

A Multi-Node Emulation Environment for Challenged Networks (2)


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Outline



- Motivation
- Testbed Requirements
- Kasuari Framework
- Use Case
- Status
- To Do

Motivation

- Workshop paper “Integrating DTN and MANET Routing”
- Extending AODV RREQ/RREP with DTN router information
- Min. 5 nodes for testing, 10 for measurements, 50+ in the future
- Lack of hardware
- Different node placements and movements needed
- Different wireless network parameters needed
-  Simulation, emulation, virtualization
- Existing solutions are outdated, non-free or resource hogs

Create my own development testbed and measurement setup!

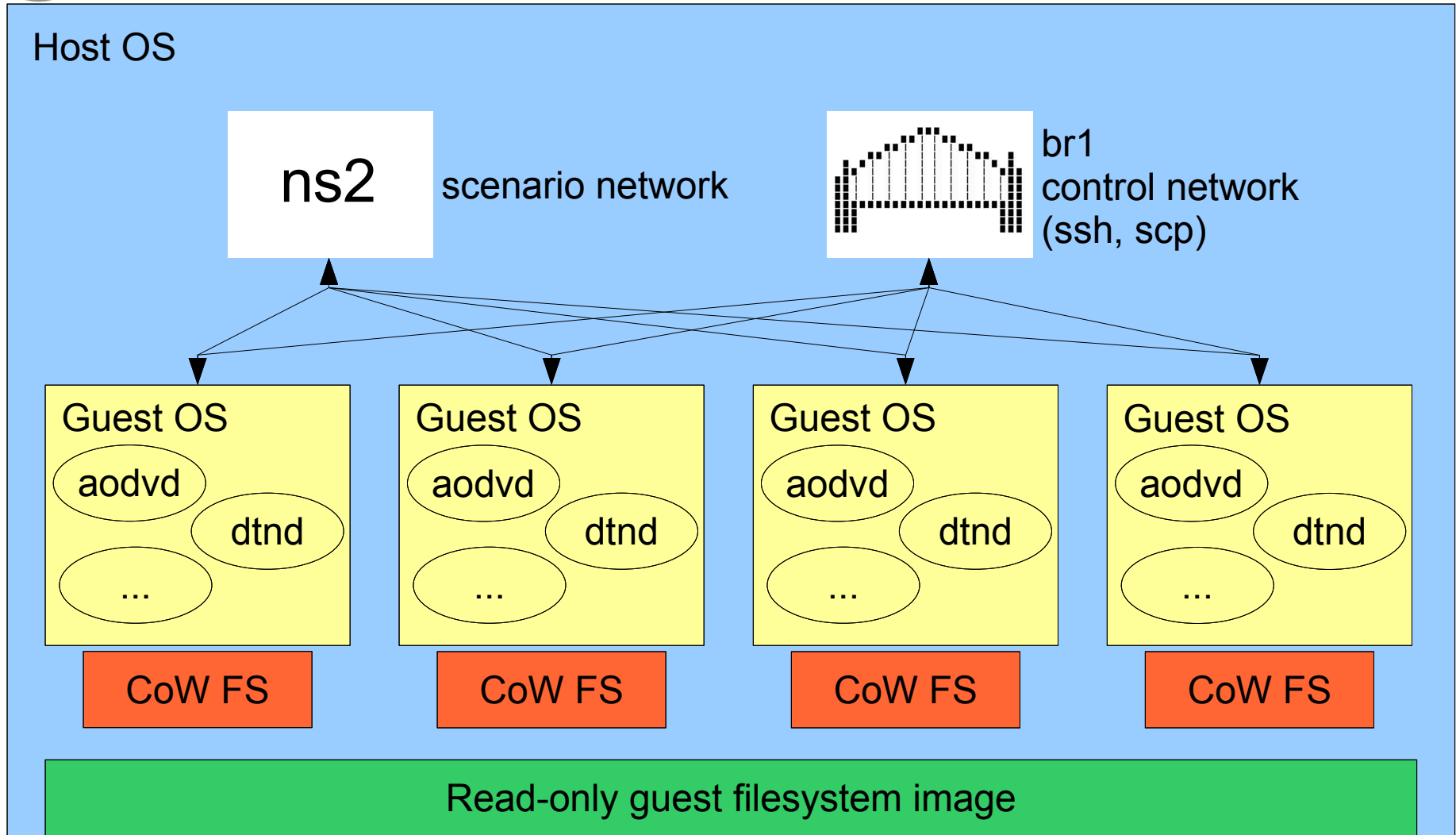
Testbed Requirements

- Easy scenario generation, common scenario specification format
- Proven and accepted network simulation and mobility models
- Scalability / low resource overhead
- Exactly reproduce scenarios
- Routing and DTN in kernel / userspace, not in simulator
- Quick bootup / shutdown process
- Shared filesystem image
- Per-node debugging
- Real-time movement visualization

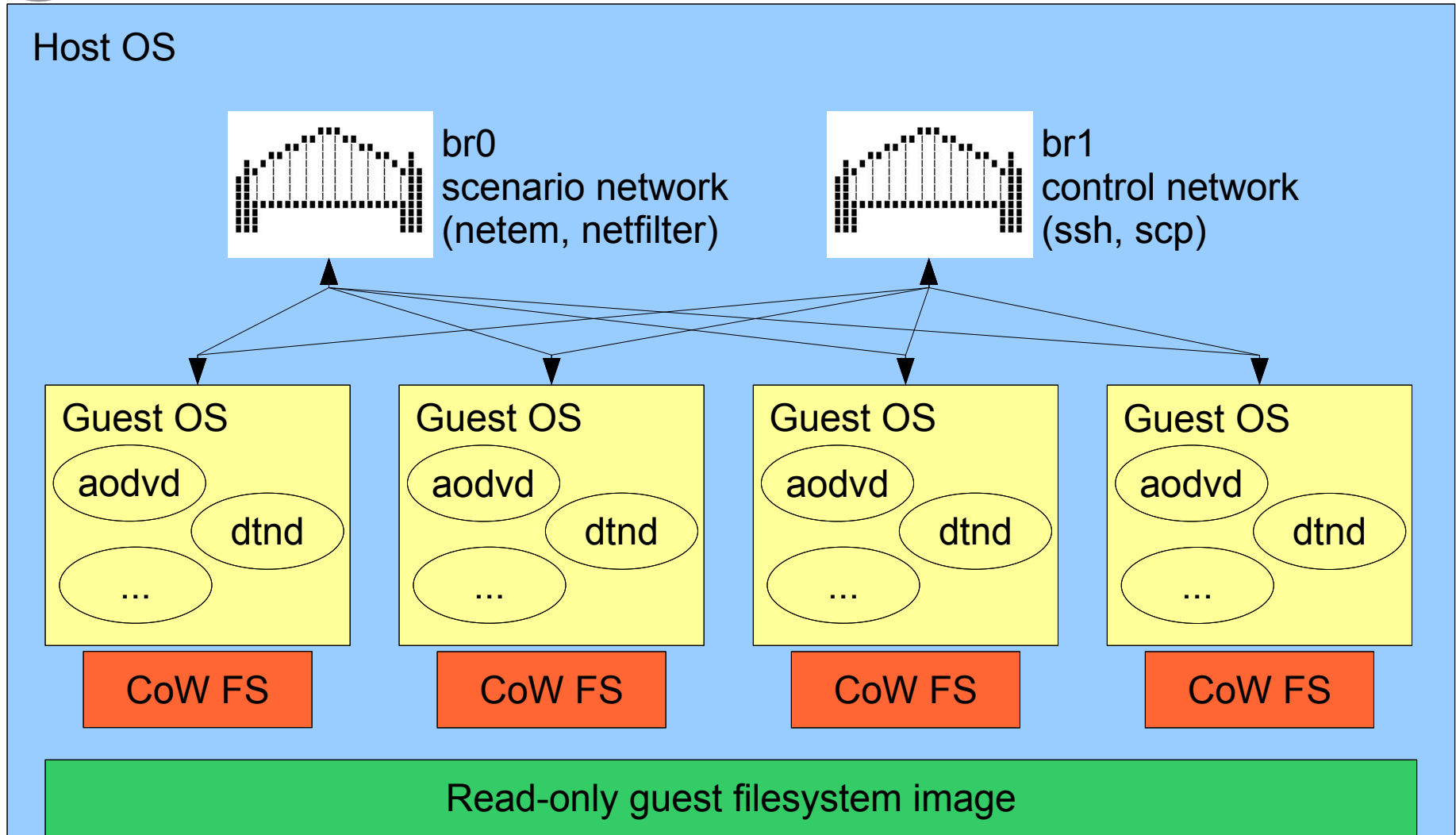
Kasuari Framework

- Custom Xen 3.0 / Linux 2.6.16 kernel
- Nsemulation: real-time ns2 with TAP device support
- Linux bridging / netfilter / netem
- Copy-on-Write block device driver (cowloop)
- Scripts to configure, create, net and shutdown VMs
- VM filesystem image containing Debian Linux with AODV and DTN implementations
- “Scenario wizard” for quick node setup
- Real-time visualization tool (nam)

Architecture (ns2 networking)



Architecture (bridge networking)

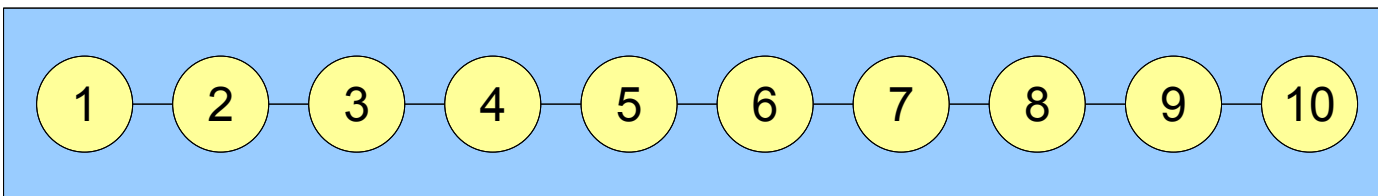


Use Case (Idea)

- Idea for workshop paper: use AODV reactive routing to disperse DTN Router information
- AODV RREQs/RREPs may carry a DTN Router Info Extension:
 - Contains DTN EID, DTN IP address / port, hop count, metric
- DTN enabled nodes add their DTN parameters to RREQ and RREP before forwarding it, and update their own tables
- A DTN enabled node who (is / has a valid path to) the destination copies the RI from the RREQ to the RREP
- If RI is not copied, RREQ forwarders will add missing RI
- If no RREP is observed by forwarding nodes after a timeout, they will generate RREQs themselves

Use Case (Coding & Testing)

- 10 Xen VMs with bridged networking, set up in a row



- Firewall rules allow only direct neighbour communication
- Each node runs:
 - modified AODV-UU (kernel module and userspace daemon)
 - DTN daemon with no configured links or routes
 - dtndctrl Perl script to feed routes from aodvd to dtnd
- Scripts for automated building, updating the fs image and VM startup/shutdown

Use Case (Measurements)

- Simulated wireless network in ns2: 10 nodes, 802.11
- 10 Xen VMs attached to ns2 (using link layer TAP devices)
- 200 meter transmission range on a 2000m x 600m field
- 30 minutes random walk, packet from node 1 to 10 every 2min
- If no direct path can be established, packet is sent as bundle
- Typical result:
 - 13 packets sent
 - 7 received over an end to end path (AODV forwarding)
 - 4 received as bundles
 - 2 bundles expired (expiration time 5 min)

Status

- First version of Kasuari released as Debian packages
 - deb <http://ftp.tzi.de/tzi/dmn/kasuari/debian/>
- Public SVN and Wiki in Trac
 - <http://prj.tzi.org/cgi-bin/trac.cgi/wiki/Kasuari>
- DTN Router Info patch for AODV-UU released (see Trac)
- Successful stress testing
 - 50 nodes, 60 minutes random walk
 - Ns2 2.29 and Xen 3.0 on a AMD Athlon XP 2400+ with 3GB RAM

To Do

- Use scripted bridging / netfilter / netem to net VMs
- Make it user friendly (“scenario wizard”)
- Run extensive AODV/DTN measurements
- Improve AODV-UU-DTN code
- Check out other routing protocols (DSR, PROPHET,...)
- Employ other mobility models
- Compare *DTN2* performance to SQLite-enabled *bundled*
- Release a Live CD for demonstration purposes
- Replace ns2 with MIRAI-SF or OMNeT++?

Further Applications

- Drive-Thru (PCMP)
- Multicast transport (FLUTE, IMG, Service Maps)
- P2P
- Real Time Multimedia (e.g. SIP over WLAN)
- ...