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AIMING HIGHER

How enhanced network performance improved satisfaction among spectators at the 2016 Summer Games in Rio

CONTENTS

METHODOLOGY

The study aims to understand consumer behaviors during key events as well as how the networks were built to cope with high demands of mobile traffic. The analysis includes consumers' usage evolution, satisfaction levels and the demands placed on the network vis a vis the actual performance. The results of this event were also compared with an event of similar magnitude in 2014, which is the international football tournament in Brazil.

A 2014 football tournament study was conducted at Sao Paulo and Rio de Janeiro among smartphone owners who watched the matches in and around the stadiums. 800 face-to-face interviews were conducted using quantitative methodology right after the matches.

THE CONSUMER SPEAKS

For gaining the user perspective in this study by Ericsson ConsumerLab, 800 face-to-face interviews were conducted amongst the 2016 Summer Games visitors across the four event areas: Barra, Deodoro, Maracana and Copacabana. Those interviewed were Brazilian (75 percent) and foreigners (25 percent) aged 16–60 who watched the matches in the stadiums and performed digital activities on their smartphones.

NETWORK MEASUREMENTS

Key performance indicators (KPIs) of Ericsson network elements collected during the 2016 Summer Games in Rio for the optimization, monitoring and support of the network were used as a base for this analysis. The statistics include more than 100 KPIs on 6500 network elements monitored in real-time and recorded every 15 minutes, 24 hours per day from August 5, 2016 to August 21, 2016.

AN EVENT WITHOUT PRECEDENT

45,000 volunteers, 3,200 technical officials and 90,000 workforce were deployed

from more than 207 countries

to more than 5 billion TV viewers across 220 countries

11,303 athletes

25,100 media professionals

350,000 hours of broadcast

7.5 MILLION tickets available

10X TRAFFIC compared to World Cup

Over 1.17 million tourists watched the games, of which 410,000 were foreigners

In Rio, 1.1 million erlangs were carried. 303 TB of voice and data traffic equivalent to 10 times the traffic on mobile networks compared to 2014 Football Tournament and four times more than the London games 2012

KEY FINDINGS

Changing consumer behaviors characterized by more videos and social networking, less voice calls and text messages

- Compared to the 2014 Football Tournament, 23 percent more consumers performed data-intensive activities like video sharing during 2016 Summer Games. Notably, 37 percent of consumers streamed live video from the event
- In Rio, more people were active on social networks (79 percent) compared to the 2014 Football Tournament (66 percent)
- Compared to the 2014 Football Tournament, there was a 20 percent fall in the number of people making voice calls while there was a drop of 28 percent for sending text messages

Impressive growth in data consumption during the Rio games, backed by agile networks

- About 303 TB data was consumed and 1.1 million Erlangs were carried at the event
- LTE data traffic absorbed 45 percent of the total traffic during the event, compared to the 34 percent in a normal day in Rio
- On an average, consumers spent more than 2 hours a day watching TV or video clips related to the event on smartphones while outdoors, as evident from the increase in network traffic by 72 percent compared to a normal day in Rio

Higher satisfaction levels among consumers achieved through faster and more reliable networks during the 2016 games

- 53 percent of users were highly satisfied with the network compared to 31 percent during the 2014 Football Tournament
- Data reliability had a 36 percent impact on their satisfaction, followed by speed at 34 percent and coverage at 30 percent
- In terms of activities, short videos had 40 percent impact on overall satisfaction with the operator followed by content search. This is much higher compared to 2014 Football Tournament, where a low data activity like instant messaging had 35 percent impact on operator satisfaction

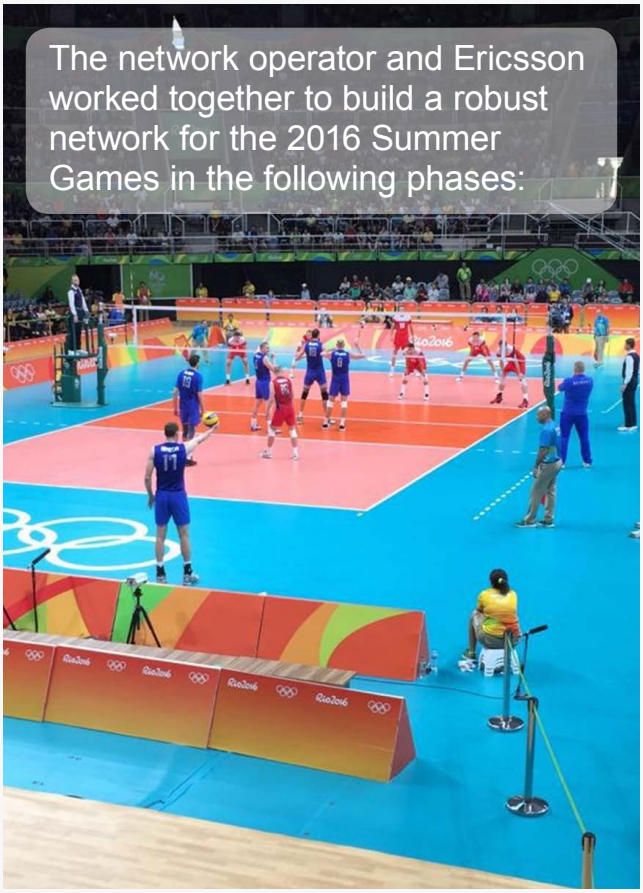
CELEBRATE THE OLYMPIC SPIRIT

The 2016 Summer Games in Rio were one of the biggest sporting events in the world with more than 207 participating countries. Millions of people travel to watch in person with millions more watching at home. An event of such staggering scale merits world-class infrastructure and flawless connectivity to offer a superior user experience to the audiences.

A dedicated team worked tirelessly to prepare the network, which involved creating high-capacity designs, high-speed configurations, performing real-time monitoring and active traffic management on the network. This was done prior to and during all of the events across all of the sporting venues, non-competition venues and other games-related sites. It also included providing operational support “on-site.”

To understand how these efforts came into fruition, it was necessary to explore the consumer perspective/ experience during the games with respect to digital activities performed and the impact of technological enhancement on user experience.

PREPARING & SUPPORTING THE NETWORK



PHASE 1

Design: Indoor and outdoor design in all the venues based on the operator and regulator premises. The design was produced using certain quality targets and some assumptions, such as the total traffic demand and percentage of Wi-Fi offload.

PHASE 2

Implementation: Shared indoor and outdoor systems in the most important venues such as Barra Olympic Park, Maracanazinho, Live sites, X Park and others. In total, there were 400 new sites.

PHASE 3

Test events: Selected sport events, shows, New Year´s Eve in Copacabana and Carnival, were chosen to prepare the processes such as optimization and monitoring during the 2016 Summer Games.

PHASE 4

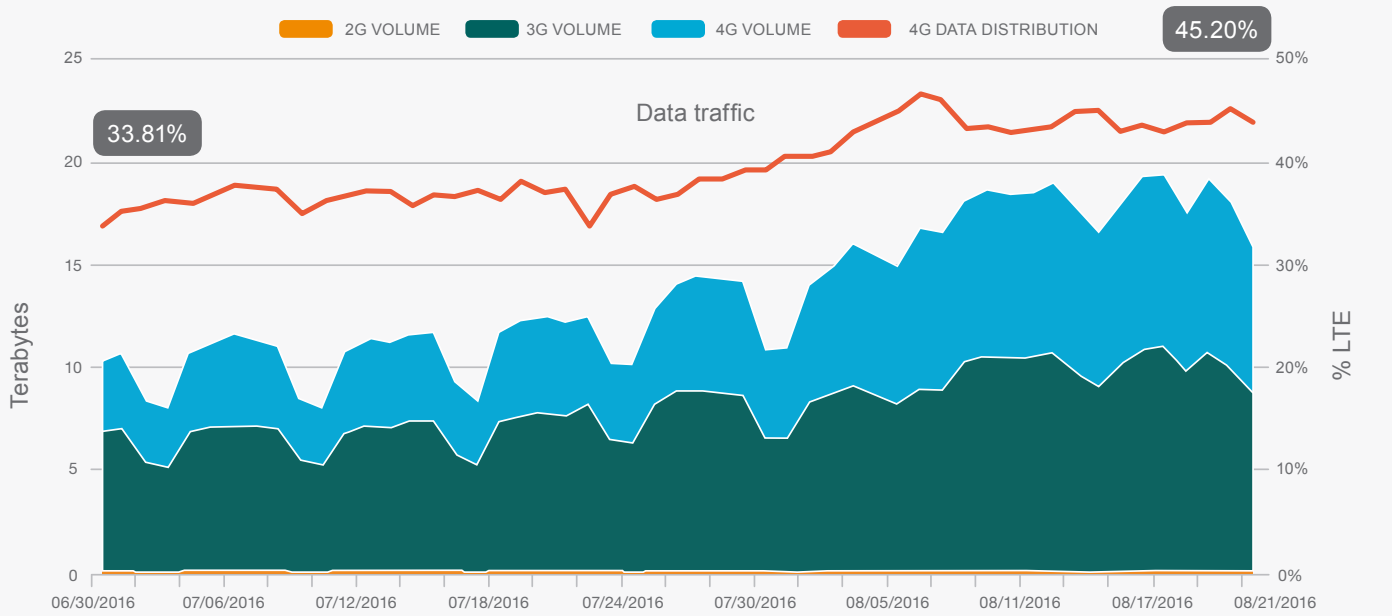
Optimize, Monitor and Support during 2016 Summer Games in Rio.

Measurement of Key Performance Indicators: KPIs were obtained from the real-time monitoring and analytics. This system constantly collected data about performance statistics for all connections (data or voice) and for all elements of the network. During the event and the Paralympic Games, more than 100 KPIs were analyzed for each one of the 6700+ elements of the network in Rio de Janeiro. The network was analyzed in real-time, from 7 am to 2 am, by dozens of engineers (60 percent for optimization, 40 percent for proactive support). Several event-customized tools were used for monitoring and to generate automatic reports.

Optimization: Network parameters were actively changed during the games to increase the quality and capacity of the system, by adapting the configuration to the traffic demand. In total, 13,200 commands were executed by the optimization team in the competition venues with an average of 20 parameter change commands per event.

STREAMING AND SHARING THE GLORY

Fig.1: Data traffic volume across technologies in 2016 Summer Games

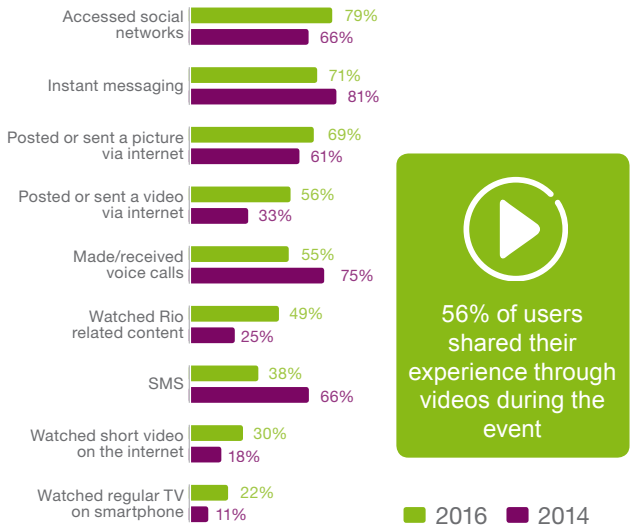


Source: RBS (Radio Base Station) data across competition venues.
Base: Network KPIs: 2G,3G and 4G traffic volume in terabytes measured during 52 days in Rio de Janeiro. In total, 1,200 sites (RBS).

During the 2016 Summer Games in Rio, an average of 80 photos were shared per day, per person at the event, which translates to 486 million photos sent and received during the games and approximately 19,000 hours of videos were streamed. Rio games saw a dramatic increase of 72 percent in network traffic compared to a normal day in Brazil, and the LTE data traffic volume increased from 34 percent to 45 percent of the total traffic (Fig 1).

Based on consumer research, there is a change in digital activities performed in Rio when compared to The 2014 Football Tournament. Data-intensive activities like video sharing (56 percent versus 33 percent) and posting pictures (69 percent versus 61 percent) were performed much more than other digital activities during the 2016 Summer Games and 2014 Football Tournament respectively (Fig.2). 37 percent of the consumers were also streaming live videos during the 2016 games. This indicates that people are not just interested in watching videos, but also creating their own content to share. This drives uplink traffic indicating the need for good network performance. In comparison to the 2014 Football Tournament, the network data traffic shows there is a significant change in the data consumption patterns due to the popularity of these data-intensive activities, translating to data consumption as high as 303 terabytes, carrying 1.1 million Erlangs.

Fig 2: Comparison of activities performed in 2016 Summer Games in Rio Vs Football Tournament 2014



Source: Ericsson ConsumerLab, Aiming Higher, 2016 Summer Games in Rio.
Base: Smartphone internet users, aged 15-60, watching the events in and around the stadium.

SOCIAL NETWORKING GETS POPULAR

The percentage of people sharing their 2016 Summer Games experiences through social networking has increased (79 percent) compared to the 2014 Football Tournament (66 percent) (Fig 2). During the games, on an average, 56 percent people performed 6 or more digital activities (Fig 3), with social networking being more popular than instant messaging compared to 2014 Football Tournament.

Locals (61 percent) performed six or more activities while a smaller percentage of foreigners (43 percent) performed the same number of activities (Fig 3). Even though they performed fewer activities, the study shows that foreigners were more interested in communicating about the games to friends and family back home through social media, with Facebook being the most used social network.

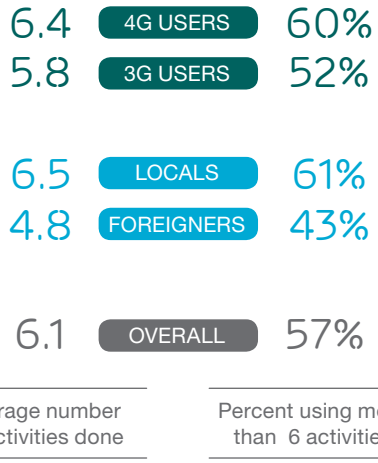
The change in the choice of digital activities could be attributed to the wider availability of 4G networks, coverage and terminal devices. From the network perspective, when comparing the metrics in the Maracanã stadium during both events, the usage of 4G network has doubled from 30 percent to 60 percent of the total traffic.

This becomes all the more evident with the difference in usage patterns among 3G and 4G subscribers.

- A higher percentage of 4G users (60 percent) performed six or more activities compared to the 3G users (52 percent) (Fig 3)
- A higher percent of 4G users were also sharing videos throughout the matches compared to 3G users
- 4G users are not only doing more number of activities, but they are also more satisfied with the network than 3G users

3 out of 4 spectators used social networks during the event

Fig 3: Average number of activities performed during 2016 Summer Games in Rio



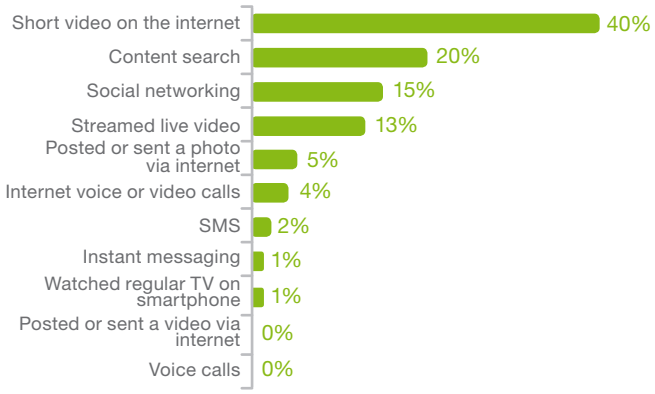
Source: Ericsson ConsumerLab Analytical Platform, 2016 Summer Games in Rio
Base: Smartphone internet users, aged 15-60, watching the events in and around the stadium.

FAST AND RELIABLE NETWORKS LEAD TO SATISFACTION

The findings from the consumer research show that 53 percent of the users in Rio were highly satisfied with the network compared to 31 percent during the 2014 Football Tournament. During the games this year, data reliability (36 percent) had the maximum impact on satisfaction followed by speed (34 percent) and coverage (30 percent) (Fig 4). In terms of activities, short videos and content search had the highest impact on overall satisfaction with the operator (Fig 5).

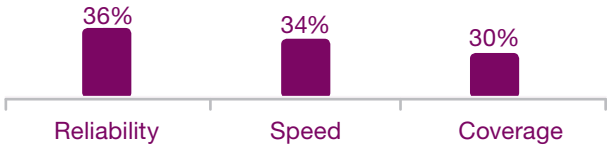
The consumer research also shows that 75 percent of foreigners obtained and used local SIMs. Foreigners expressed that it was easy and convenient in terms of cost to get a SIM, and a way to secure data coverage and speed. A higher percentage of foreigners with local SIMs (68 percent) are highly satisfied with the overall network performance at Rio than the locals (50 percent) (Fig 6). 68 percent foreigners perceive that in comparison to the services they get at home, network performance at the 2016 Summer Games in Rio is superior. Forty-five percent of the locals think that the network performance at Rio was better than their overall experience on a regular day.

Fig 5: Relative importance of digital activities on overall satisfaction with operator at 2016 Summer Games in Rio



Source: Ericsson ConsumerLab, Aiming Higher, 2016 Summer Games in Rio.
Base: Smartphone internet users, aged 15-60, watching the events in and around the stadium.

Fig 4: Relative importance of network parameters on overall satisfaction with operator at 2016 Summer Games in Rio



Source: Ericsson ConsumerLab, Aiming Higher, 2016 Summer Games in Rio.
Base: Smartphone internet users, aged 15-60, watching the events in and around the stadium.

Fig 6: Percentage of highly satisfied consumers (Top 2) at 2016 Summer Games in Rio

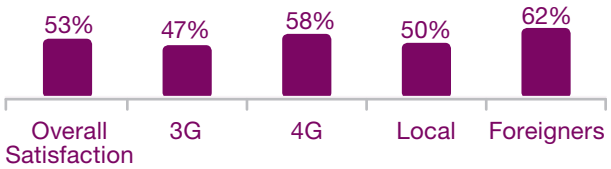
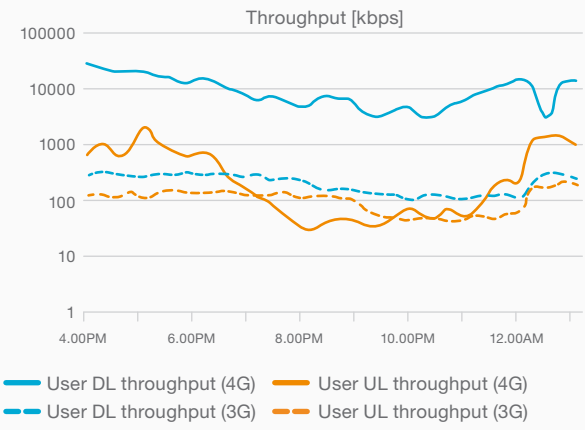


Fig 7: 3G and 4G Throughput values, Download VS Upload during Opening Ceremony of 2016 Summer Games in Rio



Source: RBS (Radio Base Station) data across competition venues
Base: Network KPIs: 3G and 4G Throughput (Uplink and Downlink).
Measured during 6 hours in Maracanã Stadium during Opening Ceremony.

Consumers with faster networks (4G users) are not only doing more number of activities, but they are also more satisfied with the network than 3G users (58 percent and 47 percent respectively) (Fig 6). This was supported by the figures from network KPIs which show that a 4G user transmits and receives at least 10 times higher speed during an event, compared to a 3G user. This in fact increases the user satisfaction during an event, because it takes less time to upload and download heavy files such as videos (Fig 7). The consumer research also shows that fifty-four percent of the 4G users were of the view that they use mobile data judiciously as it is expensive.

Around half of the audiences did not experience any network problems. Twenty percent of 3G users were concerned with a slow data connection compared to only 12 percent of 4G users. An equal percentage of locals and foreigners (15 percent) had issues with slow data connections.

NETWORKS BUILT FOR HIGH PERFORMANCE

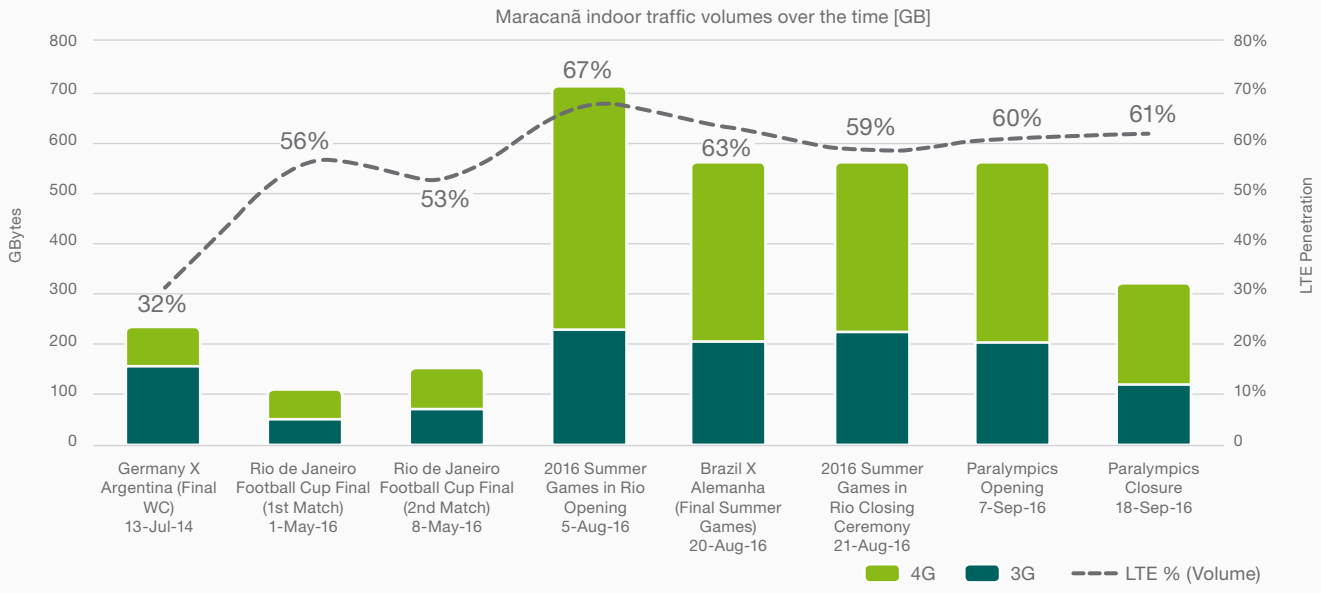
A city-wide approach to preparing the networks across all of the sporting venues, non-competition venues and other games-related sites was adopted so they can effortlessly handle 2G, 3G and 4G networks. This was done to offer a superior user experience to customers wherever they needed it. Ericsson designed the indoor and outdoor system of Olympic Park and many other areas in Rio de Janeiro in order to provide enough capacity for the expected demand (seven million spectators). Ericsson also enhanced network performance and event-related services prior to and during the event.

During the months prior to the first event, the network was prepared with special configurations that allowed higher demands and higher bit rates. Tests were performed in venues across Rio de Janeiro from May 2016 to ensure that the quality of service in all the venues and points of interest was as expected. Thanks to preparation with high-capacity configurations and activation of latest features, coupled with Pre-emptive Support and Active Traffic Management, network performance was maintained at an optimal level despite actual high traffic demands.

During both the 2016 Summer Games and Paralympic Games, accessibility and retainability values were kept above 98 percent in most of the events.
The average throughput values for 4G were between 10 and 50 Mbps during the events and for 3G between 1 and 5 Mbps. This can be attributed to the optimization before and during the events. The results were especially good considering the fact that the design premises took into account a Wi-Fi offload of 30 percent and in the end, it was only 5 percent.

The opening ceremony venue (Maracanã stadium) in particular recorded the highest data traffic in an indoor event in Brazil (700 Gigabytes) without compromising on network performance. The 4G and 3G networks in Maracanã had three times more traffic than the final match in the 2014 Football Tournament and five times more traffic compared to a normal football match in Maracanã (Fig 8).

Fig 8: Maracanã indoor traffic volume over the time at 2016 Summer Games in Rio



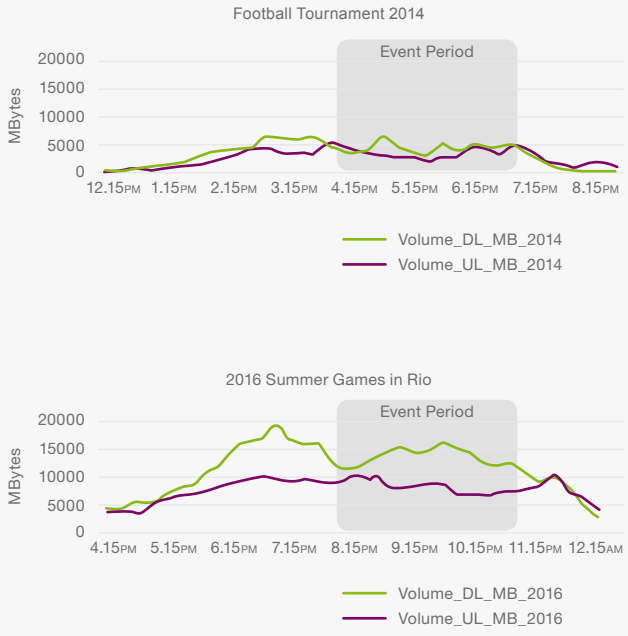
RBS (Radio Base Station) data across competition venues
Base: Network KPIs: 3G and 4G data traffic volume, and percentage of 4G data traffic measured during six hours period for different events in the last two years.
Sites (RBS) of Maracanã

DATA TRAFFIC ON THE HIGHER SIDE

There was a change in the 3G and 4G usage when comparing the demands on the network in the 2014 Football Tournament Final with the 2016 Opening Ceremony. During the games, the 4G traffic and the volume of data sent and received was much higher than it was two years ago (Fig 9).

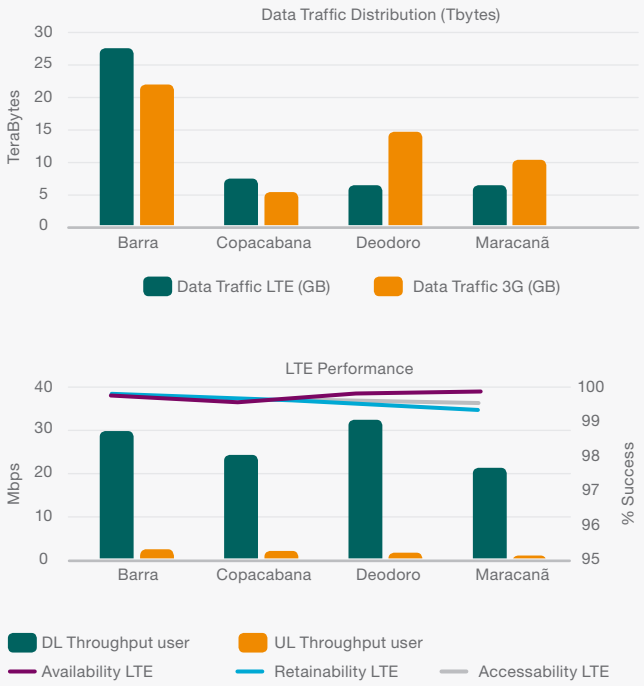
Satisfaction with operators in Maracana was on par with the overall satisfaction with operators at the 2016 Summer Games. Compared to other venues, a higher percentage of people at Maracana were of the opinion that the mobile network services were adequate.

Fig 9: Data traffic volume - 2016 Summer Games in Rio VS Football Tournament 2014



Source: RBS (Radio Base Station) data across competition venues
Base: Network KPIs: Uplink and downlink data traffic Volume (3G and 4G combined). 6 hours period, in sites (RBS) of Maracanã. Summer Games Opening Ceremony vs 2014 Football Tournament Final Game.

Fig.10: Data traffic distribution across competition venues associated with the four venue clusters at 2016 Summer Games in Rio



Source: RBS (Radio Base Station) data across competition venues
Base:-Network KPIs: 3G and 4G data traffic Volume, and accessibility, retainability, availability and throughput for 4G. Measured during 16 days in competition venues + PMC, OLV, IBC and MPC. In total, 710 sites (RBS).

When it comes to satisfaction with network performance, the Deodoro cluster emerged as the area where the most number of spectators were satisfied with the overall network experience. Although the penetration of LTE users was higher in other clusters, the 4G bit rate was, on an average, higher in Deodoro than in any of the other three clusters. This could be attributed to the fact that the network at Deodoro was not as heavily loaded as other venues such as Barra, in which the traffic was four times higher (Fig 10).

SHARING THE SPIRIT

From consumer research, we found that 62 percent of respondents said that they had a good experience during the whole period of the 2016 Summer Games in Rio. A higher percentage of foreigners (72 percent) reported having a good experience compared to the locals (59 percent). There is no doubt about the fact that audiences enjoyed a much better network experience during the 2016 Rio games than at the 2014 Football Tournament, which has had an impact on their overall perception of the event.

The concerted efforts made by the operators and Ericsson enabled a higher consumption of mobile data compared to London 2012 (4 times) and Football Tournament 2014 (10 times).

In comparison to the 2014 Football Tournament, there was a shift from instant messaging to social networking, from medium data activities to heavy data activities like sharing videos, with people wanting to convey the complete experience and the feel of the event via video to their friends and family.

The availability of high-speed networks also made it possible for people to perform a number of digital activities simultaneously.

Leading transformation through mobility
We are a world leader in the rapidly changing environment of communications technology – providing equipment, software and services to enable transformation through mobility.

Some 40 percent of global mobile traffic runs through networks we have supplied. More than 1 billion subscribers around the world rely every day on networks that we manage. With more than 37,000 granted patents, we have one of the industry's strongest intellectual property rights portfolios.

Our leadership in technology and services has been a driving force behind the expansion and improvement of connectivity worldwide. We believe that through mobility, our society can be transformed for the better. New innovations and forms of expression are finding a greater audience, industries and hierarchies are being revolutionized, and we are seeing a fundamental change in the way we communicate, socialize and make decisions together.

These exciting changes represent the realization of our vision: a Networked Society, where every person and every industry is empowered to reach their full potential.

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