Making Trustable Satellite Experiments

an Application to a VoIP Scenario

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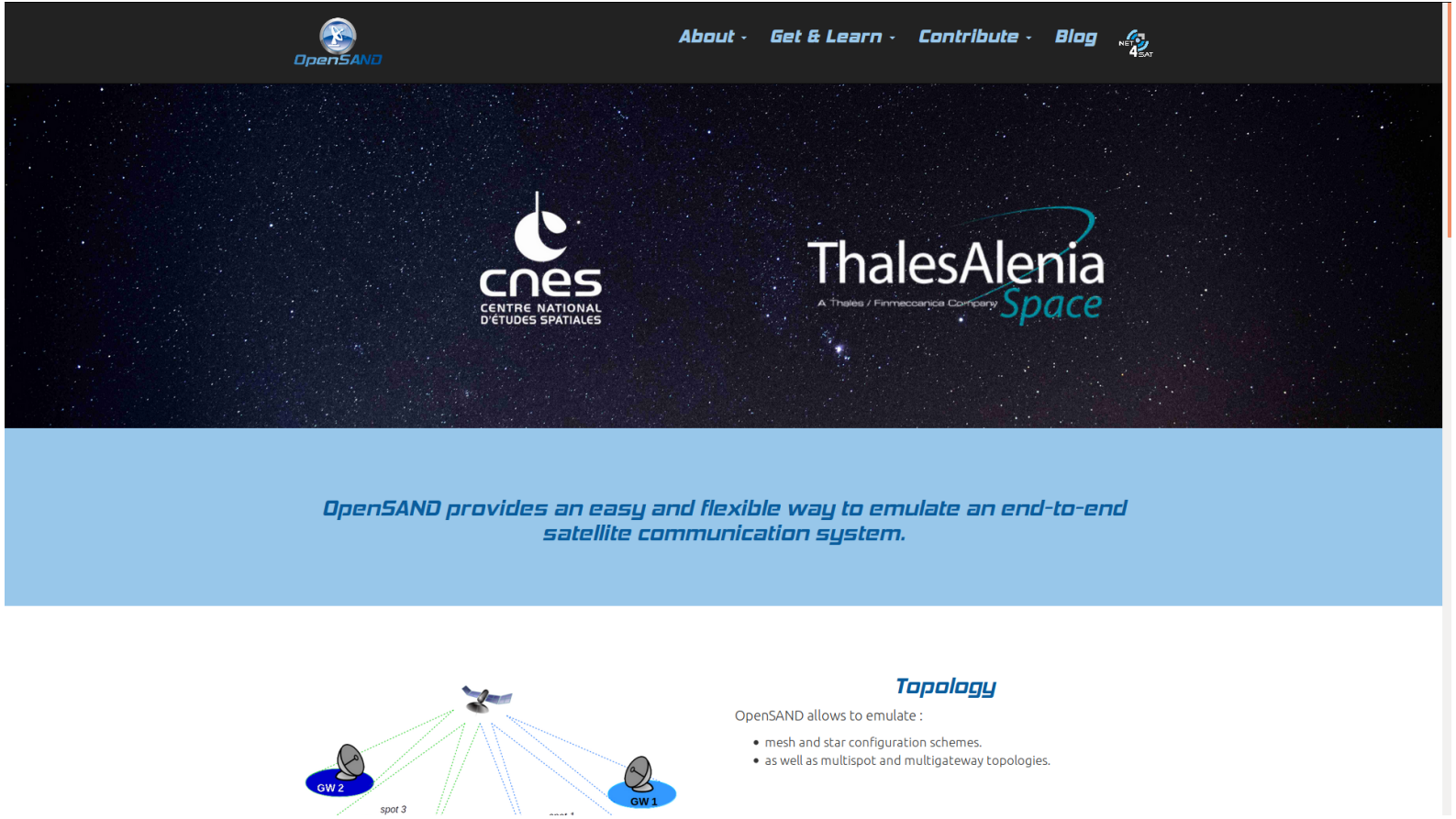
Motivation of this work

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

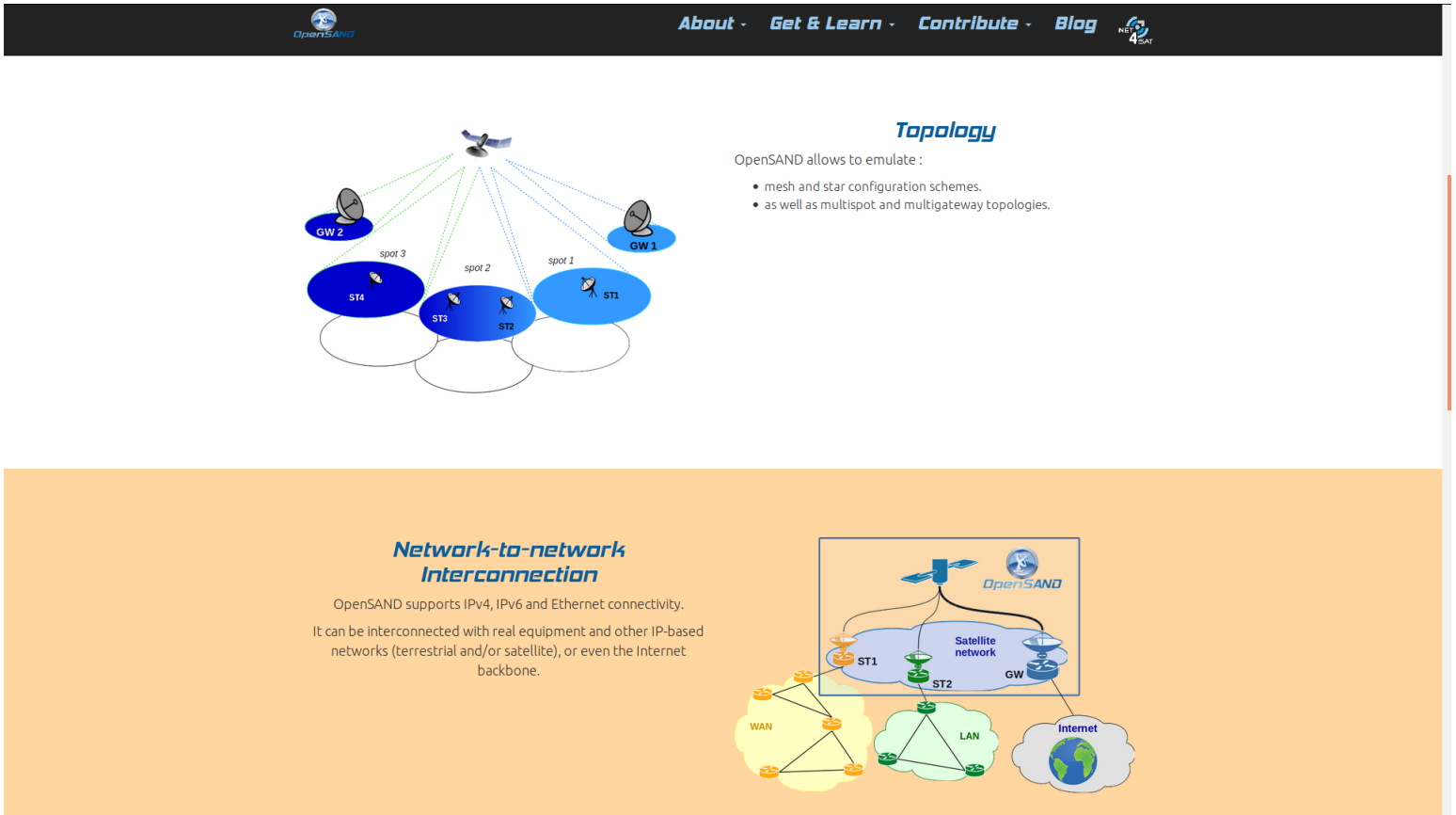
Lucky me, I can access to a SATCOM

- 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



http://opensand.org



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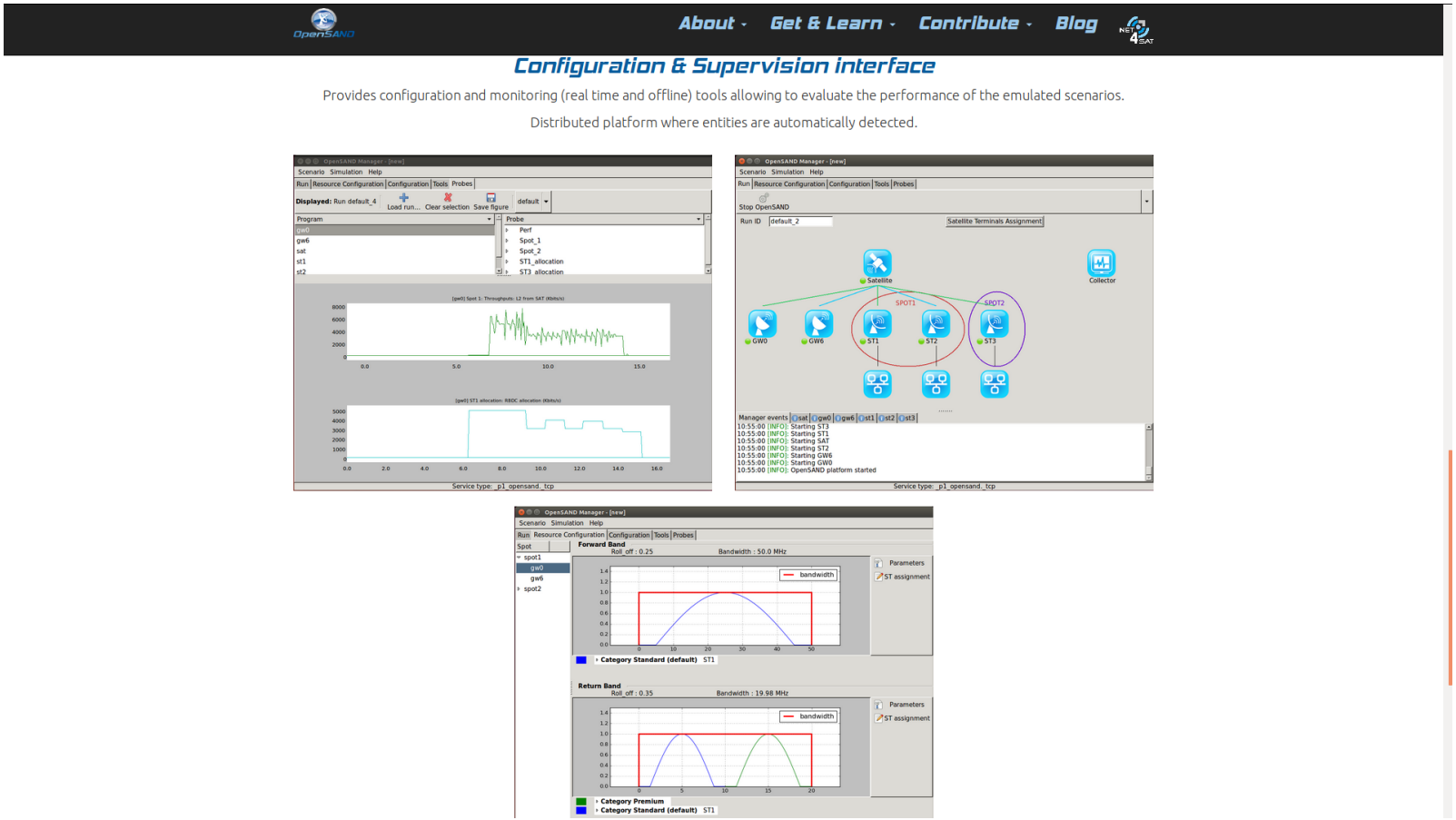


Let’s consider this experimental path

- 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)

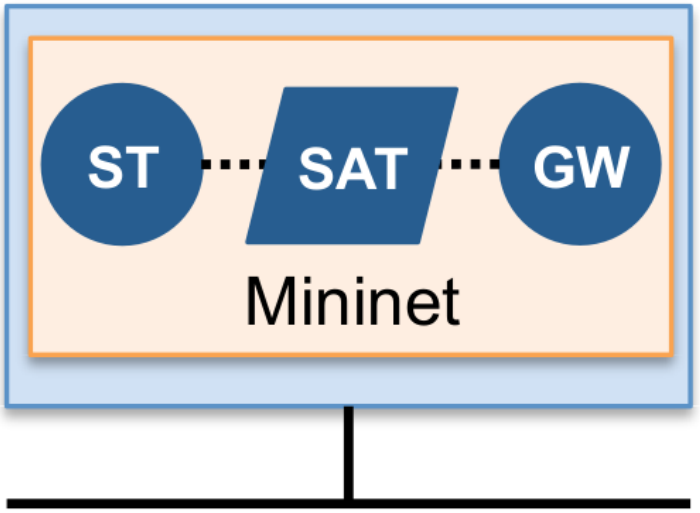
Let’s analyze

- 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** measurements

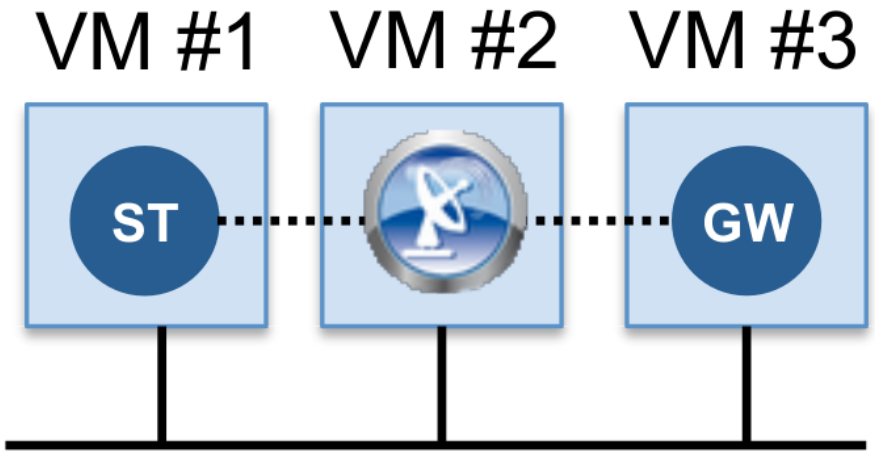
MININET



(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

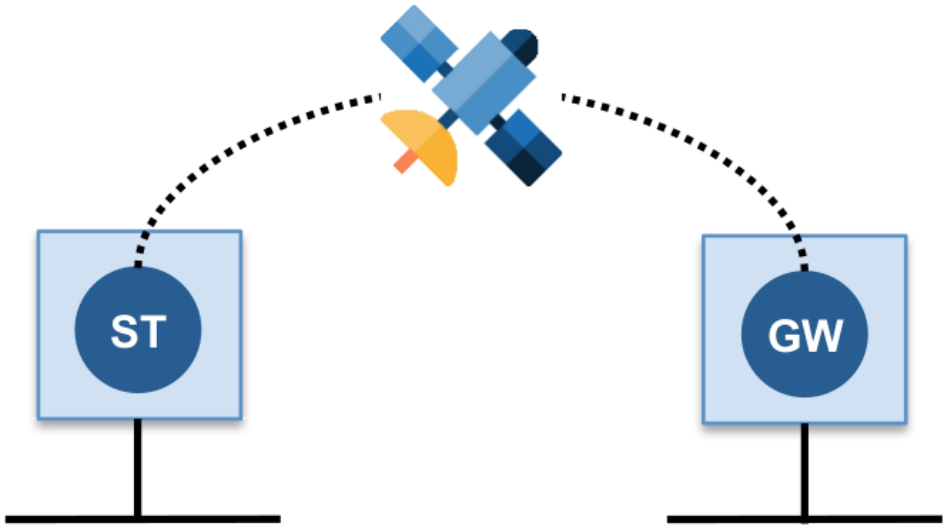
OpenSAND



(c) OpenSAND emulator

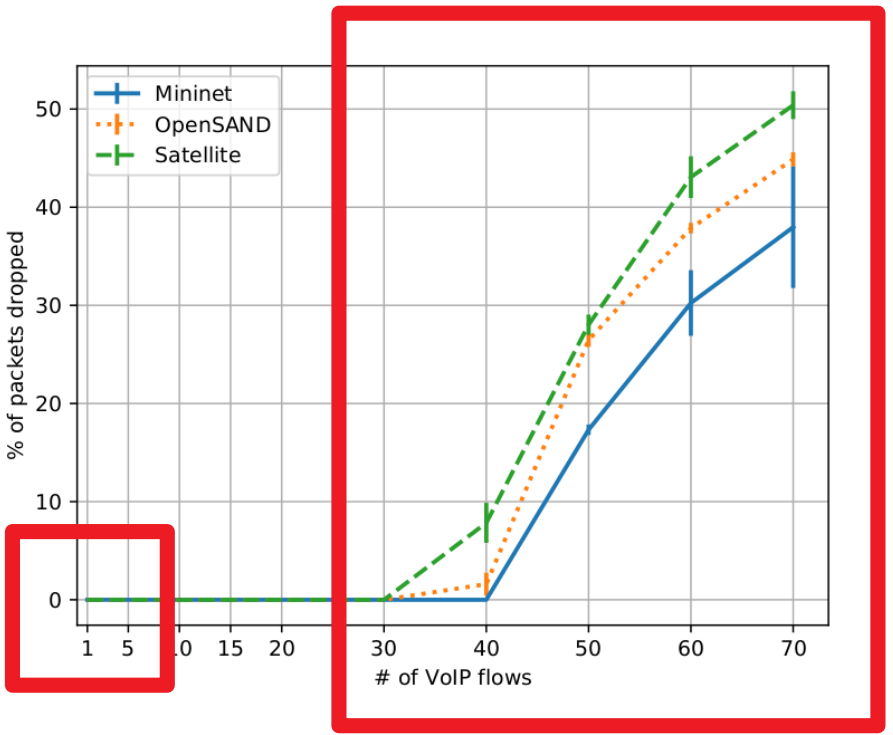
- Realistic SATCOM emulation system provided by CNES
- Source code open
- Full-team working on it providing free support for users
- Visit: http://opensand.org

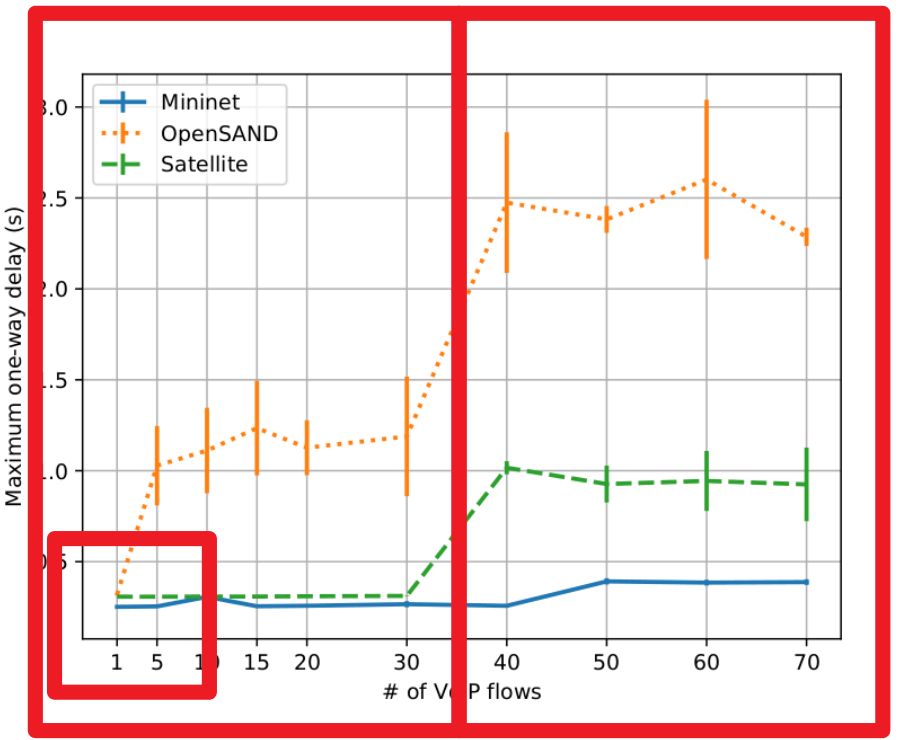
CESARS



(a) Real satellite access (CESARS)

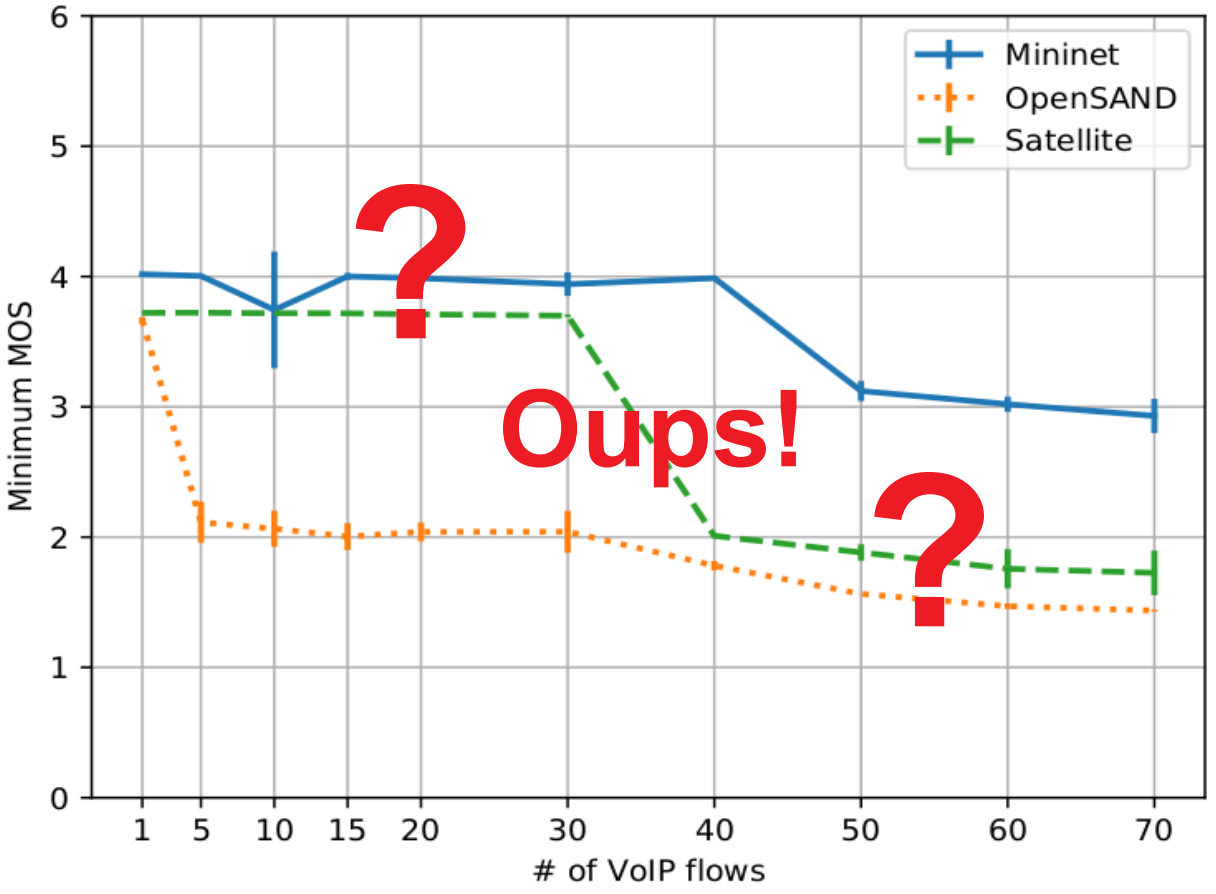
QoS metrics (loss, delay)



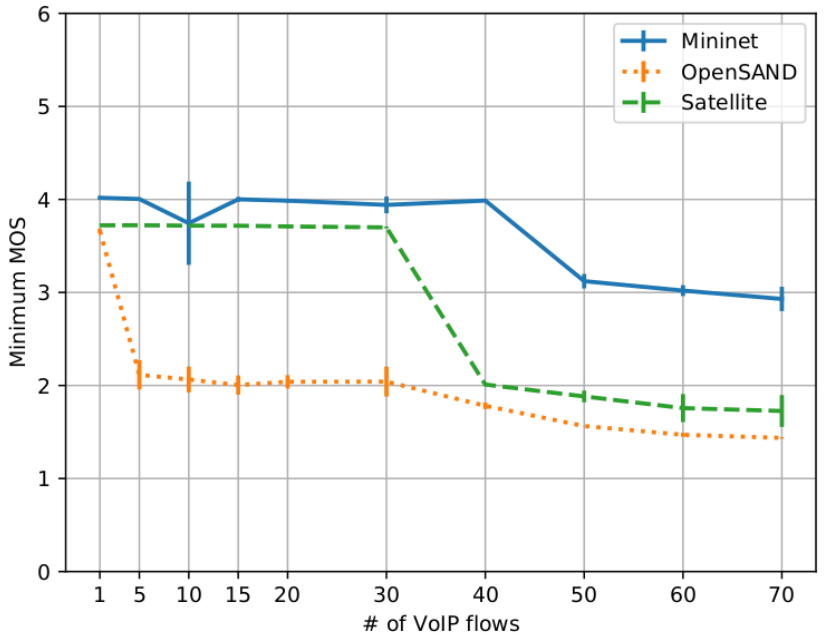


Theoretical saturation point is 35 flows

QoE metric → 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?