Advanced End-to-End Services in Brazil

RNP
Research and Development

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Agenda

• About RNP
• Brazilian R&E Networks Domains
• Multi-Domain Services
  – Cipó
  – MonIPE
  – FIBRE Testbed
• Final Remarks
RNP at a Glance

- RNP - Rede Nacional de Ensino e Pesquisa
  - National Research and Education Network
- Non profit organization
- Linked with Science, Technology & Innovation Ministry
- 250 direct collaborators
- 3 offices (Brasília, DF, Rio de Janeiro, RJ and Campinas, SP)
- 27 PoPs (Point of Presence)
- ~900 institutions and research institutions (campuses)
- ~3.5 million users
- ~27,500 research groups benefited
- More than 393 institutions outside capital cities to be connected by the end of 2012
- No connection to primary and secondary schools
RNP Multi-domain Hierarchy

- RNP Backbone domain
- RNP PoPs domain
- Regional / Metro / Campus networks domain
- User organization domain
Brazilian R&E Domains

Bandwidth
Minimum...: 20Mbps
Maximum...: 10Gbps
Aggregated: 250Gbps
Brazilian R&E Domains

Bandwidth
Minimum...: 20Mbps
Maximum..: 10Gbps
Aggregated: 250Gbps

RNP PoPs domains
Metro networks domains
Regional networks domains

10 Gbps
3 Gbps
200 Mbps
36 Mbps
20 Mbps

Internet comercial
RedCLARA
Americas Light

Ministério da Cultura
Ministério da Saúde
Ministério da Educação
Ministério da Ciência, Tecnologia e Inovação
Governo Federal
Brasil
RNP Multi-Domain Hierarchy

RNP

PoP

PoP

PoP

Metro

Campus

Metro

Campus

Regional

End user

End user

End user

End user

End user

End user
Concepts

- **Domain**: Network Administrative Domain
- **Transit Domain**: Domain that interconnect other two domains
- **Demarcation Point**: Domain location where users connect
- **Customer Premises**: End point infrastructure where services are accessible to customers
- **Customer**: End user accessing the service
- **Overlay Networks**: Logical virtual network infrastructure
- **Multi-Domain Service**: Service offered through two or more domains
  - Operated in coordination by multiple domains
  - Access controlled and federated
Multi-domain Services

• Key elements:
  – User friendly web interfaces (Portals and tools)
  – Authorization and authentication (Federation, PKI)
  – End-to-end monitoring (perfSONAR)
  – Standard interdomain protocols (IDC, NSI etc.)
  – Policies (interdomain agreements): Resource allocation / protection

• Operations
  • Service Desk (basic support) and NOC (alerts and basic troubleshooting)
  • Level 2/3 support (advanced troubleshooting)
  • Security: multi-domain coordination

– Global forum for policies (GLIF)
Multi-Domain Service Portfolio

- **Dynamic Circuit Provisioning Service (CIPÓ):**
  - Allocation of *lightpaths / bandwidth on demand* between two end customers located possibly located on distinct domains

- **Monitoring Service (MonIPÊ):**
  - *Regular network measurements* on clients of a domain and along the neighboring paths

- **Diagnostics Service:**
  - *On demand network measurements* between two end customers on same or distinct domains

- **Testbed Service:**
  - *Infrastructure resources in a overlay fashion to support testbed island/rack connections*
CIPÓ: Provisioning Service
Service on pre production phase

• Dynamic Circuit Network (DCN) Provisioning Experimental Service based on OSCARS
• End-User Interface:
  – MEICAN web-based interface for circuit scheduling
• Central Infrastructure:
  – perfSONAR Lookup and Topology Services for global integration
• Backbone Infrastructure:
  – OSCARS configuring Logical Systems on Juniper Routers
  – ODE for Resource Protection and Authorization
  – MonCircuitos for circuit monitoring (E2EMon and perfSONAR services)
• Local Services in each IPÊ Network POD:
  – VLSR(s) and NARB based on Dragon and at least one L2 switch (Cisco or Extreme)
  – OSCARS configuring VLSR(s) and NARB
  – ODE for Resource Protection and Authorization
  – MonCircuitos for circuit monitoring (E2EMon and perfSONAR services)
CIPÓ Infrastructure

Tier 1

Tier (n)

Domain A

Domain B

MonCircuitos

OSCARS

VLSR

NARB

ODE

Customer

Overlay Network

MEICAN

hLS/gLS/TopS

Customer

Overlay Network
CIPÓ International Peerings

• With ION(Internet2) and SDN(Esnet)
  – going thru AMPATH/AMLIGHT

• With Autobahn (GEANT)
  – Going thru RedCLARA or Internet2
Cipó Tools: MEICAN (OSCARS Front-end)
Cipó Tools: MEICAN (OSCARS Front-end)
Cipó Tools: Monitoring

CIPO - RNP

Monitored Links for Domain POPSC

<table>
<thead>
<tr>
<th>Mon. Link Local Name</th>
<th>E2E Link ID</th>
<th>Topology Point A</th>
<th>Role</th>
<th>Topology Point B</th>
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<td>POPSC-RNP-0-sw3remep-sw4remep</td>
<td>POPSC-SW3REMEP</td>
<td>DP</td>
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<td>POPSC-RNP-0-sw4remep-sw3remep</td>
<td>POPSC-SW4REMEP</td>
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<td>DP</td>
<td>POPSC-SW4REMEP</td>
<td>DP</td>
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</table>

Log configuration:
- Interval between log updates: 10 seconds
- Number of lines for display: 50
- Custom filter (RE EXP): Show All

Options:
- Monitoramento
- RNP-MON-DCN
- Oscars POD
- Status Service
- Status Service Histórico
MonIPÊ: Monitoring Service
Service under Review

- Regular measurement infrastructure based on perfSONAR Framework
- Metrics:
  - One-way/round-trip delay (OWAMP)
  - Achievable bandwidth (BWCLT + iperf) – 1 Gigabit
- Visualisation:
  - Reporting Tool (Relatório), PerfsonarUI, perfADMIN
  - 1 CACTISonar (scheduling, graphs, tests)
- Central Infrastructure:
  - 1 MA (PHP-SQL-MA, SNMP-MA, STATUS-MA) + 1 LS + 1 RP/AAS
- Local Services in each IPÊ Network PoP:
  - 27 MPs (CLMP)

Yellow: RNP tools / Green: to be installed / Blue: to be updated / Red: to be deprecated
MonIPE Portal

O Serviço de Monitoramento da Rede Ipê (MonIPÊ) tem como objetivo principal disponibilizar aos seus usuários:

- Caracterização do tráfego através de medições de fluxos que atravessam os seus roteadores;
- Medições de alta precisão do desempenho da rede, tais como: medidas de atraso, variação do atraso, perdas e largura de banda disponível;
- Resultado de testes regulares de conectividade;
- Medições de desempenho de última milha tendo em vista o usuário final;
- Um ambiente de verificação e acompanhamento do desempenho da rede.

Clique aqui e verifique mais detalhes do serviço.

perfSONAR

perfSONAR é a infraestrutura de monitoramento de redes de computadores que será utilizada no escopo do MonIPÊ. O perfSONAR torna fácil a resolução de problemas de performance fim-a-fim em links que atravessam várias redes de computadores. Logo, o perfSONAR é uma infraestrutura de monitoramento multidominio que contém um conjunto de serviços que atua como uma camada entre as ferramentas de monitoramento e aplicações de visualização e diagnóstico. Para saber mais, visite o site oficial ou o Wiki do projeto.
MonIPE: Relatórios (Reports)
MonIPE: Relatórios (Reports)
### Medição OWAMP
Entre 2012-03-14 21:00 e 2012-03-15 23:00

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<th>T. Perdidos (20% a 50%)</th>
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<th>P. Perdidos (&gt; 20%)</th>
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</tbody>
</table>

#### AC vs AL
- **AC-AL**
  - **Mínimo**: 42.1 ms
  - **Média**: 43.4 ms
  - **Mediana**: 43.3 ms
  - **Máximo**: 48.7 ms
  - **P**: 312 / 3120 / 0 / 0.00%
  - **T**: 312 / 0 / 0.00%

#### AM vs AP
- **AM-AP**
  - **Mínimo**: 63.3 ms
  - **Média**: 69.1 ms
  - **Mediana**: 50.6 ms
  - **Máximo**: 587.5 ms
  - **P**: 3120 / 3120 / 12 / 0.39%
  - **T**: 312 / 0 / 0.00%

#### BA vs CE
- **BA-CE**
  - **Mínimo**: 40.7 ms
  - **Média**: 40.8 ms
  - **Mediana**: 40.6 ms
  - **Máximo**: 46.8 ms
  - **P**: 3120 / 3120 / 0 / 0.00%
  - **T**: 312 / 0 / 0.00%

#### DF vs AC
- **DF-AC**
  - **Mínimo**: 24.3 ms
  - **Média**: 24.4 ms
  - **Mediana**: 24.4 ms
  - **Máximo**: 31.6 ms
  - **P**: 3120 / 3120 / 0 / 0.00%
  - **T**: 312 / 0 / 0.00%
MonIPE Reports
Diagnostics Service
Service on Conception Phase

• On-Demand Measurement Infrastructure based on perfSONAR Framework
• Metrics:
  – One-way/Round-Trip Delay (OWAMP)
  – Achievable Bandwidth (BWCTL + Iperf) – 1 Gigabit
  – Last Mile Achievable Bandwidth (NDT) – 1 Gigabit
• Visualisation:
  – End-User Scheduling Tool (PerfsonarUI, perfADMIN)
  – ICE (end-user)
• Central Infrastructure:
  – 1 MA (PHP-SQL-MA) + Lookup Service (LS) + Authentication Service (AS)
• Local Services in each IPÊ Network PoP:
  – 27 MPs (CLMP)
Diagnostic Tools

Servidores NDT por PoP/RNP

Clique no Estado desejado para realizar o teste de vazão.
FIBRE: FI testbeds between Brazil and Europe

- Proposed collaboration between 9 partners from Brazil, 5 from Europe and 1 from Australia
- Design, implementation and validation of a shared Future Internet research facility, supporting the joint experimentation of European and Brazilian researchers.
- The objectives include:
  - the development and operation of a new experimental facility in Brazil
  - the development and operation of a FI facility in Europe based on enhancements and the federation of the existing OFELIA and OneLab infrastructures
  - The federation of the Brazilian and European experimental facilities, to support the provisioning of slices using resources from both testbeds.
- Officially started on Oct 1 2011
Future developments / next steps

• MonIPE
  – To have MonIPE communicating with measurement infrastructures from other R&E networks (regional, metro, international)
  – Expand services “vertically” to services to lower tier domains, towards regional, metro and end user organizations (dissemination and training)

• Same for the DCN Service Cipó

• Investigate how to provision multipoint circuits with OpenFlow
Final Remarks

• Building Multi-Domain Services has proven to be a challenging endeavour
• The lack of a general Multi-Domain Service Model delayed the process of introducing new services on production networks
• Maturing these concepts will help deployment of new services infrastructures, such as Multi-Domain SDNs and new testbed networks
Thank you!
Obrigado!