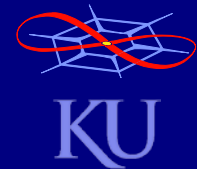# Mobile Wireless Networking
The University of Kansas EECS 882
MANET Routing Simulation with ns-3

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Ad Hoc Routing in ns-3
Outline

SR.1 Overview of MANETs in ns-3

SR.2 Ad hoc routing examples

SR.3 Laboratory assignment

Ad Hoc Routing in ns-3
Overview of MANETs in ns-3

SR.1   Overview of MANETs in ns-3

SR.2   Ad hoc routing examples

SR.3   Laboratory assignment

Mobile Ad Hoc Networks
Overview

- MANETs are typically
  - wireless
  - mobile
  - little or no reliance on infrastructure
  - communication among peers
  - limited network resources

Network Layer
Services and Functions

- Network layer provides services to layer 4
- Link layer provides services to layer 3
- Network layer operates both HBH and E2E
- Network layer functions are:
  - forwarding
  - routing
  - signalling
  - addressing
  - traffic management
- In MANETs are all of these functions available?

Routing in ns-3
Routing Protocols for Wired Links

- Global centralized routing
  - based on shortest path first algorithm
  - only for wired links (PPP and CSMA)
    - wireless nodes can use, but does not consider medium effects
  - unicast
  - `GlobalRouter` interface in each node advertises LSA
  - each node has a routing table

- Nix-vector routing
  - intended for large topologies
  - targeted for simulations with wired links

Routing in ns-3
MANET Routing Protocols in ns-3

- AODV: ad-hoc on demand distance vector
  - based on RFC 3561
- DSDV: destination-sequenced distance vector
  - developed by Hemanth Narra and Yufei Cheng @ ResiliNets
- DSR: dynamic source routing
  - developed by Yufei Cheng @ ResiliNets
- OLSR: optimised link state routing
  - mostly compliant with RFC 3626

Ad Hoc Routing in ns-3
Ad Hoc Routing Examples

Ad Hoc Routing Examples
Global Routing in ns-3

- Global centralized routing
  - by default added to node by `InternetStackHelper`
  - `Ipv4GlobalRoutingHelper::PopulateRoutingTables ();`

Ad Hoc Routing Examples
OLSR in ns-3

- ## OLSR routing

```
OlsrHelper olsr;
Ipv4StaticRoutingHelper staticRouting;
Ipv4ListRoutingHelper list;
list.Add (staticRouting, 0);
list.Add (olsr, 10);
InternetStackHelper internet;
internet.SetRoutingHelper (list);
internet.Install (nodes);
```

Ad Hoc Routing Examples
AODV in ns-3

- ## AODV routing

  ```
  AodvHelper aodv;
  InternetStackHelper stack;
  stack.SetRoutingHelper (aodv);
  stack.Install (nodes);
  Ipv4AddressHelper address;
  address.SetBase ("10.0.0.0", "255.0.0.0");
  interfaces = address.Assign (devices);
  ```

Ad Hoc Routing in ns-3
Laboratory Assignment

SR.1 Overview of MANETs in ns-3

SR.2 Ad hoc routing examples

SR.3 Laboratory assignment

Ad Hoc Routing in ns-3
Assignment Configuration$_1$

- Only 4 STA nodes
  - in ad-hoc mode
- Default physical and channel characteristics
  - optional: add propagation and loss model of your choice
- Non-QoS MAC with default configuration
- CBR traffic
- IP address block of your choice
- Enable `ASCII` tracing
  - for all *IPv4 interfaces* (`EnableAsciiIpv4All`) and *mobility*

Ad Hoc Routing in ns-3
Assignment Configuration$_2$

- Mobility model to use `GaussMarkovMobilityModel`
  - with default values in 2D
    - only x and y coordinates
  - set initial positions randomly
- Routing: DSDV
  - with default values
- Submission deadline: 25 April 2016

Ad Hoc Routing in ns-3
Extra Credit

- Using the same DSDV configuration, except:
  - use DSR routing protocol
- Briefly contrast the two routing models...
- ... from a simulation point of view
  - advantages/disadvantages?
  - easiness/difficulty?
  - briefly compare in few sentences (open question)
  - answer it only if you are sending the DSR simulation model
    - will not grade pure theoretical answers

Ad Hoc Routing in ns-3
Assignment Submission Guidelines

- Write 1–2 page summary
- Report should include the following sections:
  – experiment setup and procedure (topology, issues, etc.)
  – conclusions (what you learned, etc.)
- You can discuss with other students but …

  … everyone must submit individual report
- Attach .cc file along with your submission
- Send report in PDF `to:` GTA and `cc:` Dr. Sterbenz

Ad Hoc Routing in ns-3
EECS 882 Assignment Submission Guidelines

- Send only source files (.cc, .pl, .pdf, etc.)
  - this means no .zip, zipped, .tar files
  - no reason to send trace files
- Always `to:` GTA *and* `cc:` Dr. Sterbenz
- *Brownie points for identifying and fixing ns-3 bugs*
- ns-3 scripts will be graded based on
  - functionality
    - major grade will be deducted for errors!!!
    - warnings will reduce your grade as well
  - documentation
    - use sensible file names: e.g. lab1_ikus.cc

Ad Hoc Routing in ns-3
EECS 882 Commenting Guidelines

- Use comments as necessary:
  - Boilerplate... (optional)
  - //GNU release blah ...
  - /* File name: lab1_ikus.cc
  - Purpose: This is a sample script etc.
  - Author: Ima KU Student
  - Date: 24 October 2011
  - Version: 1 */
  - #include <iostream.h>
- Use comments for block of codes:
  - // This is an example comment for a block of code

Ad Hoc Routing in ns-3
Further Reading

- *Finish all tutorial chapters* (if you haven't yet)

  http://www.nsnam.org/docs/release/3.25/tutorial/singlehtml/index.html
  http://www.nsnam.org/docs/release/3.25/manual/singlehtml/index.html
  http://www.nsnam.org/docs/release/3.25/models/singlehtml/index.html
  http://www.nsnam.org/docs/release/3.25/doxygen/index.html

- AODV API

  http://www.nsnam.org/docs/release/3.25/doxygen/group__aodv.html
  http://www.nsnam.org/docs/release/3.25/models/singlehtml/index.html#document-aodv

- DSDV API

  http://www.nsnam.org/docs/release/3.25/doxygen/group__dsdv.html
  http://www.nsnam.org/docs/release/3.25/models/singlehtml/index.html#document-dsdv

- OLSR API

  http://www.nsnam.org/docs/release/3.25/doxygen/group__olsr.html
  http://www.nsnam.org/docs/release/3.25/models/singlehtml/index.html#document-olsr

- DSR API

  http://www.nsnam.org/docs/release/3.25/doxygen/group__dsr.html
  http://www.nsnam.org/docs/release/3.25/models/singlehtml/index.html#document-dsr

Ad Hoc Routing in ns-3
Acknowledgements

Some material in these foils comes from the ns-3 tutorial presentations from conferences, workshops:

- Tom Henderson, *ns-3 tutorial*
  SIMUTools 2009
  `http://www.nsnam.org/tutorials.html`

- Gustavo Carneiro, *NS-3 Tutorial*
  RTCM 2009
  `http://telecom.inescporto.pt/~gjc/NS-3-RTCM.pdf`

- Hemanth Narra, Yufei Cheng, Egemen K. Çetinkaya, Justin P. Rohrer, and James P.G. Sterbenz, "Destination-Sequenced Distance Vector (DSDV) Routing Protocol Implementation in ns-3" in *ICST WNS3,* Barcelona, March 2011

Ad Hoc Routing in ns-3
Other References

- C++ tutorials online
  - `http://www.cplusplus.com/doc/tutorial/`
  - and many more links and books on the subject
- GDB
  - `http://www.gnu.org/software/gdb/`
- valgrind
  - `http://valgrind.org/`
- gnuplot
  - `http://www.gnuplot.info/`
- Python
  - `http://www.python.org/`