- 130% increase in data calls
- 130% increase in uplink data volumes
- 40% increase in downlink data volumes

It was shown how per-device details can be used to estimate future aggregate data demand (based on future device mixes). This, in turn, is a critical input to network planning and optimization efforts. Network operator responses to this demand was considered in a variety of macro network offload scenarios.

It must be noted that the particular results in this paper correspond to the RNC that was studied, and that these results can vary depending on a number of circumstances (including morphologies, available devices, regional customer behaviours, and socio-economic user factors). As such, these results are intended to be illustrative rather than definitive. Each network operator should embark upon a similar subscriber & network evaluation program in order to determine the clear and present data demands being placed on their network as well as the most appropriate response strategies to best satisfy this demand.

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