

Making Trustable Satellite Experiments

an Application to a VoIP Scenario

Antoine Auger - TeSA

Emmanuel Lochin - ISAE-SUPAERO

Nicolas Kuhn - CNES



Motivation of this work

- Performing SATCOM experiments can be
 - Costly
 - Difficult to config/assess parameters
 - Not possible
- Motivates the use of simulated/**emulated** environments

Lucky me, I can access to a SATCOM

.ISAE-SUPAERO is the first aeronautical engineering school in France (under french ministry of defence umbrella)

.In the french aerospace valley (south-west of France)

–AIRBUS, Thales Alenia Space, CNES (french space agency),

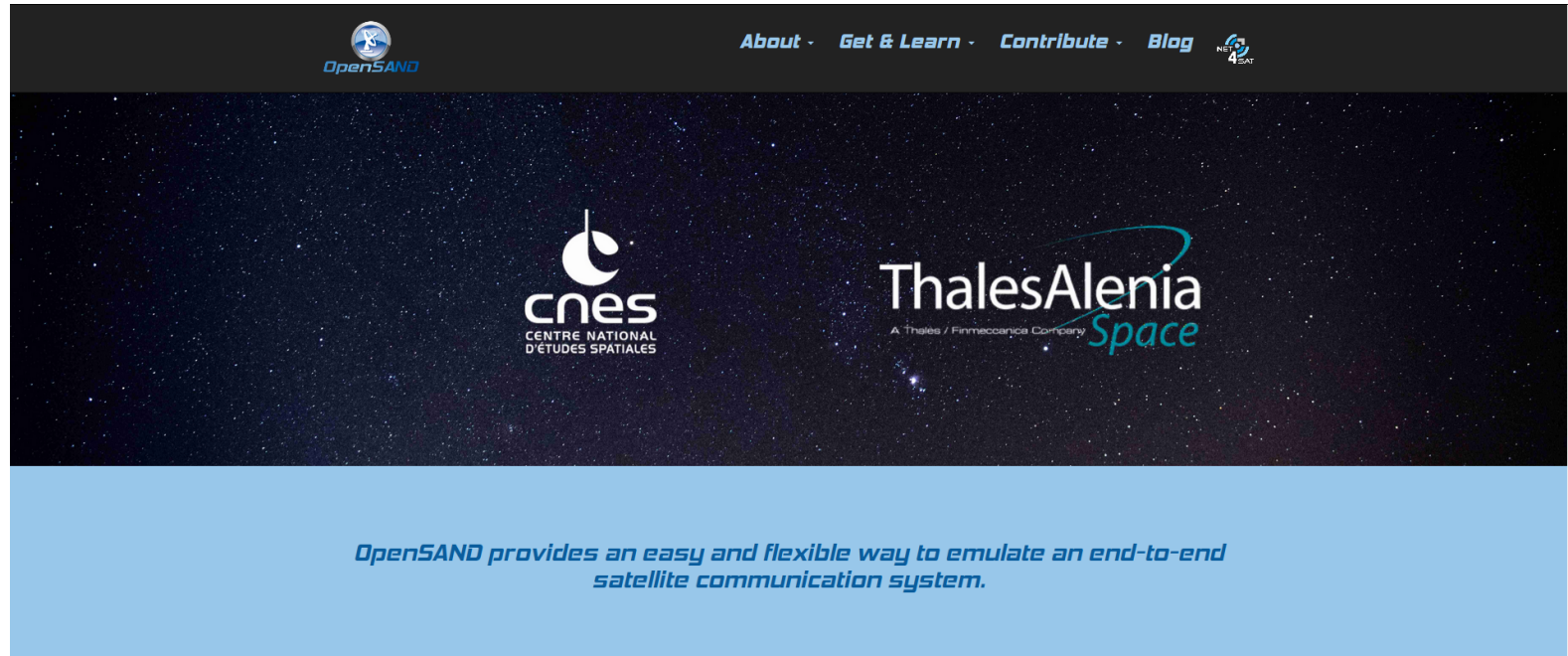
...

.CNES provides CESARS platform (real SATCOM links, various configurations)

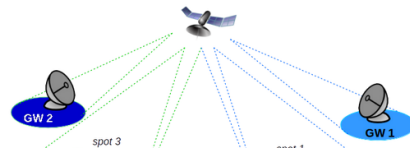
.I need to request a slot to use it...

.But I'm not the only one!

OpenSAND emulator



The screenshot shows the OpenSAND website header with navigation links: [About](#), [Get & Learn](#), [Contribute](#), and [Blog](#). It also features the OpenSAND logo and the NEOS 4EAT logo. The main content area has a dark space background with the logos of CNES (Centre National d'Études Spatiales) and ThalesAlenia Space (A Thales / Finmeccanica Company). Below the logos, a blue banner contains the text: *OpenSAND provides an easy and flexible way to emulate an end-to-end satellite communication system.*



Topology

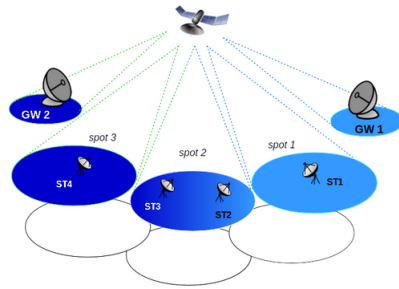
OpenSAND allows to emulate :

- mesh and star configuration schemes.
- as well as multispot and multigateway topologies.

http://opensand.org



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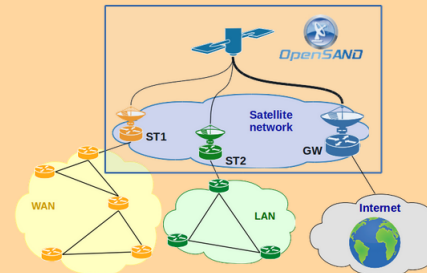
Topology

OpenSAND allows to emulate :

- mesh and star configuration schemes.
- as well as multispot and multigateway topologies.

Network-to-network Interconnection

OpenSAND supports IPv4, IPv6 and Ethernet connectivity. It can be interconnected with real equipment and other IP-based networks (terrestrial and/or satellite), or even the Internet backbone.



http://opensand.org



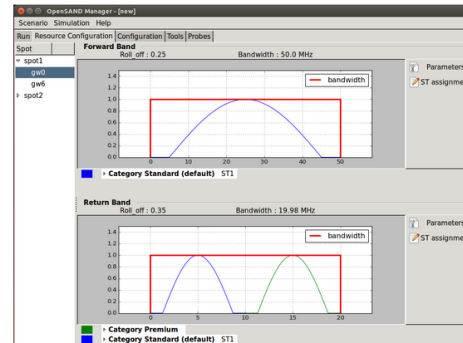
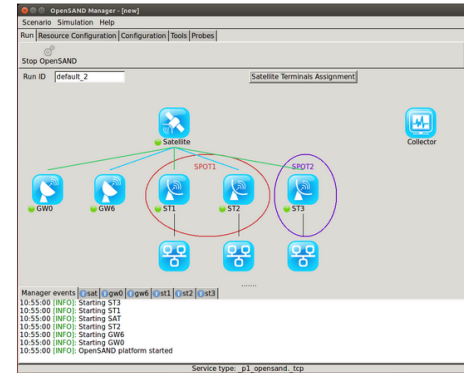
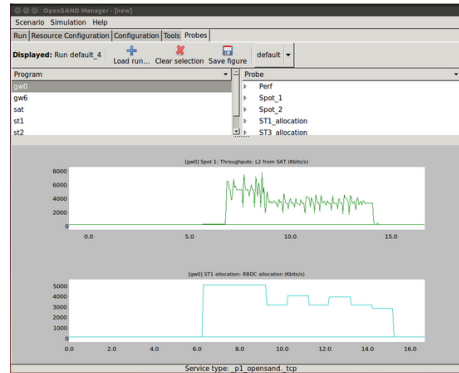
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Configuration & Supervision interface

Provides configuration and monitoring (real time and offline) tools allowing to evaluate the performance of the emulated scenarios.

Distributed platform where entities are automatically detected.



Let's consider this experimental path

.Note that I mainly test e2e components

-apps (assessing QoE), transport protocols, AL-FEC, erasure coding protocols (TETRYS, SWIF, RLNC...)

.A possible experimental path could be

1. simulation (basic algorithm)
2. emulation (with real apps, assessing QoE)
3. real testing (to confirm results)

Let's analyze

.If results are distant between simulation and emulation

-Not a problem to explain as we abstract/simplify the system

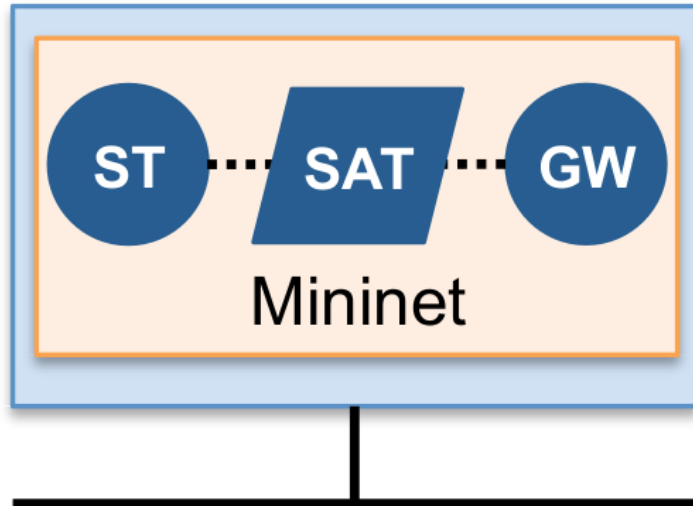
.What if results are distant between emulation and real testing?

-More subtle, where does the problem come from? Do I have set the right parameters? Are there hidden parameters? Is the comparison consistent? Can I expect the result?

The challenge → How can I trust my satellite experiments' outcome?

- QoS modeling of a satellite system can often lead to **non-conclusive or ambiguous results**
- It's a complex system
- We assess the performance of two of them
 - Mininet
 - OpenSAND
- With a VoIP scenario
 - Objective to assess either G711 or G723 performs better over SATCOM
- And estimate the distance with **real SATCOM** measurements₉

MININET



(b) Mininet standalone

- .Well-adopted network emulator

- .Gain popularity due to its capability to reproduce **trustable** experiments

- See:

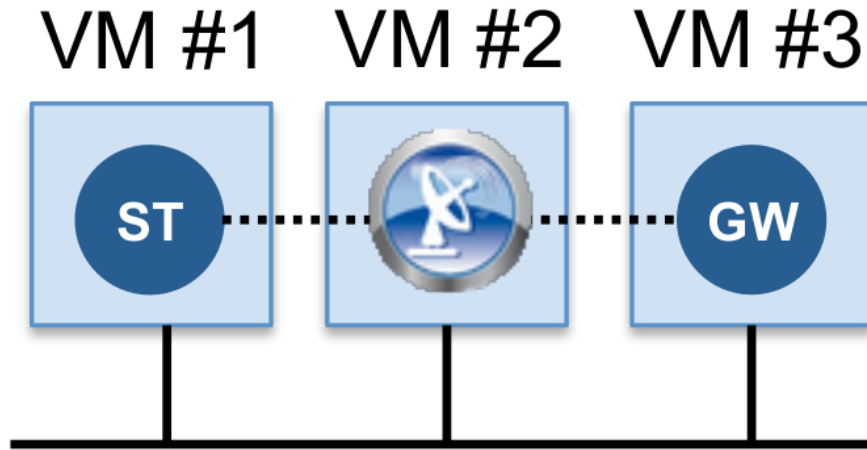
- <https://reproducingnetworkresearch.wordpress.com/>

- .VMs are utterly isolated

- The load does not impact performance

- .See: <http://mininet.org>

OpenSAND



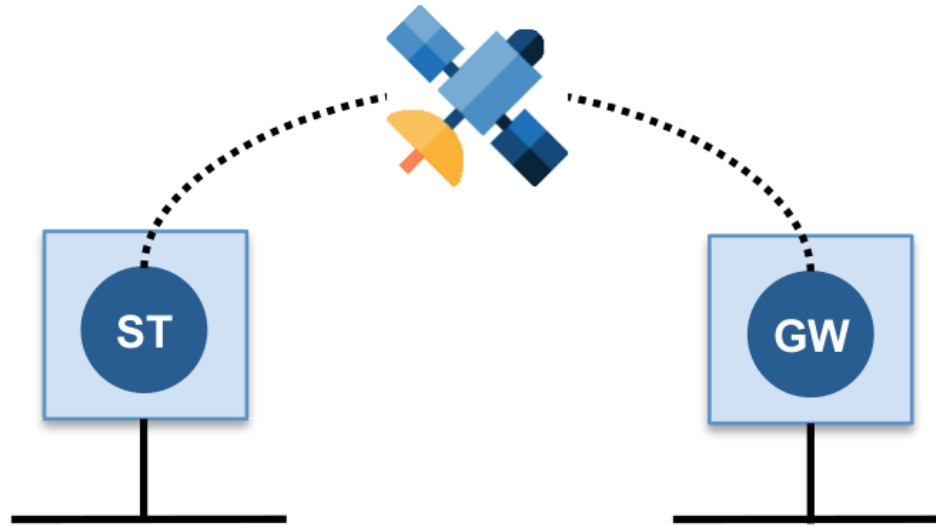
(c) OpenSAND emulator

- Realistic SATCOM emulation system provided by CNES
- Source code open
- Full-team working on it providing free support for users

•Visit:

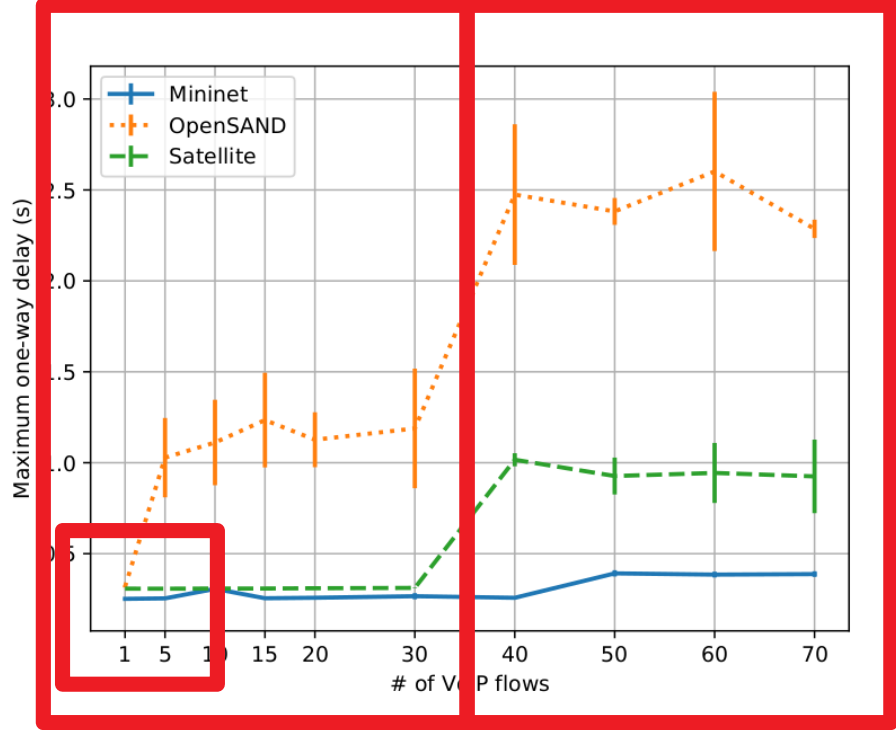
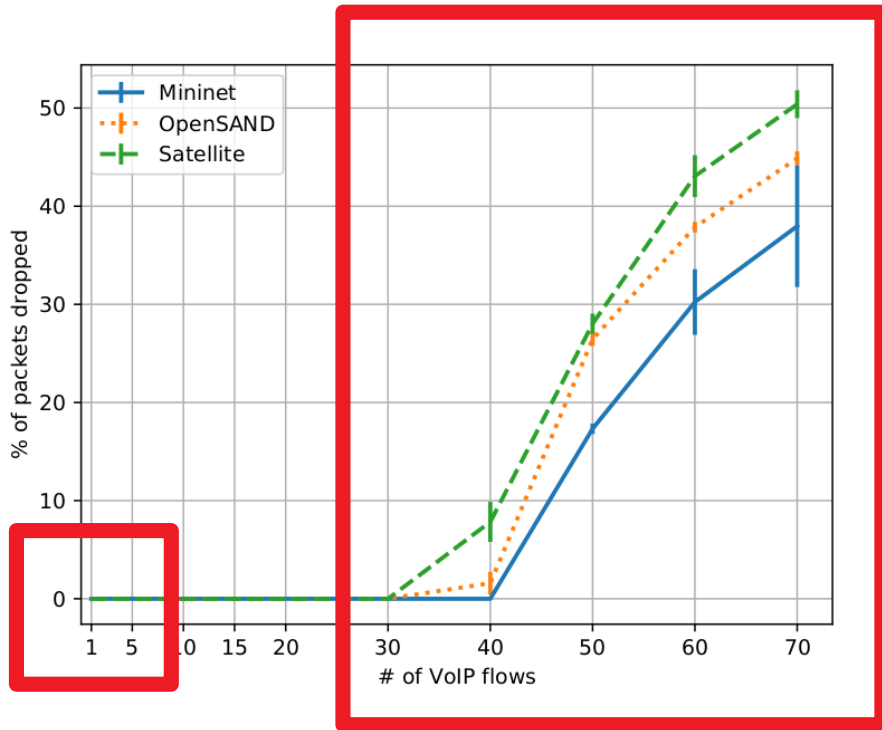
<http://opensand.org>

CESARS



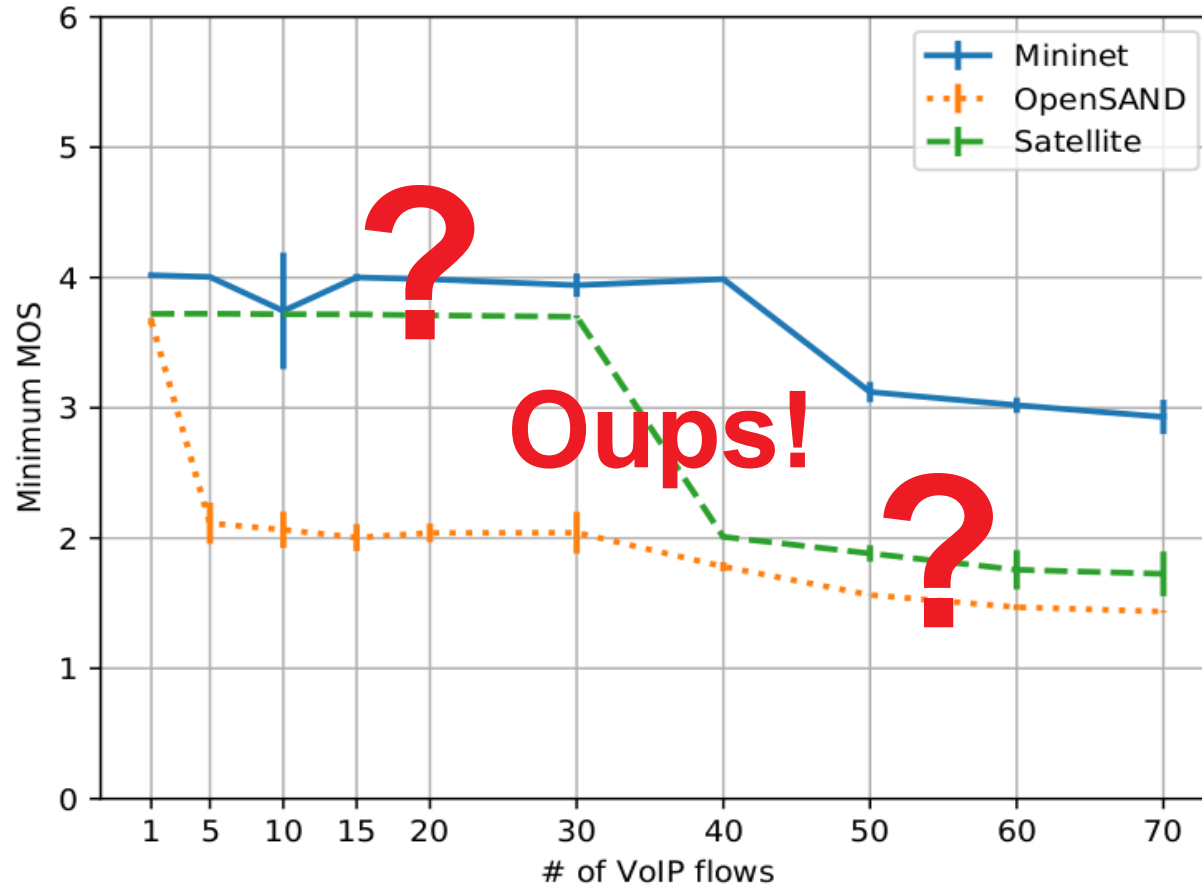
(a) Real satellite access (CESARS)

QoS metrics (loss, delay)

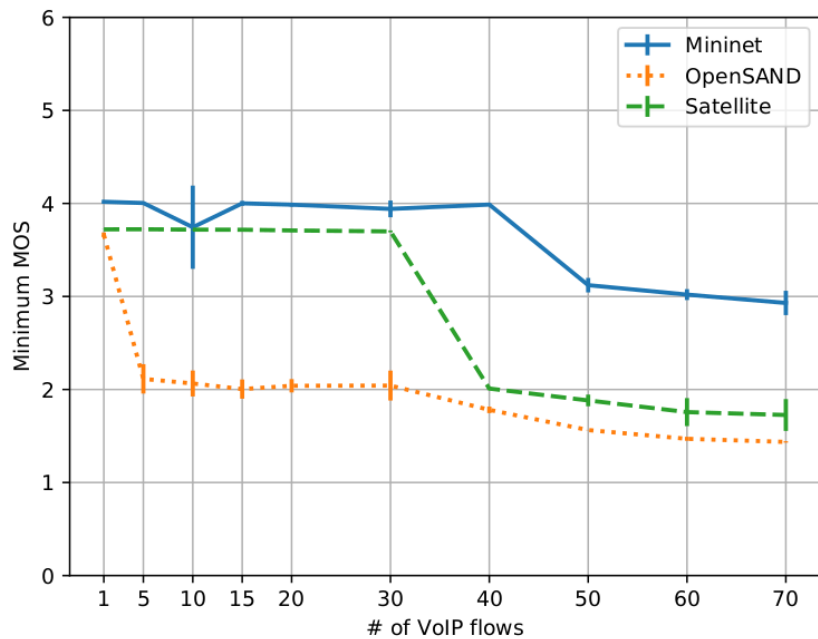


Theoretical saturation point is 35 flows

QoE metric \rightarrow MOS=f(QoS)



QoE metric (MOS)



.Mininet well-behaves before the saturation point but it's a side effect

.OpenSAND allocation scheme is **static CRA** and then **dynamic RBDC**

.We suspect real-link use **FCA-kind** scheme (confidential vendor)

Conclusion

- .Does my emulator reproduce all network conditions?
 - Think about **before/after the saturation point**
 - In our case: interested only above the saturation point
 - But we could have also tuned our emulator to mimic the whole behavior
- .When you know what you seek to measure, you know what you can choose
 - We wanted **guidelines**
 - Now ready to test other cases, codecs, video flows, etc
- .Use OpenSAND and **feedback us** your configs!
 - OpenSAND can be easily tuned to fit your real satellite link characteristics

Thank you

.Questions?