Mobile Telecommunications Networks for the 2014 World Cup

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This paper was commissioned by the GSM Association (GSMA), the world trade association of mobile operators. It analyzes the main challenges for telecommunications companies, and in particular mobile operators, as they prepare for the 2014 World Soccer Cup and the 2016 Rio de Janeiro Olympic Games in Brazil. Decisions can then be made based on the elements presented in this paper, and investments channeled in the right direction.

Acknowledgements

Executive Summary

2014 FIFA World Cup Brazil

Hosting the 2014 World Cup represents a historical point for Brazil, opening up a wide range of challenges and opportunities. Large sporting events are a major undertaking, demanding initiative, investment and oversight from the government, various segments of the economy and from society itself. Hefty investments in infrastructure will be needed and companies will face a unique opportunity, not only because of the millions of people from all over the world who will flock to Brazil, but because of the high level of exposure the country will receive.

The scale and dimension of the infrastructure demanded by the Fédération Internationale de Football Association (FIFA) to host the 2014 World Cup games is a real challenge. The enormous influx of people coming to the host cities vastly increases the need for various basic services such as transportation, telecommunications, water distribution, sanitation, electric power distribution, financial services and health care. These systems are interdependent, and an incident in one area can have critical consequences on the others. The concept of critical infrastructure protection, used to identify the critical telecommunications services during the 2007 Pan-American Games in Rio de Janeiro, will be vital for the 2014 World Cup.

Besides the stadiums and surroundings, with their great crowds of people during the games, other World Cup-related festivities and tourist attractions will present mobile phone operators with both opportunities and challenges. Among the most popular of these are the Fan Fests, created by FIFA during the 2006 World Cup in Germany. Fan Fests were set up in 12 different places in Germany, with a total of 18 million people watching the game on giant screens.

Telecommunications Networks in Brazil

The privatization of telecommunications in Brazil took place on July 29, 1998, and today four companies control the mobile sector: Vivo, an association of Telefonica and Portugal Telecom; Claro, controlled by América Móvil; TIM, a subsidiary of Telecom Italia; and Oi, a Brazilian-owned telco. Mobile telephony reached 176.8 million subscribers in February 2010, of which 82.5% were pre-paid and 17.5% post-paid. Approximately 96.6% of the population is serviced by at least one operator, while 64.7% can choose between at least four alternatives. The growth of wireless penetration has largely been driven by the implementation of pre-paid services, providing the less affluent with access to telecommunications services.

In February 2010, over two years after the first third-generation (3G) commercial operations were launched, there were 8.1 million terminals in use, or 4.6% of the market. Anatel – the Brazilian telecommunications regulator – believes that in 2014 the number of mobile accesses lines in Brazil will be over 210 million, representing a mobile teledensity of over 100%, with more than 55 million being mobile broadband subscribers. These projections to 2014 suggest a steep growth, not only in the number of subscribers but also in the resulting spectrum needs and infrastructure investment requirements.

Mobile Technology In 2014

Mobile broadband forecasts indicate that in the coming years, the most widely used technologies in the world will be HSPA/HSPA+ and LTE. HSPA is the first step in the WCDMA evolution, claiming to offer data transmission rates ranging from 1.8 Mbps to 14.4 Mbps, to support bandwidth-hungry applications. LTE introduces new radio communications technology with even greater spectral efficiency, offering from two to four times more capacity than HSPA systems.

Several commercially tested digital TV technologies are currently available and will likely become mainstream technology worldwide by 2014. After a series of risk analysis studies and standard adaptations for country-specific characteristics, Brazil chose Integrated Services Digital Broadcasting – Terrestrial (ISDB-T) in 2006. Designed from the ground up for mobile and portable reception, ISDB-T transmits HDTV programming and mobile TV within in the same frequency channel, which is a plus compared to other digital TV standards that need additional spectrum for mobile transmissions.

Brazilians' passion for TV, along with the widespread adoption of cell phone technology, is a factor that boosts the country's great potential for mobile TV. In fact, research shows that the mobile handset and the TV set are the two most important items in the average Brazilian's everyday routine (while computers with Internet access rank only in third place).

SERVICES IN 2014

From the point of view of user acceptance of services, and consequently generated revenue, the vast majority of mobile users in the world, and in Brazil too, use their mobile phones mainly for voice communications. Next come SMS (or Short Messaging Service) messages, and finally data services.

A gradual increase in data service access is expected through 2014. Besides traditional voice and SMS traffic, there will be an increase in SMS traffic associated with applications and special sales during the event. Mobile Advertising probably will add moderate traffic over SMS and MMS (or Multimedia Messaging Service), according to advertising business models. Other data services likely to expand by 2014 with 3G technology are Mobile TV and, most importantly, Mobile Social Networking.

We expect the expansion of Mobile TV in Brazil to concentrate on the free-to-air broadcasting as a result of the adoption of the ISDB-T standard. Despite the adoption of ISDB-T almost four years ago and the launch of the first fixed transmissions in the last two years, the players have only now started implementing the middleware platforms necessary to permit interactivity, consequently bringing mobile operators into the value chain as a return channel provider. Mobile TV and Mobile Services during 2014 World Cup are likely to share the same device but stay in different ecosystems (TV and telecom).

We believe that Mobile Social Networking, not just fixed Internet access to Social Networks, will be the most important mobile data service by 2014. This is a mobile data service definition more specific to the mobile ecosystem, looking at the importance of the context on the services offered.

One reason to believe in the success of Mobile Social Networking is that, unlike the uptake of SMS, Brazilian Internet users adopted social networks to a deeper degree than many other countries. Brazilian data point to the fact that users spend far more time on social networks than any other Internet application. This behavior may have huge impact on network traffic by 2014, which will demand more frequency bandwidth, network infrastructure optimization and contingency planning to guarantee the availability and quality of service.

Last but not least, because this is a worldwide sporting event and performed in a number of cities that will receive many foreign visitors, roaming is a service that must be considered carefully.

DEMAND FORECAST AND TRAFFIC ESTIMATES

By all indications, the Brazilian cell phone system will be based on HSPA and LTE technology in 2014.

It is possible to run simulations to determine the approximate rate these technologies would deliver under real working conditions. In the case of a 3G cellular phone system operating in

a 2 X 5 MHz channel in an urban area under different traffic conditions, it was found that the maximum cell throughput is approximately 9 Mbps for LTE and approximately 8 Mbps for HSPA. If it would be possible to allocate 2 X 20 MHz of bandwidth (to do this, current spectrum assignment practices would have to change), maximum cell throughput would reach 36 Mbps for LTE and 32 Mbps for HSPA.

During the 2014 World Cup, the most critical situation will very likely be covering the stadiums and surroundings, where there will be a very high concentration of subscribers, most of whom will be heavy service users. With some reasonable estimates for user density in the vicinity of the stadiums, the demand is expected to reach17 Mbps per cell area.

Even considering that changing system parameters might possibly improve network performance, it is very unlikely that HSPA or LTE cells, with a 2 X 5 MHz bandwidth, will be able to meet this demand. However, a cell with a 2 X 20 MHz bandwidth would be able to handle this amount of traffic without a problem.

An alternative way of increasing data transmission rates in areas of great user concentration, such as stadium surroundings, would be to increase the number of cells. This would, however, increase interference among the cells due to their proximity, causing system degradation and diminishing sector throughput.

FREQUENCY SPECTRUM

The implementation of a cellular communications system involves a series of stages, from planning to completion. Significant time must be dedicated to the planning stage. All definitions that are necessary for implementation, such as the available frequency spectrum, must be made well in advance.

Today, the total spectrum utilized by PMS (Personal Mobile Services) in Brazil is approximately 300 MHz. A study carried out by ITU (International Telecommunication Union) estimates that in 2015, mobile telecommunications services will need over 1.0 GHz of spectrum to meet market demands. The frequency bands for mobile communications in Brazil are distributed in the following manner: 850 MHz; 900 MHz; 1700 MHz and 1800 MHz; and 1900 MHz and 2100 MHz (reserved primarily for 3G).

To be able to offer higher traffic rates, larger spectrum bands would have to be allocated. Following an ITU recommendation, in 2009 Anatel launched a public consulting project in order to assign 140 MHz in additional spectrum to PMS in the 2.5 GHz band (2500 MHz - 2690 MHz). Dedicated to mobile data, this additional bandwidth will be crucial for mobile data transmission at both the 2014 World Cup and the 2016 Olympic Games.

It's important for Brazil to follow continue analyzing the situation in order to define the proper spectrum utilization to meet the increased demand for mobile communications traffic during the 2014 World Cup. Service providers and other entities that represent mobile technology suppliers can help Anatel evaluate the most viable options to comply with the mobile broadband frequency needs.

RISK MANAGEMENT, CRITICAL INFRASTRUCTURE PROTECTION AND INFORMATION SECURITY

Large sporting events like the 2014 World Cup demand painstaking procedures, involving government, private initiative, and members of society in general, since they are the main stakeholders. It is not sufficient to simply estimate the volume of traffic and demand; instead, networks must be carefully planned out, taking into consideration all the risks involved, especially those posed by new emerging threats that might affect the quality and availability of existing mobile services.

The 2014 World Cup will take place in a convergent world with total mobility, and Brazil must be prepared to face a whole new set of threats. Events of great magnitude are always opportunities for new services, but also for new

scams. The problem of cell phone cloning has been resolved; however, now hackers are using cell phones to steal identities, and this is becoming an increasingly critical problem.

The increased importance of information risk management is clear all along the entire telecommunications value chain. Not only must the reliability and integrity of communications be preserved, but service availability as well. In times of new emerging threats, high-quality telecommunications services are not just a question of properly working equipment or operational efficiency. To achieve this, a risk management system that can identify, assess and deal with existing risks is one of the most vital factors.

A proper risk management system cannot be limited to accidents or natural disasters, since these are already efficiently handled by the operators. It must also include intentional threats, which are proliferating rapidly thanks to the new possibilities and opportunities (both legal and illegal) made possible by new technology and services. Opportunities must also be delineated according to this risk assessment. A major sporting event like the 2014 World Cup opens up a host of new threats to be identified and analyzed, so operators can provide spectators, tourists, athletes, committees, journalists and the Brazilian population as a whole with hig-quality and uninterrupted telecommunications services.

Critical Infrastructure Protection is a concept that relates to the preparedness and response to serious incidents that involve the critical infrastructure of a nation or region. It consists of a security strategy to prevent basic services such as energy, transportation, water, health care and even mobile telecommunications from being disrupted. Critical infrastructure systems can be damaged, destroyed or disrupted by deliberate acts of terrorism, natural catastrophes, negligence, accidents, acts of piracy, among other threats.

One of the most important things needed to organize a major sporting event, or for the development of the country in general, is to have a solid knowledge of the priorities of essential services such as telecommunications, founded on the social and economic needs of all the stakeholders. This knowledge is fundamental for developing effective Critical Infrastructure Protection. With a proper view of risks and opportunities, investments can be prioritized and the right strategy implemented to guarantee the continuity of vital services.

This concept is not only critical not only for a nation's development, but also for major sporting events like the 2014 Brazil World Cup and the 2016 Olympics in Rio de Janeiro. The first major experience with Critical Infrastructure Protection in Brazil was during the Pan- and Parapan-American Games in 2007, hosted by the city of Rio de Janeiro. MI²C, provided by the PICT (Telecommunication Infrastructure Protection) Project, was used to assess the critical telecommunication infrastructure.

In preparation for the Olympic Games and Para-Pan American Games, the International Olympic Committee (IOC) provided a "book of practices" for information security. Similarly, for the 2014 World Cup and for the 2016 Olympic Games, as disclosed in the application file, Brazil should implement a CTIP project (Critical Telecommunications Infrastructure Protection Project). In addition, FIFA should also provide a "book of best practices" for the event.

RECOMMENDATIONS

Major sporting events, such as the World Cup and the Olympics, are tremendous opportunities to spark economic growth, since both the government and the private sector invest heavily in preparation for them, leaving a legacy of development for the host country.

When it comes to telecommunications, we see a great opportunity to increase both capacity and data speeds in Brazil's mobile

networks. Guaranteeing the security and reliability of mobile networks for these large events is also crucial. The following recommendations are designed to benefit the entire mobile services value chain:

- **Planning jointly between the government and the private sector:** To ensure the security and reliability of mobile networks in particular and telecommunications networks more broadly, mobile operators, together with the association of cities representing the 12 host cities and the major event sponsors, must agree on the possible locations for the eventual Fan Fests. Planning for the traffic and capacity of the networks must be aligned with the expectations of security and transportation agents.

- **Structuring partnerships with organizers of similar events:** The experience from other major sporting events is essential for the Brazilian players to acquire the needed expertise to plan and execute these events to ensure their complete success. It is vital to seek partnerships with bodies such as the organizing committees of similar upcoming events, such as the South Africa 2010 World Cup and the London 2012 Olympic Games, or of previous events such as the German 2006 World Cup, the China 2008 Olympics and the Canadian 2010 Winter Games. Telecommunications service providers that covered these events or are planning future ones can provide valuable contributions to the 2014 World Cup in Brazil as well as the 2016 Rio de Janeiro Olympics. These partnerships can provide benchmarks and other parameters such as case studies and forecasts for planning and execution purposes.

- **Acquiring hands-on experience from similar upcoming events in Brazil:** The Military World Games 2011 and FIFA Confederations Cup 2013, both large sporting events in Brazil, represent challenges to the telecommunications players. Gaining from this hands-on experience can contribute significantly to the planning and execution of the 2014 World Cup and the 2016 Olympic Games.

- **Planning for innovative new services:** Mobile carriers, broadcasters and soccer team associations can use the next state and national championships – between 2011 and 2013 – to try out new services and applications based on broadband access and mobile TV. Real network traffic requirements can thus be forecasted and important aspects regarding usability, appeal, security and end-user quality of experience can be defined.

- **Planning capacity and traffic demand:** Detailed planning must be carried out beforehand regarding what services will be offered during the World Cup and their respective impact on traffic demand and processing capacity, considering the user profile, the estimated demand for roaming, and concentrated areas of high usage such as the stadium surroundings and Fan Fests. The Fan Fests that will take place during the 2010 World Cup (South Africa) will be an excellent opportunity for Brazil to evaluate the infrastructure needed to provide users with the best possible service. Event planning must also include suppliers' delivery and execution capacity. Another critical area will be media centers at the stadiums and cities, where traffic demand from Brazilian and foreign media professionals will be huge.

- **Allocating the frequency spectrum:** There is strong evidence that the frequency spectrum currently allocated in Brazil for mobile services will not be able to adequately cover the areas of great user concentration in the next few years. Anatel is taking actions in compliance with ITU recommendations to align Brazil's mobile service frequency spectrum with that of other countries around the world. An example is the 2.5 GHz band. For the 2014 World Cup and the 2016

Olympics, the importance of an adequate new band for mobile communications is underscored by the great concentrations of users with a high demand for mobile services. It is therefore highly recommended to continue seeking and evaluating different alternatives to increase the frequency spectrum for mobile services, such as the allocation of 140 MHz spectrum band for FDD in the 2.5 GHz in a timely fashion.

- **Adopting a model of critical infrastructure protection:** Using a critical infrastructure protection model will allow joint planning between the government, telecommunications service providers and the 2014 World Cup organizing committee to ensure that mobile services will work flawlessly during the event. This model must encompass at the very least the following activities: identification and analysis of the main assets; identification and analysis of the main threats and vulnerabilities of the environment, in the context of the 2014 World Cup and the 2016 Olympics; analysis of the interdependency of the different sectors; risk analysis; and finally, the creation of an ideal scenario for critical infrastructure protection.

- **Defining contingency and business continuity strategies, based on delineated threats:** Once the critical infrastructure model has been defined, it is highly advisable to delineate contingency and business continuity strategies to improve the ability to react quickly and resolve problems. It is therefore crucial that, before risks are analyzed, this plan be defined, implemented and, most important of all, tested. Furthermore, all input from the organizing committee and information from FIFA itself, such as game databases, credentials and any other pertinent data, must be taken into consideration.

- **Conducting in-depth analysis among all market players:** Each player should be developing an in-depth analysis to define the best solution for mobile users. This analysis might reveal that more frequency bands will be needed if the other factors involved (e.g., data compression or transmission technology) do not evolve sufficiently to meet increased traffic demand. A common strategy among all players, however, is essential to secure the necessary measures from federal, state and local governments.

1   ABOUT CPqD

1.1   IDENTITY

CPqD is an independent institution focused on innovation through Information and Communication Technologies (ICT), aiming at contributing to competitiveness and the digital inclusion of the society. It develops the most extensive research and development program in ICT in Latin America, fully dedicated to the development of ICT solutions for telecommunication, banking, finance, energy, and other industries, to both corporate and government sectors.

1.2   HISTORY

CPqD was established in 1976 by Telebrás, the holding company which controlled the public telecom services in Brazil, as a center for research and development in telecommunications. Since its inception, the company has been on the technological forefront, anticipating the needs of a fast paced and ever-changing society. In 1998, as a result of the privatization process of Telebrás, CPqD became a private-law corporation, broadening its scope of competencies to embrace new markets.

CPqD is located in the city of Campinas, state of São Paulo, in an area of approximately 3,873,600 square feet. Its offices and laboratories occupy an area of over 861,092 square feet.

1.3 STRATEGIC POSITIONING

Employing over 1200 highly skilled professionals dedicated to achieving high levels of quality, CPqD is a globally integrated and dynamic organization, strategically positioned to add value to its customers through technological innovation and intelligence, widely recognized as a leading developer of ICT and important partner of the Government Administration. CPqD strengthens its position by providing a unique combination of skills and expertise.

The knowledge generated by CPqD reaches the market in the form of product technologies, software systems, technological services, consulting services, and intellectual capital supporting technology-based emerging companies. All this creates new job opportunities, increases the competitiveness of customers and partners, promotes digital inclusion in society and produces wealth for the country.

The product technologies developed by CPqD are transferred to several companies, which are then responsible for their production and commercialization.

The Operations and Business Support Systems (OSS/BSS) are CPqD's flagship software solutions, which have been successfully deployed in several organizations from different industries in Brazil and abroad. Considered as mission-critical systems, these solutions contribute to the reduction of losses, improvement of results, fraud prevention, improvement of customers' satisfaction and risk mitigation, resulting in higher efficiency and competitiveness for such organizations.

CPqD holds a wide range of telecom and IT solutions such as the information systems for Operation Support on Inside and Outside Plant Management, Workforce Management, Asset Management, as well as Business Support on Billing and Customer Care; Information Systems for Network Management, Speech Processing, Broadband Access Management, Digital TV, Business Intelligence, Wireline and Mobile Telecommunication Networks, among several other systems. CPqD's market share is integrated by customers from Government Agencies, the Electric Power sector, Financial Institutions and large Corporations. CPqD has provided outstanding contributions in the fields of Social Intelligence and E-Government, which direct positive effects in the welfare of citizens, minorities, small-scale companies, and the public administration.

CPqD laboratories offer more than 700 accredited tests and technological services in different fields. Some examples are optical fiber cables and accessories, switching and terminals, radio systems, electromagnetic compatibility, mechanic characterization, electrical safety, SAR, batteries and colorimetry.

The solutions developed by CPqD are present in Brazil and in several Latin American countries, in the USA, Angola, Samoa and Europe, where CPqD has established strategic business alliances with local companies.

1.4 CPQD CERTIFICATIONS

- ISO 9001:2000 Quality Management (http://www.iso.org)
- ISO 14001:1996 – Environmental Management (http://www.iso.org)
- CMMI Level 3 Software Engineering Institute (http://www.sei.cmu.edu)
- PMI Project Management Institute (http://www.pmi.org)
- Agência Nacional de Telecomunicações – Anatel (http://www.anatel.gov.br)

Anatel has designated CPqD as a Certifying Institute in the Brazilian Communication market, i.e., CPqD is allowed to evaluate and issue certifications within the Brazilian market.