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# Improving Network Monitoring with the PI System

Presented by **Stéfano Bassan**  
**Diogo Cruz**



Operador Nacional  
do Sistema Elétrico

**radix**  
Engineering and Software

# Agenda

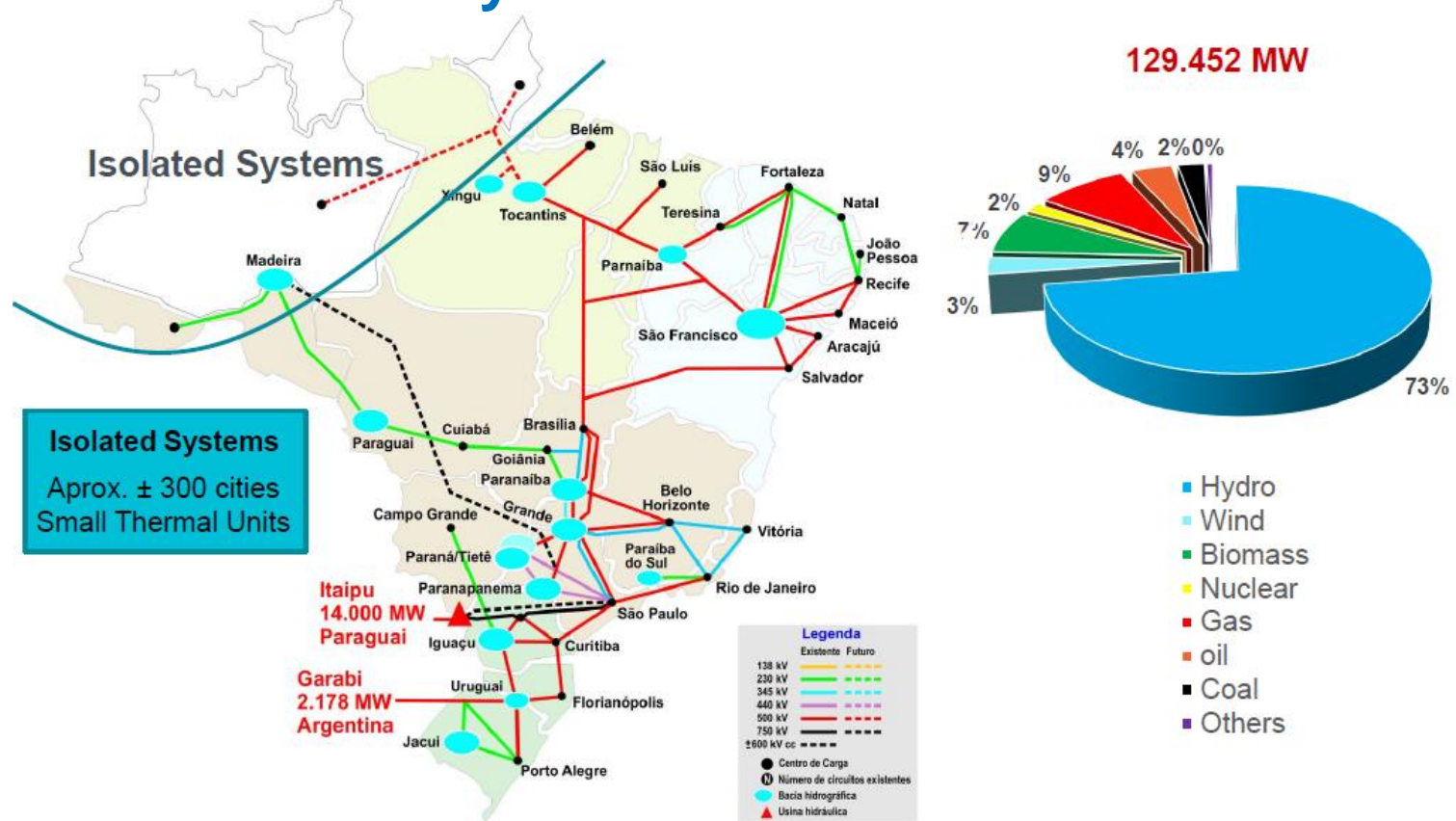
- ▶ About ONS
- ▶ Brazilian Electrical System
- ▶ ONS PI System Architecture
- ▶ Monitoring System Performance (MDS)
- ▶ Implementation Details
- ▶ Results Obtained / Business Impact
- ▶ Next Steps

## About ONS

- ▶ Independent System Operator (ISO) of Brazilian Electrical System;
- ▶ Private, non-profit organization founded in 1998;
- ▶ 721 employees, 586 with university degree, 400 engineers;
- ▶ Mission: Operate the National Interconnected System in an integrated manner with transparency, fairness and neutrality in order to ensure security, continuity and economic efficiency of electricity supply in Brazil;
- ▶ Vision: To be an organization recognized as essential to the safety and economics of electricity service in the National Interconnected System.



# Brazilian Electrical System



## About ONS

ONS's operation is divided into five centers:

- ▶ CNOS (Brasília);
- ▶ COSR-NE (Recife);
- ▶ COSR-NCO (Brasília);
- ▶ COSR-S (Florianopolis).
- ▶ COSR-SE (Rio de Janeiro);

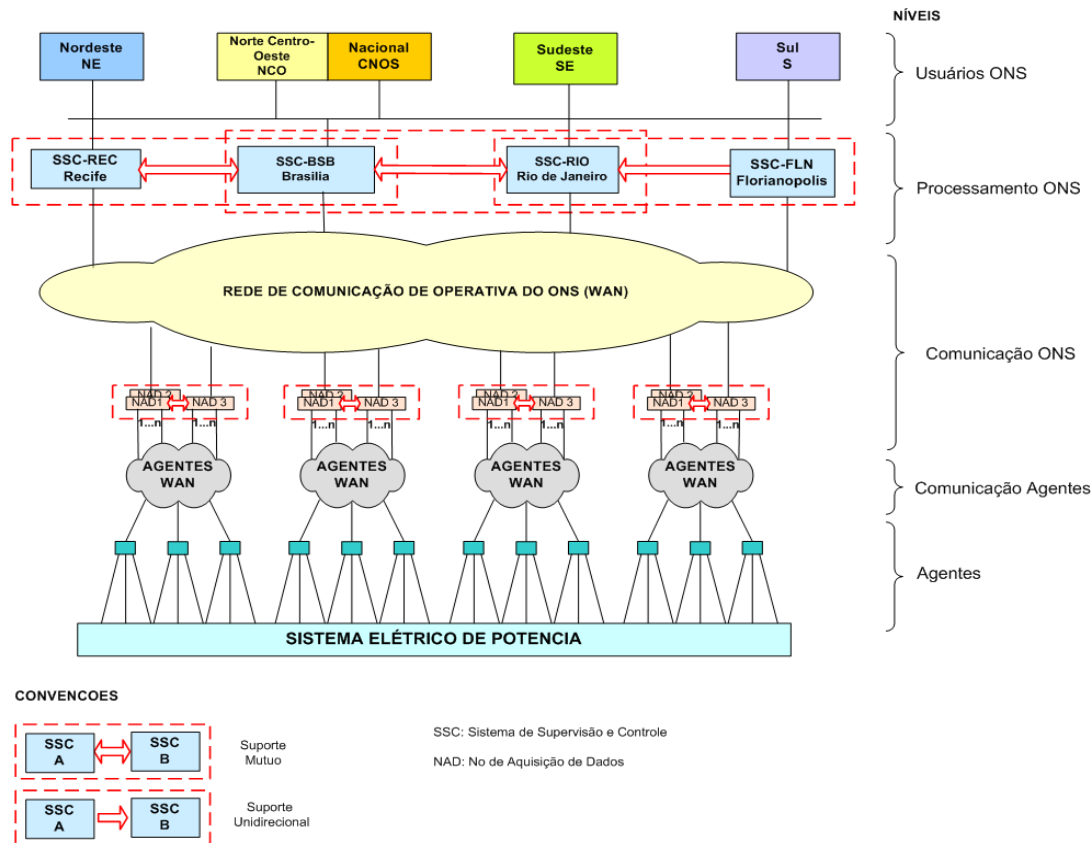
If one center is not able to do the operation the other three have the capacity to do the work;

**Activities:** voltage control, flood control, system recovery coordination in case of more serious occurrences (blackouts), power load management, guarantee the power reserve, generation control, and more than 50,000 daily interventions in the system.



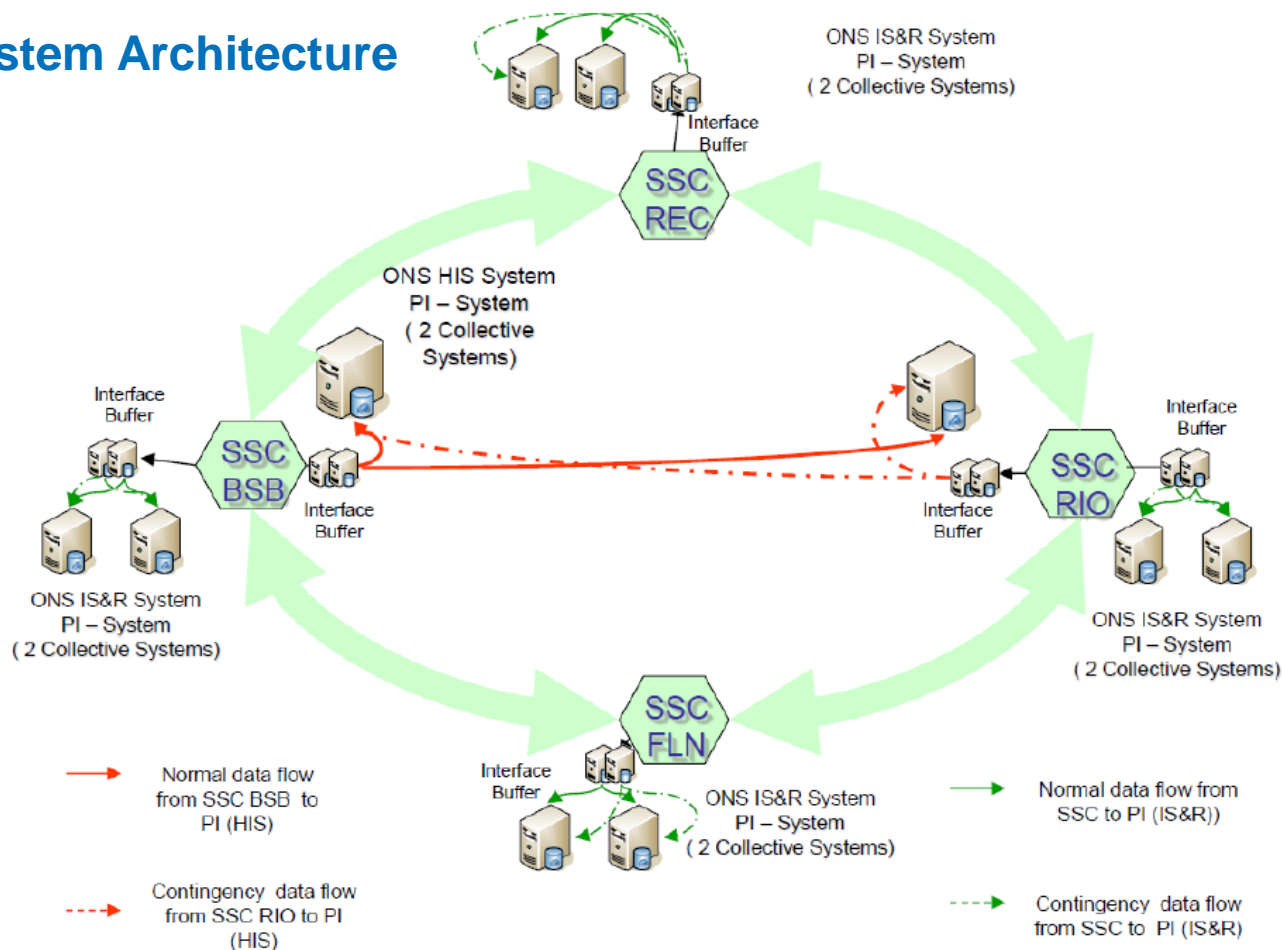
# ONS PI Architecture

- ▶ Largest PI System in Latin America;
- ▶ Over **3 million tags**;
- ▶ Get about **87,000** analogic values and **157,000** digital states;
- ▶ Records more than **20,000** measurements per second.
- ▶ High availability;





# ONS PI System Architecture





## Monitoring System Performance (MDS)

- ④ Monitor the availability of ONS and Agents' Supervision and Control Systems (SSCs);
- ④ Monitor more than **370 channels** of connections with agents;
- ④ Keep operating more than **120 servers**;
- ④ Act in sync with the agents in order to maintain high availability of the SSCs;
- ④ Faster and more accurate diagnoses of problems in SSCs;
- ④ System situation awareness.

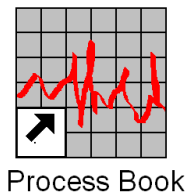
## Monitoring System Performance (MDS)

- ▶ Monitor in one application the status of the supervision systems connections and control system connections with the agents;
- ▶ Aggregate in one application the needs of network and supervision teams;
- ▶ Check the agent's network availability, agents with availability lower than **98.8%** are punishable by a fine;
- ▶ Usage of Asset Framework to get all necessary information;
- ▶ Application easy to use and do maintenance.



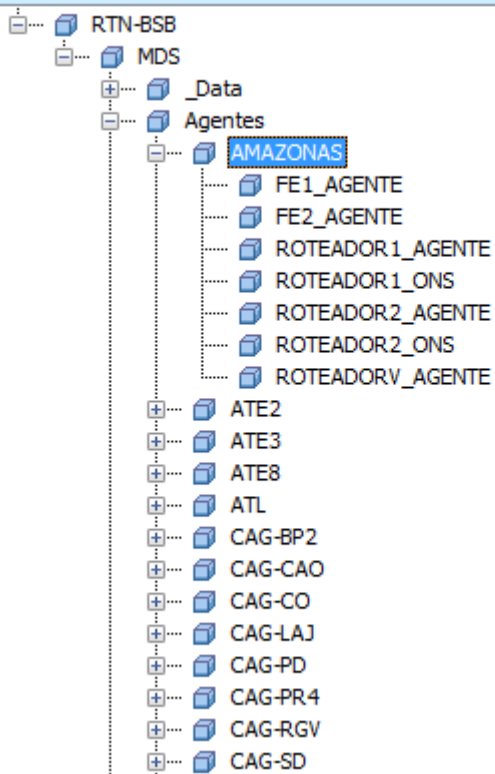
## Implementation Details (PI System tools used)

- ▶ Asset Framework;
- ▶ Event Frames;
- ▶ Analysis;
- ▶ PI ProcessBook;
- ▶ PI SDK;
- ▶ PI OLEDB Enterprise.



# Implementation Details (Agent)

## Elements













## AMAZONAS

General Child Elements Attributes Ports Analyses Version

Filter

Name	Value	Description
BARRAMENTO_AGENTE		Ip do Barramento no Agente
BARRAMENTO_REGIONAL		Ip do Barramento no Regional
CENTRO	COSR-NGO	Centro
CIRCUITO1		
CIRCUITO1_DESIGNACAO		
CIRCUITO2		
CIRCUITO2_DESIGNACAO		
CONFIG_VOZ_AGENTE		
CONFIG_VOZ_REGIONAL		
DISPONIBILIDADE	Conectado	
DISPONIBILIDADE_30_DIAS	99,599922180175781	
HOT_LINE_1_AGENTE		
HOT_LINE_1_REGIONAL		
HOT_LINE_2_AGENTE		
HOT_LINE_2_REGIONAL		
LAQ		Estado de conexão do Agente no REGER
LINK_OPMANAGER	Q:\GOS\SGO Resultados\SGO Resultados Operacionais\R...	Link para a tela de monitoração do OpManager
NATUREZA_DADOS	a	
NOME_INSTALACAO		
PROTOCOLO	ICCP	
PROVEDOR1		Empresa Provedora 1
PROVEDOR2		Empresa Provedora 2
RESPONSAVEL_TECNICO		
RESPONSAVEL_TECNICO_EMAIL		
RESPONSAVEL_TECNICO_TELEFONES		
TELEFONE_RECLAMACAO		
TIPO_CONFIGURACAO	1	Tipo de configuração da ligação (numero de FE's, Roteadores, etc)
TIPO_ENLACE	ICCP	

## Implementation Details (Agent Router)

ROTEADOR1_ONS		
General Child Elements Attributes Ports Analyses Version		
Filter		
Name		Description
 Agente	AMAZONAS	
 Circuito	BSA/0748065	
 Descricao	Roteador 1 lado ONS - Dados	Descricao do ativo
 IP	172.19.8.1	Endereço IP do ativo
 Local		Local de instalação do equipamento
 Ping	0 ms	
 Provedor	OI	Fornecedor do canal de comunicação utilizado pelo Roteador do Agente
 SADST	AME-0748065 dados1	
 Status	1	Valor do Status
 Status1	1	Staus do Ip1

# Implementation Details (Agent Availability Analysis)

General	Equation	Scheduling	Security	Archive	Classic	System		
Name:	MDS_AGENTE_AMAZONAS_DISPONIBILIDADE					Rename	Server:	RBSR01
Descriptor:	Disponibilidade do agente Amazonas Energia							
Point class:	classic						Point source:	(
Point type:	Digital	Digital set:	DisponibilidadeAgente					
Eng Units:							Display digits:	
Extended Descriptor:	if BadVal(MDS_PING_AGENTE_AMAZONAS_ROTADOR1_161.79.10.250) AND BadVal(MDS_PING_AGENTE_AMAZONAS_ROTADOR2_161.79.10.251) AND BadVal(MDS_PING_AGENTE_AMAZONAS_ROTADORV_161.79.10.253) then 0 else 1							

General	Equation	Scheduling	Security	Archive	Classic	System		
Name:	MDS_AGENTE_AMAZONAS_DISPONIBILIDADE.30D					Rename	Server:	RBSR01
Descriptor:								
Point class:	classic						Point source:	C
Point type:	Float16	Digital set:						
Eng Units:							Display digits:	
Extended Descriptor:	TimeEq("MDS_AGENTE_AMAZONAS_DISPONIBILIDADE";"-30d";"";"Conectado")/(TimeEq("MDS_AGENTE_AMAZONAS_DISPONIBILIDADE";"-30d";"";"Desconectado")+TimeEq("MDS_AGENTE_AMAZONAS_DISPONIBILIDADE";"-30d";"";"Conectado"))*100							

# Implementation Details (Agent Drop Event Frame)

AMAZONAS

General Child Elements Attributes Ports Analyses Version

Name	Backfilling
Interrupcao	
Interrupcao_LAQ	

Name: Interrupcao\_LAQ

Description:

Categories:

Analysis Type: ☐ Expression ☐ Rollup ☒ Event Frame Generation

Event Frame Template: Interrupcao\_LAQ

Name	Expression	Value
StartTrigger	'LAQ'="Estado do ponto digital:off"	
EndTrigger		

Add a new expression

Evaluate



## Implementation Details (PI ProcessBook displays)

### ④ Network Topology

- Status of all agents;
- Agents drops;
- Status of all ROP circuits;
- Protocol and provider filters.

### ④ Agent Router Details

- Router ping trend;
- Router availability;
- Higher, lower, average ping.

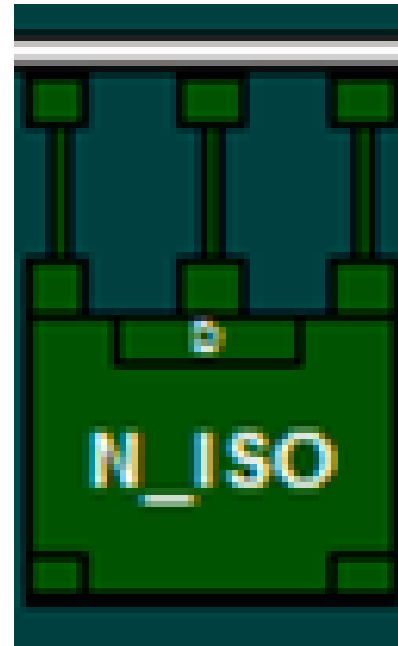
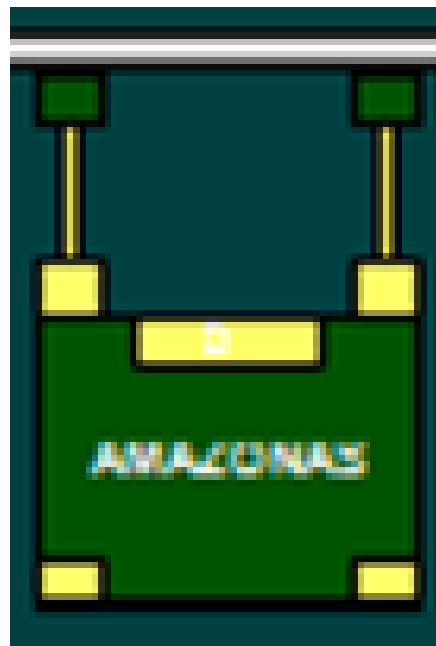
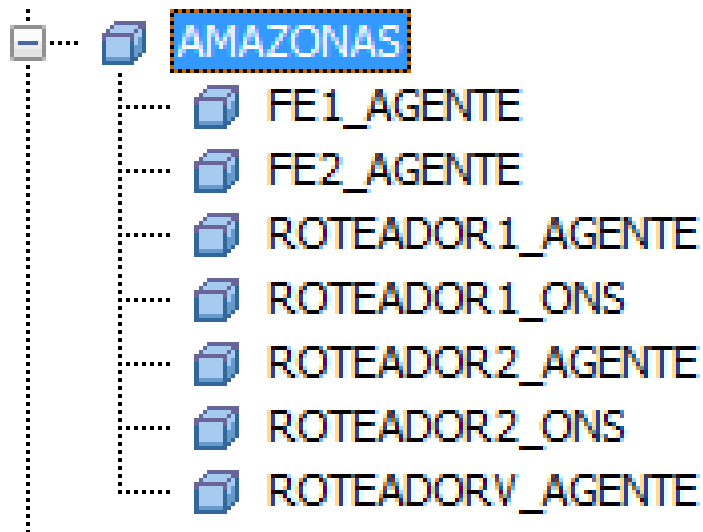
### ④ Agent Details

- Status of all agent's routers;
- Routers drops;
- Agent availability;
- Agent information.

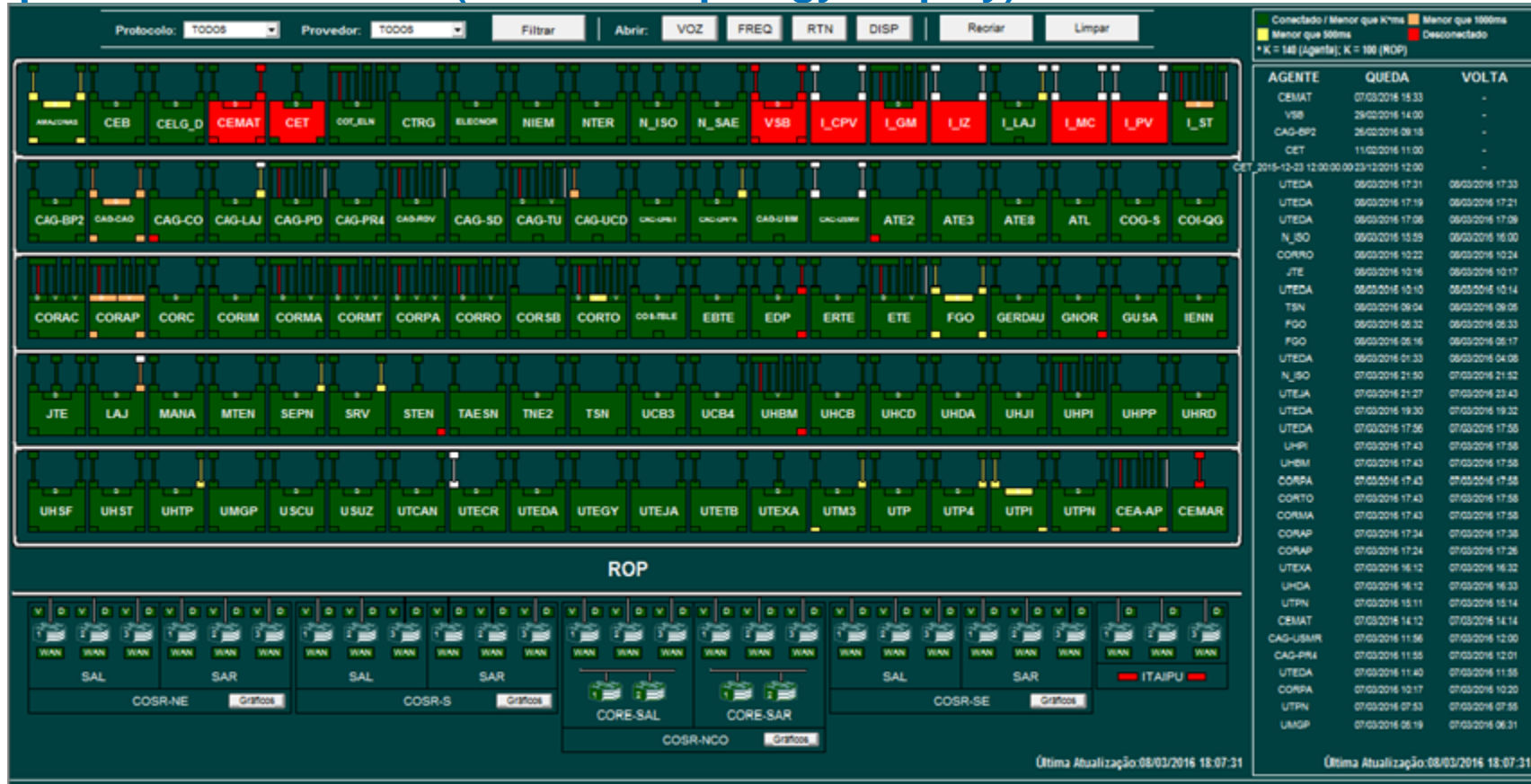
### ④ ROP Router Details

- Router ping trend;
- Router availability;
- Higher, lower, average ping.

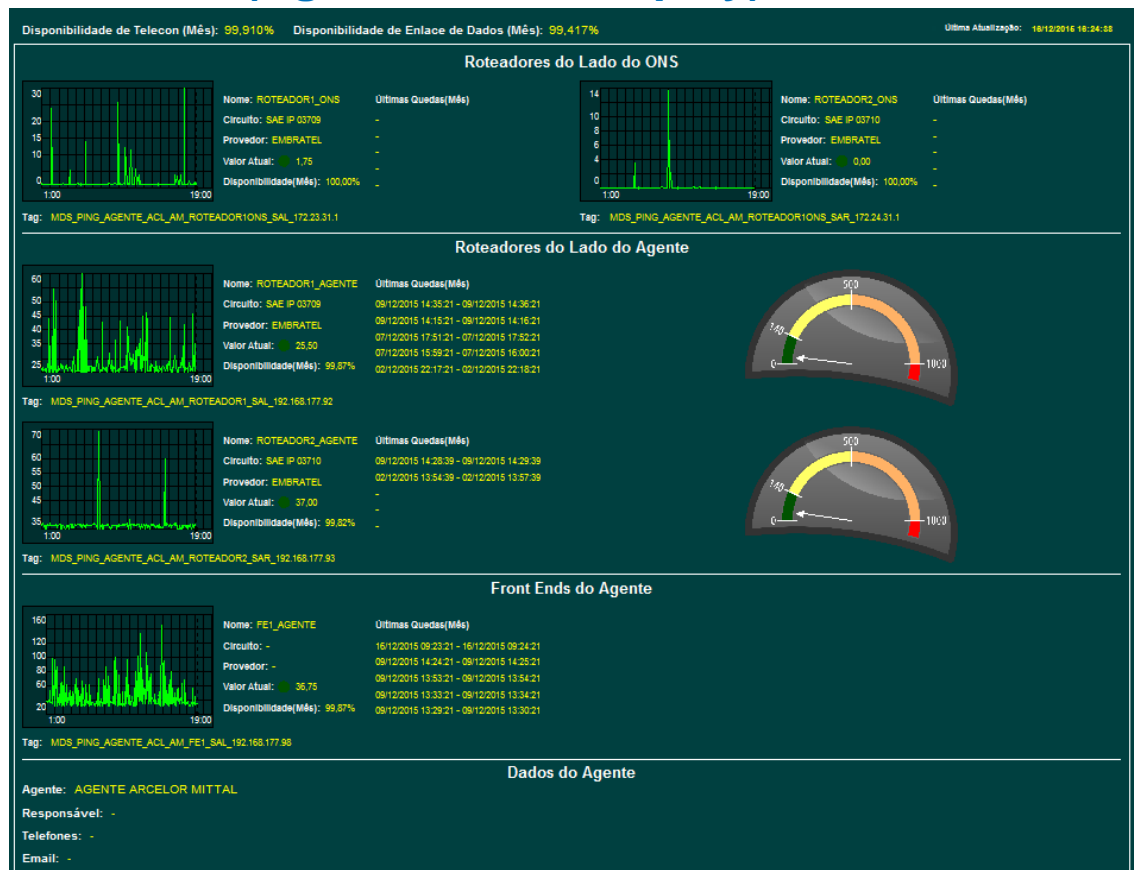
## Implementation Details (Agent)



## Implementation Details (Network Topology Display)

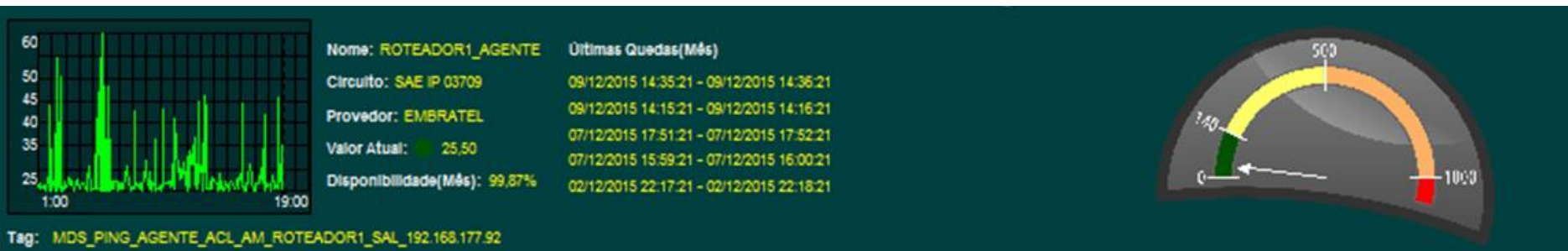


# Implementation Details (Agent Details Display)



# Implementation Details (Agent Details Display)

Disponibilidade de Telecon (Mês): 99,910%    Disponibilidade de Enlace de Dados (Mês): 99,417%    Última Atualização: 18/12/2016 18:24:55



## Dados do Agente

Agente: **AGENTE ARCELOR MITTAL**

Responsável: -

Telefones: -

Email: -

# Implementation Details (Agent Router Details Display)

COSR-SE4

DISPONIBILIDADE AGENTES

COSR-SE

Agente: AM

Elemento: ROTEADOR1\_AGENTE

Consultar

OP Manager

Recrutar

Limpar

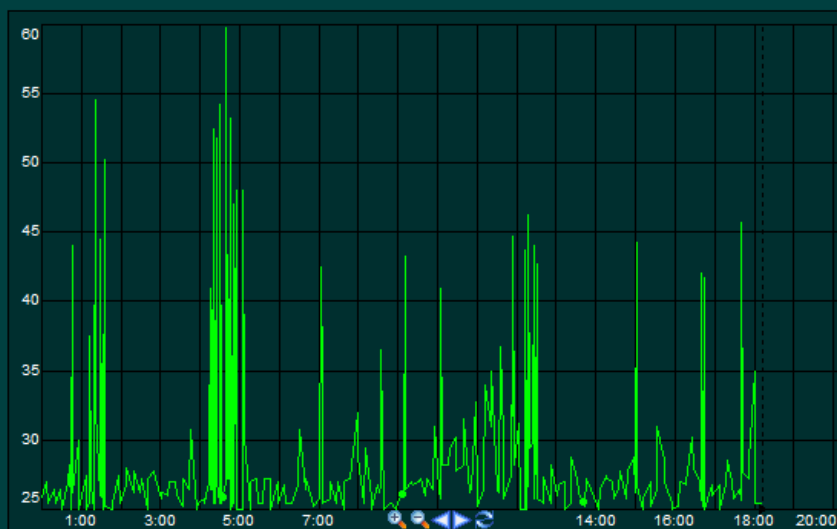
Agente: AM

Elemento: ROTEADOR1\_AGENTE

IP: 192.168.177.92

Circuito: SAE IP 03709

Provedor: EMBRATEL



Tag: MDS\_PING\_AGENTE\_ACL\_AM\_ROTEADOR1\_SAL\_192.168.177.92

Valor Atual: 25,5

Disponibilidade (140 ms)

Anual: -

Mensal: 99,865%

Diário: 100%

Menor Valor (ms)

Anual: -

Mensal: 25

Diário: 25

Média (ms)

Anual: -

Mensal: 26,736

Diário: 27,418

Disponibilidade (Good Value)

Anual: -

Mensal: 99,865%

Diário: 100%

Maior Valor (ms)

Anual: -

Mensal: 67,5

Diário: 59,75

Últimas 3 Quedas (Bad Value - Mês)

07/03/2016 20:10:21 - 07/03/2016 20:11:21

06/03/2016 17:01:21 - 06/03/2016 17:02:21

06/03/2016 13:20:21 - 06/03/2016 13:21:21

Última Atualização: 08/03/2016 18:13:11

# Results Obtained / Business Impact

## ⏮ Before

- Long time to detect network problems;
- Lots of applications to monitor the system;
- Lack of information;
- Any change in the network topology would cause many maintenance needs.



## ⏮ After

- AF tree based application;
- All information needed in one application;
- Knowledge of agent drops;
- Less maintenance effort, scalable application;
- Availability calculation;
- Network situation awareness.



## Next Steps

- ▶ MDS Web;
- ▶ Automatic reports;
- ▶ Bring more information to user;
- ▶ Start using the availability calculation to charge the agent about their lack of information;

# Improving Network Monitoring with PI System

## COMPANY and GOAL

ONS is an Independent System Operator that operates and coordinates the Brazilian Electrical System and wanted to **improve the Network Monitoring**.



## CHALLENGE

Monitor the network connections with all Brazilian electrical agents.

- Monitor in one application the status of the supervision systems connections and telecom connections with the agents;
- Aggregate in one application the needs of network and supervision teams.

## SOLUTION

PI ProcessBook application that show all information needed by the user.

- Agent status;
- Agent routers status;
- Protocol and Provider filters;
- Last Agent drops;
- Agent and routers availability;
- Usage of Asset Framework to get all information needed.

## RESULTS

Better user experience, less maintenance.

- Easy to change the network topology;
- Reduced the number of applications;
- Reduced the time to discover network problems.

# Credits / Project Team

## ONS

**Adriano de Araújo**  
Support Analyst

**Antonio Alegria**  
Support Analyst

**Diogo Cruz**  
Senior Electrical Engineer

**Hector Volskis**  
Specialist Engineer

**Jamerson de Jesus**  
Support Analyst

**Jamil de Almeida**  
Quality and Permanency Manager

**José Renato**  
Support Analyst

**Juvenor Pereira da Silva**  
Executive Manager

**Luiz Cláudio de Araújo Ferreira**  
Executive Manager

**Márleo Santana**  
Support Analyst

**Robson Nóbrega**  
Support Analyst

**Victor Fonseca**  
Support Analyst

# Credits / Project Team

## RADIX

**Alexander Clausbruch**  
Energy Director

**Aline Bordoni**  
Project Engineer

**Bernard Cruzeiro**  
Project Coordinator

**João Zaiden**  
Project Manager

**Stéfano Bassan**  
Project Engineer

**Tárik Siqueira**  
Project Engineer

# Contact Information



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Senior Electrical Engineer  
ONS



**Stéfano Bassan**

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Control and Automation Engineer  
Radix

## Questions

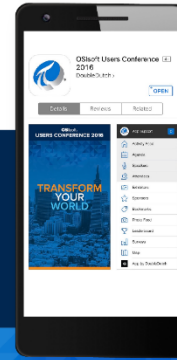
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Thank You  
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ありがとう  
Danke  
Obrigado



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