



**Internet Society**  
InterPlanetary  
Networking SIG



**IETF 111**  
**IPNSIG Pilot Projects Working Group**

**Oscar Garcia**

Group Lead

**Dr. Ronny Bull**

Group Member

July 26th, 2021

# IPNSIG DTN Testing Plan

## Background

On September 24, 2020 conversations started between Vinton Cerf, Oscar Garcia and Scott Burleigh about testing DTN connectivity and interoperability in cloud servers.

Next weekend, Oscar Garcia made testings and designed a DNS model for determining endpoints DTN locations in an Earth environment and tested bundle transfer between cloud servers with bping and bpecho ION software.

The concept evolved to the development of a tool that could be integrated and simple to use in end user software environments.



7, 2020

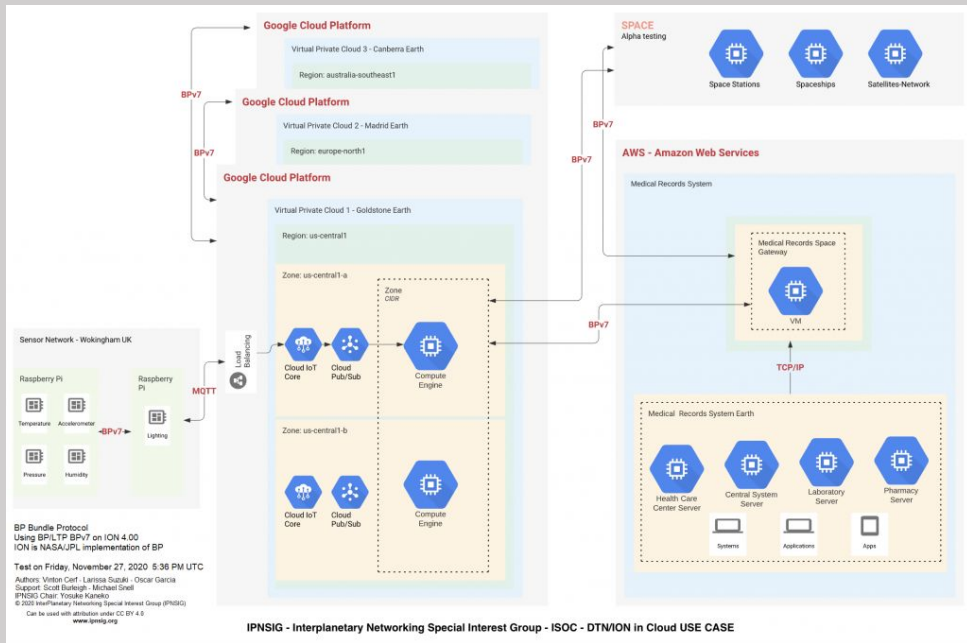
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<https://ipnsig.org/2020/12/17/connecting-clouds-with-dtn/>

# IPNSIG DTN Testing Plan

February 1st, 2021 the Pilot Projects Working Group (PWG) of the IPNSIG was launched. <http://ipnsig.org/2021/02/01/929/>

On March 5th, 2021. Draft of the DTN BP Cloud Connectivity Testing and Network Reliability and Stability Plan Draft PWG-IPNSIG was started by Oscar Garcia.

Project supported by IPNSIG Chair Yosuke Kaneko (JAXA).

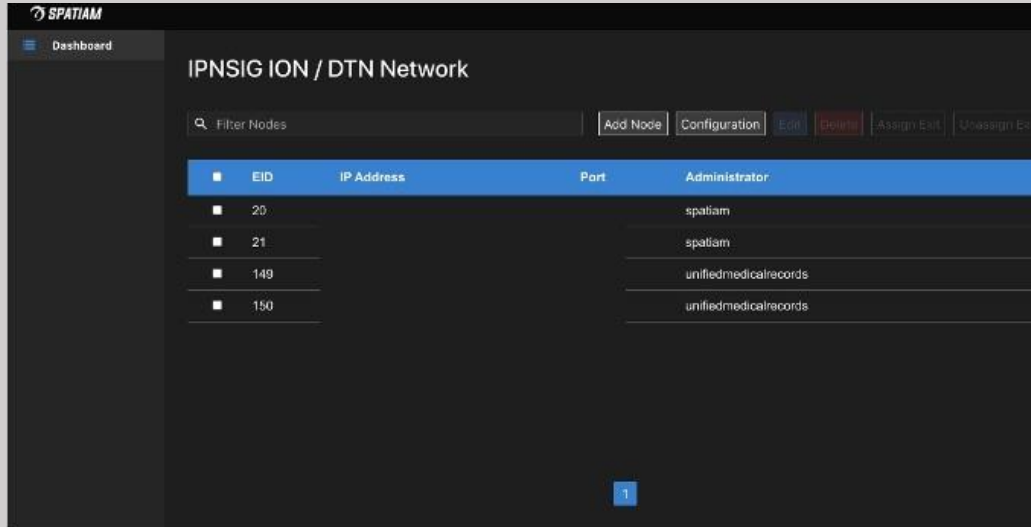
Contributions by Vint Cerf, Alberto Montilla Ochoa, Scott Burleigh, Leigh Torgerson, Samo Grasic and Ronny Bull.

# DTN Network Management - Spatiam Corporation

February, 2021

## IPNSIG ION DTN Network Manager

- Contact Plan Generator
- Contact Graph Routing
- Exit node implementation



# DTN Testing in Artic - Samo Grasic -Dálvvadis Economical Association Sweden

May, 2021

## Lora-DTN ION-DTN Interoperability test in Artic

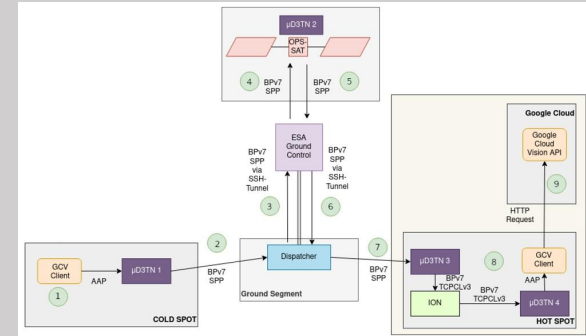
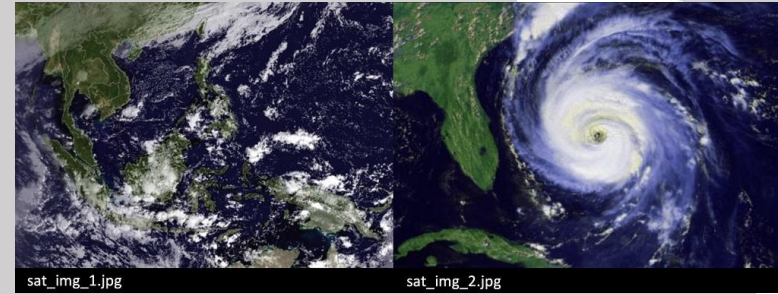
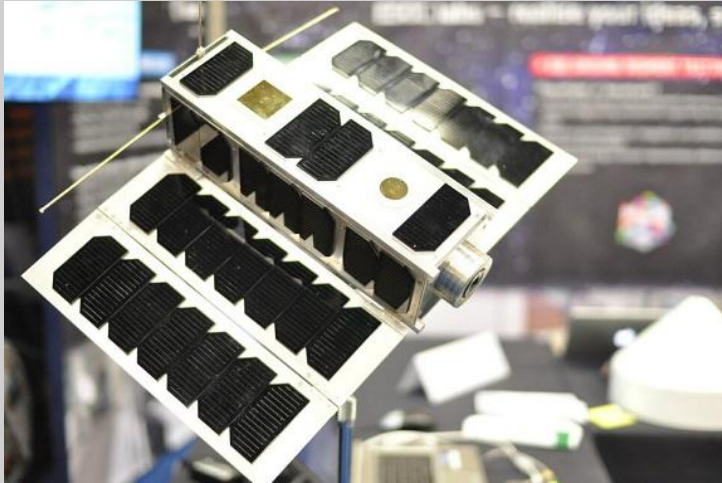
- Messages sent from Nomatrack mobile App on Lora-DTN connecting to ION-DTN to Raspberry Pi running remotely connecting to IPNSIG Network





# European Space Agency - IPNSIG - D3TN GmbH - Spatiam Corp.

ESA OPS-SAT Space Lab Controlled by DTN  
Interoperability ION-DTN <=> D3TN DTN



← Tweet



Our #OPSSAT Space Lab is already being used to test out new software experiments in space.

Find out about one that's just concluded – the first time OPS-SAT was controlled over the internet it tested a new communications technology called the 'Ring Road' [ipnsig.org/2021/06/09/esa...](https://ipnsig.org/2021/06/09/esa...)

Received 'sat\_img\_1.jpg' from 'dtn://coldspot.dtn/source\_cv'  
Identified '10' Labels in the image: Water resources, World, Map, Watercourse, Water, Fluvial landforms of streams, Natural landscape, Geological phenomenon, Astronomical object, Geology  
Forwarding labels to 'dtn://coldspot.dtn/source\_cv', see logs for more details

Received 'sat\_img\_2.jpg' from 'dtn://coldspot.dtn/source\_cv'  
Identified '10' Labels in the image: Tropical cyclone, Water, Cyclone, Whirlpool, Body of water, Vehicle, Astronomical object, Wind wave, Storm, Geological phenomenon  
Forwarding labels to 'dtn://coldspot.dtn/source\_cv', see logs for more details

# IPNSIG DTN Testing Plan

Launching of IPNSIG Global DTN Testing Plan

IETF 111 July 26 2021

Test the  
**Interplanetary Internet**  
at home before you go to  
**Space !**





# IPNSIG DTN Testing Plan

## Requirements and Goals

- Ease of Usage
- Global participation and awareness about DTN
- Easy to configure and use by non experts on DTN
- Multipoint
- Easy installation in Servers and PC or laptops
- Interoperability and Compatibility testing
- Automatic Processing
- Low Hardware and connectivity requirements.
- Adaptability to different implementations



# IPNSIG DTN Testing Plan

## DTN Software for End Users

### Development environment

- Linux standard tools and bash programming
  - Windows version planned
- Open source ION tools C code was modified to allow structured output
- Backoffice processing in php and mysql / mariadb
- Reporting and graphics daily and monthly with reportico open source tool.



# IPNSIG DTN Testing Plan

## Minimum Hardware Requirements

On May 10, 2021 we made the first testing on the DTN Testing Plan software on a \$150 laptop running on a virtual machine with Ubuntu, connected to a home coaxial cable with dynamic IP, from Argentina exchanging bundles from the testing plan software to cloud servers in US.

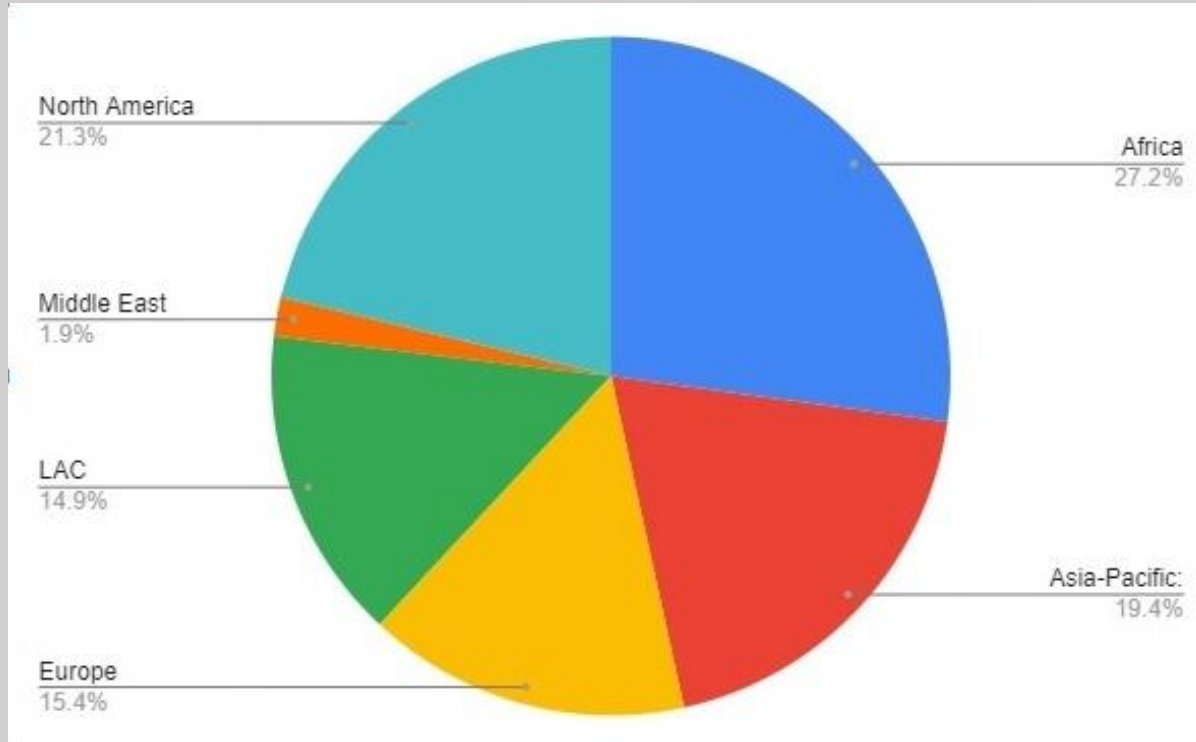


# IPNSIG DTN Testing Plan

## Development Team

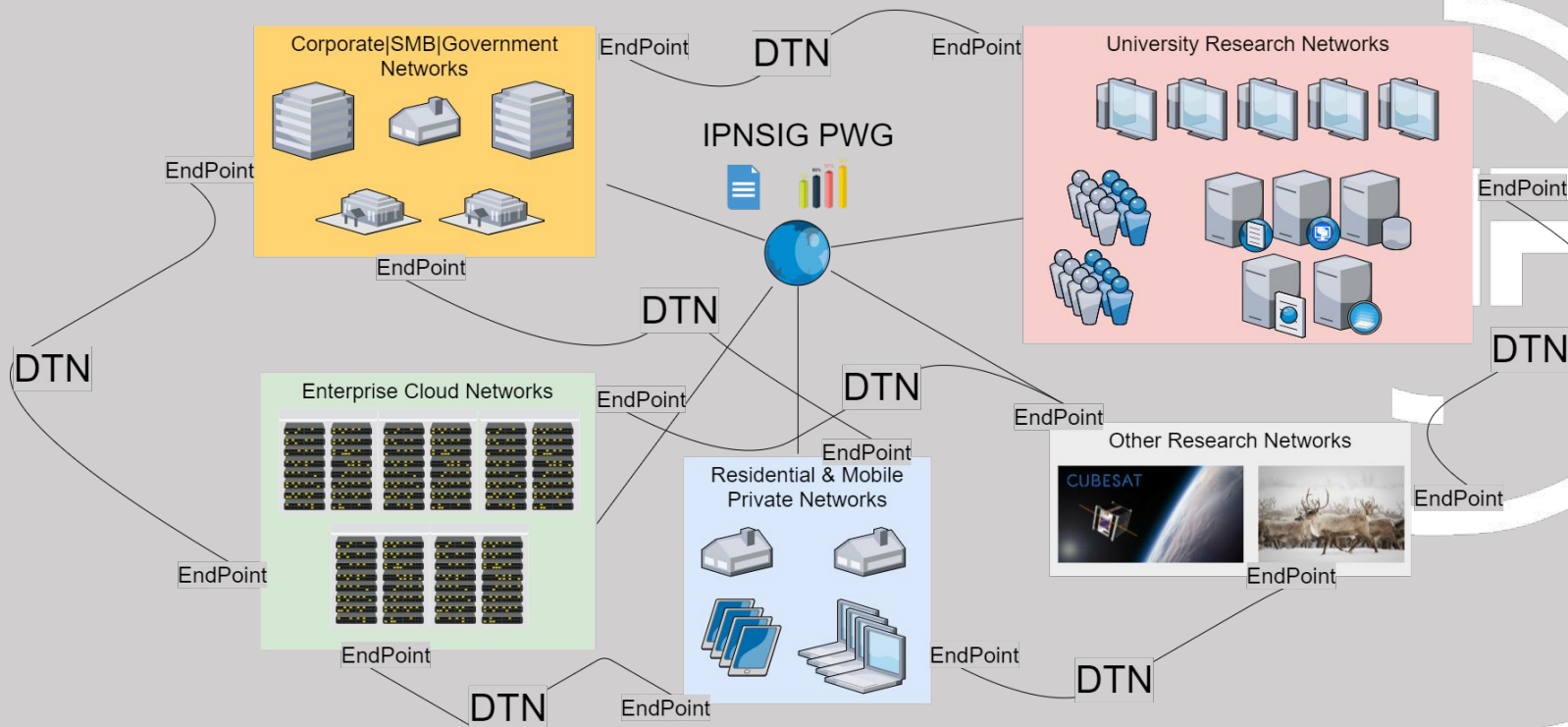
- Design: Oscar Garcia - 38 years developing and deploying applications.
  - C programming: Ronny Bull - PHD in Computer Science - 30 years experience.
  - Bash programming: Oscar Garcia
  - Testing: Facundo Novik - Support manager at Unified Medical Records - Daniela Caula
  - Documentation: Facundo Novik Ernesto Yattah (Columbia University)
- Development time supported by Digital Health Information Network & Utica College.
  - Development time: 835 hours = 2000 lines coding.
  - Creative Commons license planned for distributed software.

# IPNSIG Global Participation - 700+ Members



# IPNSIG DTN Testing Plan

IPNSIG PWG - Interplanetary Internet Prototype Network  
Concept Network Diagram



# IPNSIG DTN Testing Plan

# Implementation

IPN





# IPNSIG DTN Testing Plan

## Backoffice System



### Interplanetary Networking Special Interest Group - DTN Endpoints System

#### Endpoints System Operations

[Endpoint Owners](#)  
[Endpoints and Enpoints testing](#)  
[Bping Statistics and Reports](#)  
[Upload your statistics to this server](#)  
[List of registered Endpoints and current IPs txt](#)  
[Get the update link for your Endpoints](#)  
[Get current IP for an endpoint hash + endpoint id](#)  
[List of registered Endpoints and current IPs csv](#)

#### Endpoints System Documentation

[User Manual](#)  
[Bping Bash Script for your server](#)  
[Bping database structure for statistics](#)  
[CSV structure for uploading your statistics to this server](#)  
[Example of script to update ION host configuration](#)

# IPNSIG DTN Testing Plan

## Client Menu

```
root@ubuntu:
IPNSIG Interplanetary Networking Special Interest Group
Pilot Projects Working Group
DTN Testing Plan Menu - ION Release
Developed by Oscar Garcia - Ronny Bull - Facundo Novik
Running host: 103

1) Configure Testing Plan
2) Configure Hosts in Testing Plan
3) Build ION connectivity plan
4) Start ION
5) Test Bping loopback
6) Test Bping to another server
7) Test Bpecho
8) Test Bping to all participating servers in Test Plan
9) View Bping logs
10) View Bpecho logs
11) Test Upload
12) Instructions for cron
13) View ION log
14) Quit menu
Please enter your choice: 4
We are going to start ION DTN now - press enter
```



# IPNSIG DTN Testing Plan

## Easy Configuration

```
root@ubuntu:
Testing plan configuration
-----

Your configuration is empty - Starting initial configuration
Do you want to modify your configuration ? yn y
Modifying configuration
Input your host EID 103
Bping sending service number 1
Bpecho receiving service number 2
Board name - you can get this from ifconfig ens33
DTN Manager server code - you can get this from dtn-manager 64059d09cc8aeabbe818
a0c02bbc2c708d6d5e2c
DTN Manager node number - you can get this from dtn-manager 21
UDP Port number for ION - regularly is 1113 is used 1113
Contact length - the contact length in seconds 86400 is one day 86400
Input your upload username
Input your upload password

Please confirm
Do you wish to update the configuration with the new values ? yn y
```

IPN

# IPNSIG DTN Testing Plan

## Testing multiple Servers

```
root@ubuntu:
Please enter your choice: 8
This testing will run bping to all servers in the test plan
The receiving server must have bpecho setup and running - Press Enter to start testing
    Processing bundles for servers in Testing Plan

Servers to receive bping
ipn:149.2 ipn:150.2 ipn:103.2 ipn:1358.2 ipn:42.2 ipn:50.2 ipn:51.2
Sending from: host103
Results stored in ./testpwglogs/host103_20210719_bping.csv

Trying ipn:149.2 ...
BPING to ipn:149.2 is OK
Sending 20 bundles to ipn:149.2 and saving to file. Please wait...
Trying ipn:150.2 ...
BPING to ipn:150.2 is OK
Sending 20 bundles to ipn:150.2 and saving to file. Please wait...
Trying ipn:103.2 ...
BPING to ipn:103.2 is OK
Sending 20 bundles to ipn:103.2 and saving to file. Please wait...
Trying ipn:1358.2 ...
Error:Host ipn:1358.2 is OK
BPING to ipn:1358.2 FAILED
Trying ipn:42.2 ...
Error:Host ipn:42.2 is not responding
BPING to ipn:42.2 FAILED
Trying ipn:50.2 ...
BPING to ipn:50.2 is OK
Sending 20 bundles to ipn:50.2 and saving to file. Please wait...
Trying ipn:51.2 ...
Error:Host ipn:51.2 is not responding
BPING to ipn:51.2 FAILED

You can review the test logs for results

Process Test Bping to all participating servers in Test Plan Finished - Press Enter
```



# IPNSIG DTN Testing Plan

## Upload of testing results

```
root@ubuntu:
7) Test Bpecho
8) Test Bping to all participating servers in Test Plan
9) View Bping logs
10) View Bpecho logs
11) Test Upload
12) Instructions for cron
13) View ION log
14) Quit menu
Please enter your choice: 11

This process will try to upload the results of your testing to the storage server
The username and password for uploading must be set in the configuration in advance
If you do not have a username and password to upload please fill up a support form
Press Enter to test upload

Sending ./tosend/host103_20210719_bpecho.csv
Upload: host103_20210719_bpecho.csv
Type: application/octet-stream
Size: 10.482421875 kB
Stored in: host103_20210719_bpecho.csv
Upload OK
Sending ./tosend/host103_20210719_bping.csv
Upload: host103_20210719_bping.csv
Type: application/octet-stream
Size: 19.880859375 kB
Stored in: host103_20210719_bping.csv
Upload OK
Process Test Upload Finished - Press Enter
```

IPN

# IPNSIG DTN Testing Plan

Unattended operation  
Cron setup

```
root@ubuntu:
After you have tested the Plan installation you can make the process run automat
For this to happen please copy the following commands (between lines) in your cr

# -----
#### IPNSIG Testing Plan ####
## updates connectivity plan on reboot and starts ion
@reboot root /yourdirectory/dtntestsuite/procplan.sh updateip
@reboot root /yourdirectory/dtntestsuite/procplan.sh>>/yourdirectory/dtntestsuit
## updates connectivity plan 25 mins every hour for new servers that join the p
25 * * * * root /yourdirectory/dtntestsuite/procplan.sh>>/yourdirectory/dtntests
# process test
0 * * * * root /yourdirectory/dtntestsuite/bpingalltestpwg.sh
0 * * * * root /yourdirectory/dtntestsuite/bpechotestpwg.sh
# upload test results to server
10 * * * * root yourdirectory/n/dtntestsuite/uploadfile.sh
# -----

Process Instructions for cron Finished - Press Enter
█
```

IPN

# IPNSIG DTN Testing Plan

Processing results are emailed to participants

From

Subject **Your file host150\_20210719\_bping has been processed**

To

host150\_20210719\_bping

Previous Process

eid	receiving_eid	last_contact	tries	No_connection	Connection
ipn:150.1	ipn:149.2	2021-07-19 00:50:32	120	0	120
ipn:150.1	ipn:150.2	2021-07-19 00:51:13	120	0	120
ipn:150.1	ipn:103.2	2021-07-19 00:51:21	6	6	0
ipn:150.1	ipn:1358.2	2021-07-19 00:51:32	6	6	0
ipn:150.1	ipn:42.2	2021-07-19 00:51:43	6	6	0
ipn:150.1	ipn:50.2	2021-07-19 00:51:54	6	6	0
ipn:150.1	ipn:51.2	2021-07-19 00:52:05	6	6	0

This Process

eid	receiving_eid	last_contact	tries	No_connection	Connection
ipn:150.1	ipn:149.2	2021-07-19 14:50:33	349	0	349
ipn:150.1	ipn:150.2	2021-07-19 14:51:13	340	0	340
ipn:150.1	ipn:103.2	2021-07-19 14:51:21	165	9	156
ipn:150.1	ipn:1358.2	2021-07-19 14:51:32	17	17	0
ipn:150.1	ipn:42.2	2021-07-19 14:51:43	17	17	0
ipn:150.1	ipn:50.2	2021-07-19 14:51:54	17	17	0
ipn:150.1	ipn:51.2	2021-07-19 14:52:06	17	17	0







# IPNSIG DTN Testing Plan

## Reports - Options

Bping Processed Graph Servers

Style ☒ Table ☐ Form



Show ☐ Criteria ☒ Group Headers ☒ Detail ☒ Group Trailers ☒ Column Headers ☒ Graph

Connection\_type

☒ All  
☐ Only Connected  
☐ No Connection  
☐ Lost Bundles

Sender EID

ipn:.1  
ipn:103.1  
ipn:1358.1  
ipn:149.1  
ipn:150.1  
ipn:50.1  
ipn:51.1

>>

Receiving EID

ipn:103.1  
ipn:150.1  
ipn:149.2  
ipn:104.1  
ipn:20.1  
ipn:150.2  
ipn:1.1  
ipn:11.1  
ipn:42.1  
ipn:50.2

>>

Date range

2021-07-01 - 2021-07-31

Reset

Go

Enter Your Report Criteria Here. To enter criteria use the appropriate expand key. When you are happy select the appropriate output format and click OK.

# IPNSIG DTN Testing Plan

## Reports and Graphics

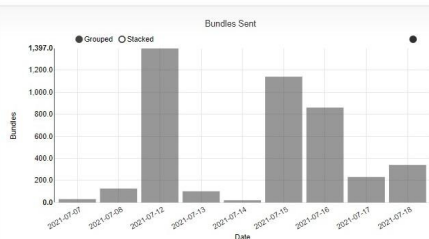
Processing Time: 2021-07-19 14:45:38

### Bping Processed Graph Servers

EID	Location name	Place	Infrastructure	Planet	Country	Implementation
ipn:103	Obras Sociales Network	Mar del Plata	PC Cable	Earth	Argentina	ION
ipn:1358	PWG	Mar del Plata	PC ADSL	Earth	Argentina	ION
ipn:149	Earth Unified Medical Records Gateway	AWS-East Virginia	Cloud VPS	Earth	United States	ION
ipn:150	Unified Medical Records Space		Cloud VPS	Earth	Orbit	ION
ipn:50	Obras Sociales Network	Mar del Plata	PC Fiber	Earth	Argentina	ION

Date Process	Sender Eid	Receiving Eid	Sent	Positive	Lost	Min Response Time	Max Response Time	Avg Response Time
2021-07-07	ipn:103.1	ipn:150.2	31	0	31			
2021-07-08	ipn:103.1	ipn:150.2	127	0	127			
2021-07-12	ipn:103.1	ipn:150.2	1397	1372	25	0.435592	12.194457	2.844218
2021-07-13	ipn:103.1	ipn:150.2	102	40	62	0.725571	1.710795	0.527765
2021-07-14	ipn:103.1	ipn:150.2	21	0	21			
2021-07-15	ipn:103.1	ipn:150.2	1141	1140	1	0.410870	3.396461	1.551881
2021-07-16	ipn:103.1	ipn:150.2	861	840	21	0.422743	4.655145	2.148487
2021-07-17	ipn:103.1	ipn:150.2	232	160	72	2.300232	9.671791	4.148743
2021-07-18	ipn:103.1	ipn:150.2	341	340	1	2.937378	6.716474	4.612566

Total Sent 4253  
Total Positive 3892  
Total Lost 361  
Total Avg Response Time 2.261951



Processing Time: 2021-07-19 14:53:22

### Bping Processed Graph Servers



Total Sent 6152

Total Positive 6086

Total Lost 66

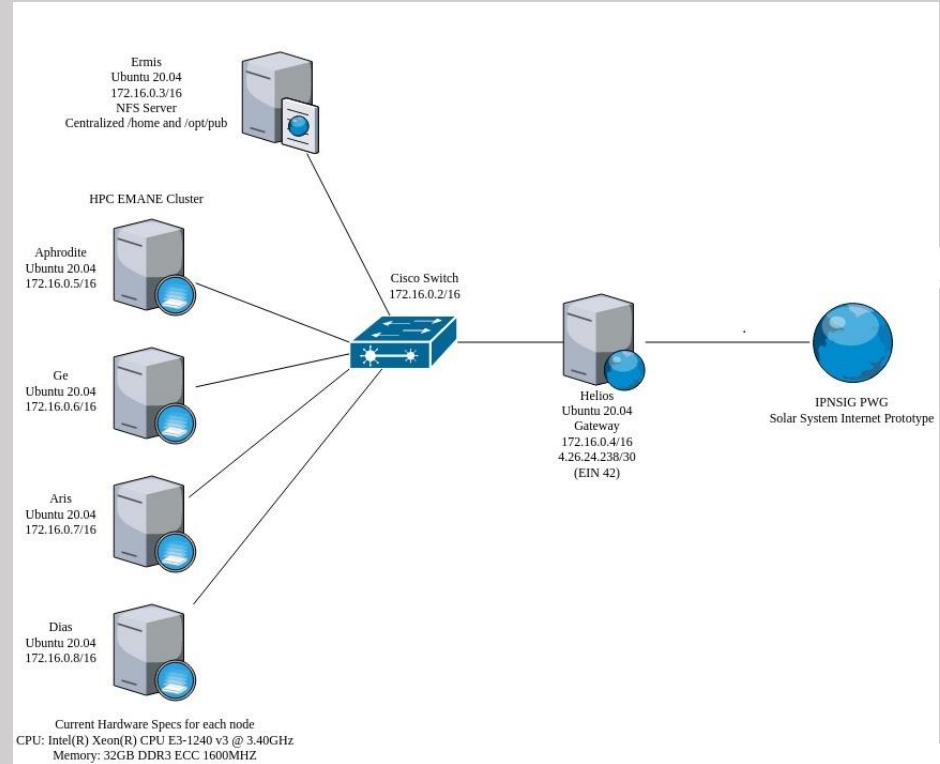
Total Avg Response Time 1.959750



# Support Infrastructure

## DTN Servers - Dr. Ronny Bull

### Utica College - US



# Virtualized IPNSIG PWG Testbed

## Dr. Ronny Bull - Utica College, USA

- 6x - 1U Rackmount Supermicro Servers
  - Ubuntu 20.04 Server
  - Helios - Gateway|Endpoint Server (Node ipn:42 on IPNSIG PWG)
  - Ermis - Network & Systems Monitoring + Shared NFS storage
  - EMANE Cluster (Provides 100's of virtual nodes behind Node 42)
    - Aphrodite
    - Ge
    - Aris
    - Dias

# Virtualized IPNSIG PWG Testbed

Dr. Ronny Bull - Utica College, USA

- Each EMANE cluster node is capable of launching up to 200+ virtual nodes.
- All physical servers are connected on a isolated network with a single public IP on the gateway node
  - Virtual EMANE networks|nodes can be bridged to the physical backbone network
  - Virtual EMANE nodes can be arranged in clusters (regions) located on their own individual subnets simulating an Internet
  - Highly complex and dynamic network configurations are possible
  - Ability to add latency, delay, jitter, etc. to network segments
  - Can assign multiple network cards to each virtual node, each on their own subnet

# Virtualized IPNSIG PWG Testbed

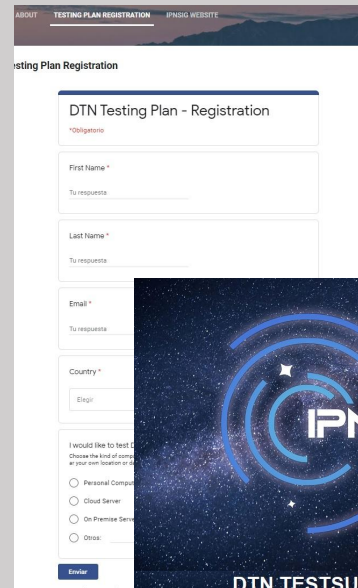
Dr. Ronny Bull - Utica College, USA

- Automated node configuration and scenario deployment
  - Python-etce control framework
    - Python 3 based
    - Automate node configuration, network setup and topology
    - Automate configuration, startup, and shutdown of applications on nodes
    - Automate data collection processes

# IPNSIG DTN Testing Plan

## Complete System

- Registration forms
- Downloadable software
- Installation manual
- User manual
- Support Form
- Support personnel
- Feedback of results to users
- Statistics publication



The screenshot shows a web browser window with the IPNSIG website header. The main content is a registration form titled "DTN Testing Plan - Registration". The form includes fields for "First Name", "Last Name", "Email", and "Country", each with a "To: requestor" label. Below these fields is a section for "I would like to test DTN" with radio button options for "Personal Computer", "Cloud Server", "On Premise Server", and "Other". A blue "Endor" button is at the bottom of the form.





# IPNSIG DTN Testing Plan

## To Do List

Translation of end user system to different languages

Incorporate more DTN implementations

Add more testing functionality

Generate wider statistics

- 1. delivery completion time (start of message send, last bit received at destination)
- 2. amount of data sent
- 3. statistics of bundle sizes (average, distribution)
- 4. effective data rate
- 5. retransmissions
- 6. if LTP lywe statistics





**IPNSIG STRATEGY WORKING GROUP REPORT**

**STRATEGY TOWARD A SOLAR  
SYSTEM INTERNET FOR HUMANITY**

Yosuke Kaneko

Vinton Cerf

Scott Burleigh

Maria Luque

Kiyohisa Suzuki

# IPNSIG

## Strategy Working Group Report

- **EVOLUTION OF THE SOLAR SYSTEM INTERNET (SSI)**
- **KEY PROPERTIES OF AN SSI**
- **STRATEGIC PRINCIPLES FOR PUBLIC-PRIVATE DEPLOYMENT OF AN SSI**
- **OPEN ISSUES**
- **A ROADMAP IN SUPPORT OF THE EVOLUTION OF THE SSI**
- **IPNSIG ROLES**

Download from  
<http://ipnsig.org/2021/06/30/announcing-strategy-working-group-report/>

# IPNSIG DTN Testing Plan

## Advisors

Vinton Cerf

Yosuke Kaneko

Scott Burleigh

Kiyohisha Suzuki

Keith Scott

Michael Snell

Leigh Torgerson

## PWG Team

Lead: Oscar Garcia

Alberto Montilla Bravo

Ronny Bull

Larissa Suzuki

Alberto Montilla Ochoa

Facundo Novik

Samo Grasic

Pablo Reda

Daniela Caula

Juan Fraire

Jesus David Terrazas Gonzalez



# IPNSIG DTN Testing Plan

Register to  
test the  
**Interplanetary Internet**  
at home  
before you go to  
**Space**

<https://ipnsigpwg.blogspot.com/p/testing-plan-registration.html>  
[dtntestingplan@gmail.com](mailto:dtntestingplan@gmail.com)





**Internet Society**  
InterPlanetary  
Networking SIG



**IETF 111**

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**Oscar Garcia**  
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**Dr. Ronny Bull**  
Group Member

[www.ipnsig.org](http://www.ipnsig.org)