IoT and Smart Cities: Opportunities for Brazil

October 29th, 2014

Marcelo Fernandes
BNDES
BNDES – The Brazilian Development Bank

- Founded on June 20th, 1952.
- 100% state-owned company under private law.
- Key instrument for implementation of Federal Government’s industrial, technology and infrastructure policies.
- Main provider of long-term financing in Brazil.
- Support to Exports and Internationalization of Brazilian companies.

Converted to US dollar on the disbursement dates

Average growth of 18.4% in disbursements (in R$) during the 2003-2013 period.
## Instruments

- **Direct Operations**
- **Indirect Operations**
- **MSME (financing and guarantee)**
- **Exports (Pre and Post shipment)**
- **Project finance**
- **Grants**
- **Investment bank**

<table>
<thead>
<tr>
<th></th>
<th>BNDES</th>
<th>KFW</th>
<th>CDB</th>
<th>JFC</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Assets</strong></td>
<td>367.8</td>
<td>657.3</td>
<td>1,191.6</td>
<td>318.4</td>
</tr>
<tr>
<td><strong>Outstanding Loans</strong></td>
<td>254.0</td>
<td>526.4</td>
<td>1,016.9</td>
<td>272.4</td>
</tr>
<tr>
<td><strong>Net Profit</strong></td>
<td>3.0</td>
<td>3.1</td>
<td>9.9</td>
<td>-3.6</td>
</tr>
<tr>
<td><strong>ROA (%)</strong></td>
<td>0.90</td>
<td>0.47</td>
<td>0.92</td>
<td>-1.13</td>
</tr>
<tr>
<td><strong>NPL (%)</strong></td>
<td>0.06</td>
<td>0.21</td>
<td>0.30</td>
<td>2.98</td>
</tr>
</tbody>
</table>

Source: Banks' balance sheets.

### Equity Portfolio

- **Estimated market value (US $ b.)**: 45.4
- **Nº firms with direct support**: 203
- **Nº Investment Funds**: 44

Source: BNDES
BNDES relative performance and funding

Funding

- By Constitution, 40% of proceeds from Workers’ Assistance Fund (FAT), a public fund financed by a levy on wage bills to provide unemployment benefits and retraining. No amortization schedule exists.
- Since 2008, very long term loans from Treasury adding up to US$ 200 billion

<table>
<thead>
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<th>2012 (US$ billion)</th>
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<td>ROE (%)</td>
<td>12.5</td>
<td>11.5</td>
<td>13.4</td>
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<tr>
<td>NPL (%)</td>
<td>0.06</td>
<td>0.21</td>
<td>0.30</td>
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Source: Banks' balance sheets.

Sources of funding for annual budget

- Market 11.5%
- FAT 2.8%
- Treasury 8.3%
- Return on operations 77.4%

- Largely, funding and financing is referenced to the “TJLP”, Long-Term Interest Rate which is lower than the market based short term rate

Source: BNDES
BNDES Disbursements

Lending Commitments & Disbursements
(US$ billion)

Source: BNDES
*12 months, until June/2014
A strong demand for financing infrastructure

Lending Commitments & Disbursements for Infrastructure (US$ billion)

Source: BNDES

* 12 months, until June/2014
Scale and scope matters

Number of segments supported X number of instruments and asset size: Select International Development Finance Club (IDFC) members (2012)

Bubble size represents the asset amount of each institution

Each and every priority requires specific expertise, financing instruments and compatible funding.

Source: Annual reports.
Directives

- Patiently face and deal with uncertainty
- Support policy development and long term planning
- Finance expansion of capacity, capabilities and learning; fill gaps; fix failures; induce externalities.
- Foster a long term financing industry
- Contribute to systemic stability (anti-cyclical role)
- Appropriate and distribute (to society, via the State) returns of (financial) investment decisions
Brazilian Economy
Population by income class strata (% of people)*

* Source: IPEA, based on PNAD/IBGE data. Forecast by Data Popular
Brazil will be the fifth largest market by 2020

Global Consumer Market

in US$ trillion

Source: based on McKinsey, prepared by Ministry of Finance
Economic inclusion: a revolution! ... but high demand for capabilities

**2003 – 2012**
- Middle class: from 67 to 120 million
- Per household $: + 51%
- Income of poorest 10%: + 106%

**2007 – 2012**
- Public sewage: 26 to 33 million households (57% total)
- Computer w/internet: 9 to 22 million households (40% total)

% Workers with at least completed high schooling (2008)

R&D/GDP (2011) - %

Source: IBGE/PNAD

Source: ILO

Source: Brazil - MCTI
Increasing investments by the public sector

**Public Sector Investment (as % of GDP)**

- **2003**: Central Government (0.2), States & Municipalities (0.3), State Owned Enterprise (1.2)
- **2004**: Central Government (0.1), States & Municipalities (0.2), State Owned Enterprise (1.2)
- **2005**: Central Government (0.4), States & Municipalities (0.3), State Owned Enterprise (1.4)
- **2006**: Central Government (0.4), States & Municipalities (0.4), State Owned Enterprise (1.4)
- **2007**: Central Government (0.5), States & Municipalities (0.4), State Owned Enterprise (1.4)
- **2008**: Central Government (0.6), States & Municipalities (0.4), State Owned Enterprise (1.9)
- **2009**: Central Government (0.4), States & Municipalities (0.3), State Owned Enterprise (1.8)
- **2010**: Central Government (0.6), States & Municipalities (0.3), State Owned Enterprise (1.9)
- **2011**: Central Government (0.6), States & Municipalities (0.3), State Owned Enterprise (1.7)
- **2012**: Central Government (0.7), States & Municipalities (0.4), State Owned Enterprise (1.9)

Source: IPEA.
Sound macroeconomic fundamentals: Strength of the external sector

International Reserves (US$ billion)

- IMF Loans
- International Reserves

*Position on 07/18/2014

Source: Brazilian Central Bank
On going expansion of road system

2007-2010 (1.5 thous. kms)

2011-2014 (3.3 thous. Kms)

2011-2014 Duplication existing roads

2012-2014 New concessions and duplications (7.1 thous. kms)
FDI at its highest levels

Foreign Direct Investment - FDI (US$ billion)

<table>
<thead>
<tr>
<th>Country</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>198</td>
<td>227</td>
<td>168</td>
</tr>
<tr>
<td>China</td>
<td>115</td>
<td>124</td>
<td>121</td>
</tr>
<tr>
<td>Belgium</td>
<td>86</td>
<td>103</td>
<td>Hong Kong</td>
</tr>
<tr>
<td>Hong Kong</td>
<td>83</td>
<td>96</td>
<td>Brazil</td>
</tr>
<tr>
<td>Germany</td>
<td>57</td>
<td>67</td>
<td>UK</td>
</tr>
<tr>
<td>Singapore</td>
<td>54</td>
<td>65</td>
<td>Australia</td>
</tr>
<tr>
<td>UK</td>
<td>51</td>
<td>56</td>
<td>Singapore</td>
</tr>
<tr>
<td>Brazil</td>
<td>49</td>
<td>67</td>
<td>Russia</td>
</tr>
<tr>
<td>Russia</td>
<td>43</td>
<td>55</td>
<td>UK</td>
</tr>
<tr>
<td>Ireland</td>
<td>43</td>
<td>51</td>
<td>Canada</td>
</tr>
<tr>
<td>Spain</td>
<td>40</td>
<td>49</td>
<td>Chile</td>
</tr>
<tr>
<td>Australia</td>
<td>35</td>
<td>41</td>
<td>Ireland</td>
</tr>
<tr>
<td>Luxembourg</td>
<td>35</td>
<td>39</td>
<td>Luxembourg</td>
</tr>
<tr>
<td>France</td>
<td>34</td>
<td>36</td>
<td>Spain</td>
</tr>
<tr>
<td>Switzerland</td>
<td>33</td>
<td>34</td>
<td>India</td>
</tr>
</tbody>
</table>

Source: UNCTAD
Expected business growth

Countries where companies expect to expand their business
(% of total answers)

Survey* (with more than 1,300 CEOs) shows Brazil as the third most mentioned country for expanding business over the next 12 months

Increasing demand for infrastructure

Sources: National Agency for Civil Aviation (ANAC), National Agency for Aquatic Transportation (ANTAQ), Brazilian Association of Highway Concessionaires (ABCR) and Brazilian Association of Automotive Vehicle Manufacturers (ANFAVEA).
IoT World: Perspectives
Drivers do IoT

Computing Growth Drivers Over Time, 1960-2020E

1st Era
Select work tasks

2nd Era
Broad-based computing for specific tasks

3rd Era
Computing as part of our lives

Desktop Internet
1B+ Units

Mobile Internet
10B+ Units

The Internet of Things
100B+ Units

Source: Adapted from Morgan Stanley, Nov 2009

Fonte: Ceitec, Morgan Stanley
Market perspective

9 Billion *IoT devices* - 2018

25 Billions *devices* connected - 2020

3.7 Tri USD - 2016

50 Billions *smart objects* 2020
The Internet of Things Is Already Here

<table>
<thead>
<tr>
<th>World Population</th>
<th>6.3 Billion</th>
<th>6.8 Billion</th>
<th>7.2 Billion</th>
<th>7.6 Billion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Connected Devices</td>
<td>500 Million</td>
<td>12.5 Billion</td>
<td>25 Billion</td>
<td>50 Billion</td>
</tr>
</tbody>
</table>

Source: Cisco IBSG, 2011

Fonte: Cisco
There are several continuing challenges for the Internet of Things

**Technology challenges**

- Cost and capability of sensors and actuators
- Reliability for critical networks
- Technical standards for open networks
- Software for massive data analytics in real-time
- Visualization technology

**Policy and organizational challenges**

- Data privacy
- Data security
- Legal liability
- Organizational implications (e.g., role of IT function)

Fonte: McKinsey & Company
IoT Brazil: Perspectives
Brazilian Market

1.34 mobile phones per capita
# 5 market for mobile phones in 2013

9.2 million of M2M terminals in Jul/2014
+ 45.4% in less than 2 years (37.6% average growth in the world)
Among the top 10 countries in M2M connections

156 million broadband accesses in May/2014
+ 51% in 1 year

Telecommunications sector generated R$ 227.9 billion gross revenue in 2013
R$ 29.3 billion were invested

Sources: Brazilian Ministry of Communications, Teleco and GSMA
Estimates for Brazil

IoT value for Brazil: USD 330 Bi in 2020 (Totvs/Cisco)

3.5% of global total (McKinsey)

2 billion M2M connections in 2020 (Ericsson)

#9 of the 12 countries that could benefit the most with IoT in the Public Sector - up to USD 70.3 Bi in the next decade (Cisco)
BNDES States and Cities
Brazilian Geography and Demographics

5 Macro-regions

27 Sub-national states

Demographic Concentration

Cities Linkages

Biomes

Water basin
Public Sector: what we do

Water Supply and Sewage System
Public Management
Urban Development and Mobility
Education, Health and Public Safety

Disbursements 2014: US$ 6 bi *
October
Federative Division of the National Taxes and Expenditures

Source: National Treasury; Afonso and Castro (2014)
## Municipalities by Group of Inhabitants, 2013

<table>
<thead>
<tr>
<th>Group of inhabitants (per 1,000)</th>
<th>Number of municipalities</th>
<th>Population (per 1,000)</th>
<th>Distribution of municipalities (% of total)</th>
<th>Distribution of population (% of total)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 5</td>
<td>1.247</td>
<td>4.229</td>
<td>22.4</td>
<td>2.1</td>
</tr>
<tr>
<td>5-10</td>
<td>1.227</td>
<td>8.738</td>
<td>22.0</td>
<td>4.3</td>
</tr>
<tr>
<td>10-20</td>
<td>1.378</td>
<td>19.725</td>
<td>24.7</td>
<td>9.8</td>
</tr>
<tr>
<td>20-50</td>
<td>1.080</td>
<td>32.865</td>
<td>19.4</td>
<td>16.3</td>
</tr>
<tr>
<td>50-100</td>
<td>339</td>
<td>23.512</td>
<td>6.1</td>
<td>11.7</td>
</tr>
<tr>
<td>100-500</td>
<td>260</td>
<td>52.763</td>
<td>4.7</td>
<td>26.2</td>
</tr>
<tr>
<td>+500</td>
<td>39</td>
<td>59.202</td>
<td>0.7</td>
<td>29.4</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>5.570</strong></td>
<td><strong>201.033</strong></td>
<td><strong>100.0</strong></td>
<td><strong>100.0</strong></td>
</tr>
</tbody>
</table>
Disbursements

2008 – 2013

US$ 23 billion
Disbursements 2013

- Urban Transport: 34%
- Roads: 21%
- Arenas: 12%
- Propac: 9%
- Health, Education, Public Safety: 10%
- Water Supply: 7%
- Equity Public Companies: 4%
- Urban Infrastructure: 2%
- Public Management: 1%
- Urban Public Management: 2%
Urban Mobility
Supported Projects 2013

- **Line 4 Subway RJ**: 16 Km, 7 stations. US$ 4.3 bi.

- **Monorail (Line 15) Subway SP**: 24.5 Km, 17 stations, 54 trains. Loan US$ 0.7 bl.

- **Supervia Rio de Janeiro**: New trains, electric systems, stations renewals, transportation capacity from 560 th to 1.4 mi per day. Loan US$ 0.6 bi.

- **Espirito Santo**: Bus Rapid Transit implementation will benefit 1.8 million people. Loan US$ 0.45 Bi
Some Examples – Smart Cities

**Rio de Janeiro**
- Operations Center: real time information, chrisis management
- Mayor is currently Chair of the C40 Cities Climate Leadership Group
- Digital Inclusion and Creative Economy
- Urban Projects
- **Winner of the World Smart Cities Awards in 2013**

**Curitiba**
- Curitiba’s ICT Institute: integrated and georeferenciated services, situation room, public management solutions
- Mobility and Urban Control: M2M in public transportation, monitoring system, eco electric project
- Smart Curitiba
- **#3 World’s Smartest Cities (Forbes, 2009)**

**Porto Alegre**
- Integrated Command Center
- Integrated Asset Management System
- Digital POA Project
- **Winner of IBM’s Smarter Cities Challenge 2013**

Other projects: Águas de São Pedro, Aparecida, Vitória, Parintins, Fortaleza, Fernando de Noronha, Sete Lagoas, Búzios, Cidade de Fazenda Rio Grande (most of them: smart grid)

+ PILOT: University of São Paulo
5

Legal Framework
IoT Related Government Programs

Digital Cities Project

ICT Policy

- Ministry of Science, Technology & Innovation
- Ministry of Development, Industry and Foreign Trade
- Ministry of Communications

PNBL

PADIS

Financial Instruments: BNDES + FINEP
Digital Cities Project

- 2,400 free internet access points
- Fibre optic network connecting local public bodies
- Municipal personnel’s training
- Provision of apps to support the cities administrators in financing, taxes, health and education

ICT Policy

- Ministry of Science, Technology & Innovation
- Ministry of Development, Industry and Foreign Trade
- Ministry of Communications

ICT Act

Financial Instruments: BNDES + FINEP
IoT Related Government Programs

Digital Cities Project

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ICT Act

PADI S

Financial Instruments: BNDES + FINEP
Financial Instruments: BNDES + FINEP

**Digital Cities Project**

- Promote access to broadband with cheaper prices and terminals
- Expand telecommunications services to rural and remote areas
- Encourage investments in telecommunication infrastructure
- Tax and regulatory framework to reduce prices and tariffs
- Improve Quality of Service (QoS) for voice and data

**ICT Policy**

- Ministry of Science, Technology & Innovation
- Ministry of Development, Industry and Foreign Trade
- Ministry of Communications

**ICT Act**
IoT Related Government Programs

Digital Cities Project

ICT Policy
- Ministry of Science, Technology & Innovation
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- Ministry of Communications

PNBL

PADIS

Financial Instruments: BNDES + FINEP
IoT Related Government Programs

Digital Cities Project

- Financial Instruments: BNDES + FINEP
- Microelectronics and Displays Special Programme
- Taxes exemption
- R&D Policy

ICT Policy
- Ministry of Science, Technology & Innovation
- Ministry of Development, Industry and Foreign Trade
- Ministry of Communications

ICT Act

PNBL
IoT Related Government Programs

Digital Cities Project

ICT Policy
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PNBL

PADIS

Financial Instruments: BNDES + FINEP
IoT Related Government Programs

Digital Cities Project

ICT Policy

ICT Act

- Encourage ICT companies that produce in Brazil to invest in R&D
- Tax Reduction Program

PADIS

Financial Instruments: BNDES + FINEP
INOVA (2011): a leap forward in Brazil’s Technology Policies

- **R&D financing** (launched in 2011): to strengthen innovation strategies, induce new investments and attract new players

- **Partnerships**: Ministries and regulatory authorities, FINEP/BNDES, R&D institutions and private companies

- **Government expenditure**: R$ 28.5 Bi (≈ USD 12 Bi)

- **Sectors**:
  - Energy (including Smart Grid)
  - Telecommunications
    - Optical communications
    - Digital wireless communications
    - Data networks
    - Tele-health
  - Oil&Gas
  - Health
  - Agriculture
  - Aerospace/Defense
  - Sustainability

*ALL of them include microelectronics and/or embedded electronics*
Government Industrial and Technological Policies
- Ministry of Communications
- Min. of Science, Technology, and Innovation
- Min. of Development, Industry and Foreign Trade

Private Sector
- Investments (CAPEX, R&D)
- Cooperation (amongst companies and/or with R&D Institutes)

Financial Support
- BNDES
- FINEP
- Other Development Bank (States)

R&D
- R&D Institutes
- Universities
- “Ciência sem Fronteiras”
Summing Up ......

Government Industrial and Technological Policies

- Ministry of Communications
- Min. of Science, Technology & Innovation
- Min. of Development, Industry and Foreign Trade

Financial Support

- BNDES
- FINEP
- Other Development Bank (States)

Private Sector

- Investments (CAPEX, R&D)
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R&D

- R&D Institutes
- Universities
- Innovation Law
- “Ciência sem Fronteiras”

Articulation and Cooperation are the key words!!!!
Challenges for Brazil

Industry and Technology Development

Be part of the new wave...

Finding solutions for Brazilian people’s needs

Unit-wise, the potential is significant
Computing Growth Drivers over Time, 1960-2030e

Source: Company Data, Morgan Stanley Research
Challenges for Brazil

- Industry and Technology Development
- Be part of the new wave...
- It is NOT a dichotomy...
- Finding solutions for Brazil's people's needs
The Internet of Things or several Intranets (vertical)?
- Security/Reliability:
- Critical Infrastructure and Systems
- Ethics and Citizenship

Challenges Brazil may face

- What are the choices? The Internet of Things is a tool and not an end in itself...
  - Public policies: scope, coordination and consistency
    - Building a State-run Policy for a mix-match reality entailing several different institutions/ministries => Governance?
  - Grabbing opportunities for Brazil:
    - IoT as a platform to create new Brazilian companies, locally developing technology, generating value....

IoT: represents a significant opportunity for economic and technological development in Brazil, but requires long-term strategic vision.
Safely inserting Brazil into the universe of the Internet of Things requires **consistent and structured planning** so as to guarantee investments in broad-band infrastructure, strategic components, appropriate systems and services.

Discussing the economic and technological scope of this new digital revolution is important, provided that it aims at creating **solutions for Brazil** that will foster a more just and inclusive society

- health
- education
- basic sanitation
- urban mobility
- public services (e-gov)
It doesn't matter how many resources you have.

If you don't know how to use them, it will never be enough.
Brazilian Development Bank - BNDES
Marcelo Fernandes
mcbf@bndes.gov.br
www.bndes.gov.br/english
BNDES: Mission and Vision

Mission
“To foster sustainable and competitive development in the Brazilian economy, generating employment while reducing social and regional inequalities.”

Vision
“To perform its duties as the development bank of Brazil, an institution of excellence that is innovative and proactive in light of the challenges in our society.”
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Brazil has solid fundamentals

- Stable legal and institutional framework;
- Social inclusion leveraging the domestic market;
- Healthy banking sector not exposed to troubled assets;
- Robust external sector;
- Long-term planning;
- Government has conditions to foster growth:
  - Fiscal and monetary instruments;
  - Improvement of regulatory framework;
  - Partnership with private sector.