UNIVERSITY OF SCIENCE AND TECHNOLOGY OF HANOI

USTH
VIETNAM FRANCE UNIVERSITY

Network Simulation

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Course Information

- Prerequisites:
  - Basic Programming
  - Computer Networks
- Materials: NS-3 tutorial
- Class organizing:
  - Groups: 5-6 students/group
  - Attendance check: fingerprint, exercise submission…
  - Online classes: google classroom classcode 7ozrrxr
- Assessment:
  - Attendance (absent >30% not allow to join final examination)
  - Project Report (40%)
  - Final exam: Presentation (60%)

Course plan

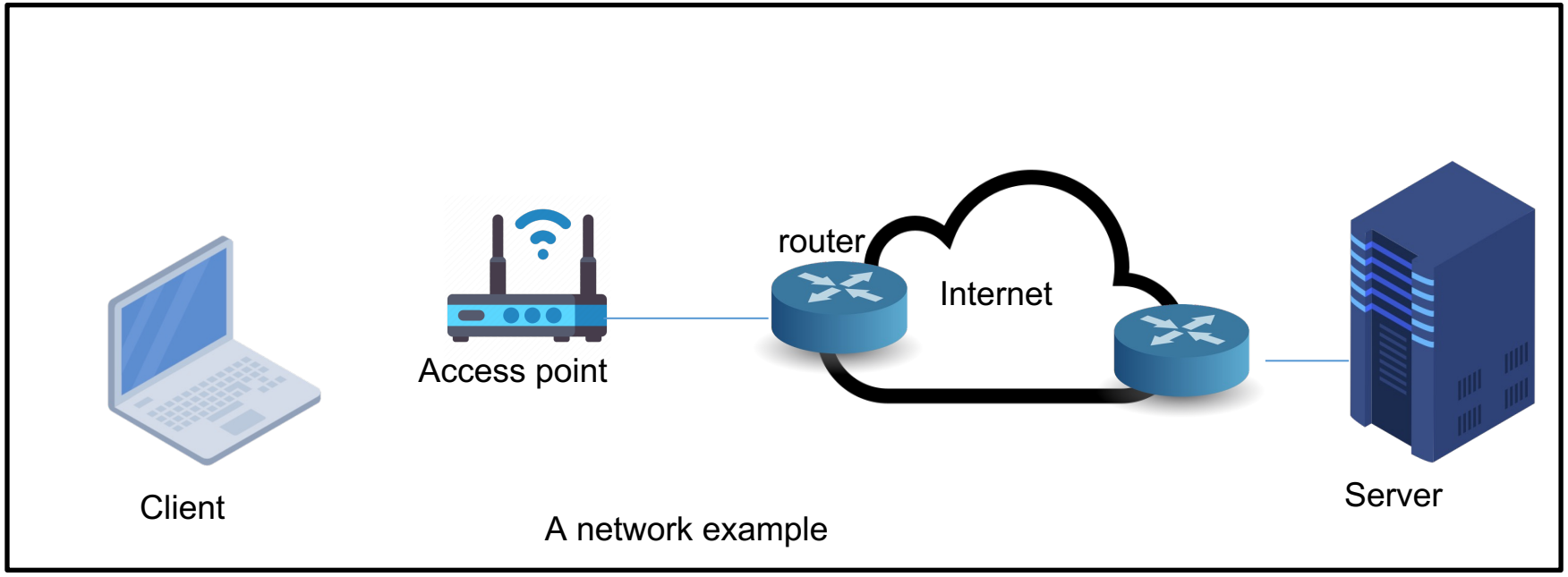
1. Introduction to Network Simulation
2. Computer Networks revise
3. Network models in NS-3
4. Design simulation scenarios
5. Implement simulation scenario in NS-3
6. Logging and analyze results

Lecture 1: Introduction

- What is Network Simulation?
- Why NS is necessary?
- The tool: NS-3
- Practical time

What is Network Simulation?

- Research method of computer networks
- Modeling the behavior of a network:
  - Interaction between network entities (?)



A network example

What is Network Simulation?

- Roles:
  - Network design
  - Analyzing network performance
  - Testing behavior of various applications:
    - Modeling network topology
    - Modeling, visualizing and logging application flow (traffic)

What is Network Simulation?

- Tools:
  - Network simulator: a software modeling network entities
  - Network emulation: a test network with real devices

Why NS is necessary?

- Wireless technology increasing rapidly
- Unproven protocols must be tested before executed in real world and in large scale
- Network simulation is useful and economic

The tool NS-3

- What?
  - A discrete-event network simulator
  - C++ or Python
- Why?
  - Open-source project
  - On-going contribution
  - Available model set:
    - Internet protocols
    - Wireless networks: Wifi, Wave, LTE…

How NS-3 simulates Computer Networks?

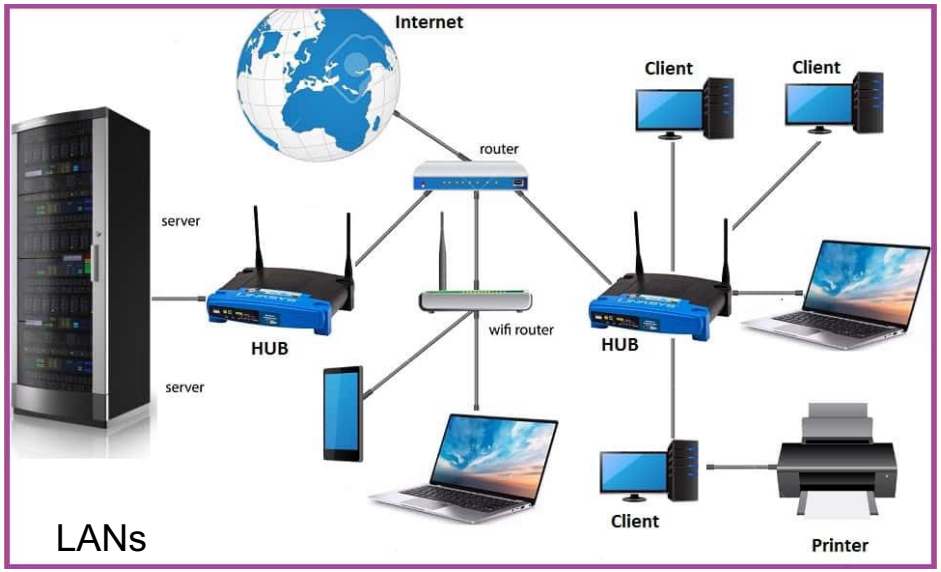
- Computer networks:
  - Computers interconnect by a single technology
  - Uses:
    - Business application
      - Resource sharing
      - VPN
      - Client-Server model
    - Home applications
      - Internet
      - Peer-to-peer communication
      - E-commerce
    - Mobile networks

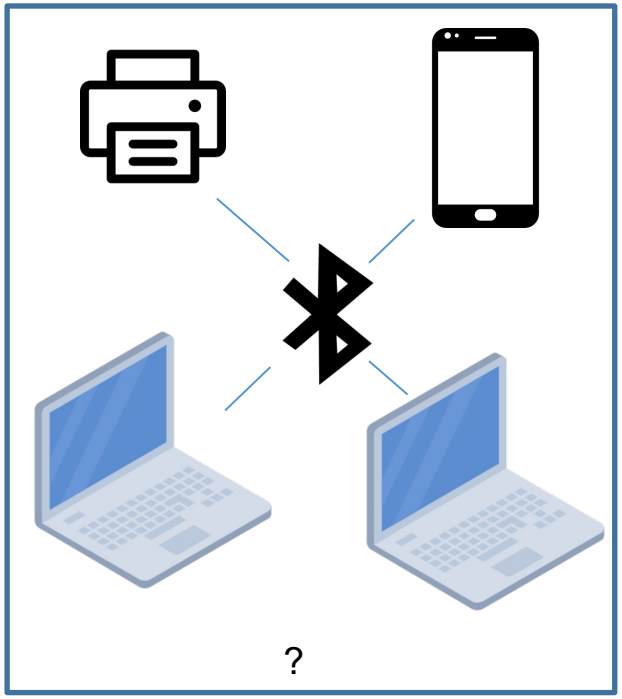
Textbook: Andrews S. Tannebaum, Computer Networks, 4th edition, Prentice Hall, 2002.

Computer Networks

- Network hardware
  - Transmission technology: broadcast, multicast and unicast
  - Scale:
    - Personal Area Networks (PANs)
    - Local Area Networks (LANs)
    - Metropolitan Area Networks (MANs)
    - Wide Area Networks (WANs)
    - Internetworks

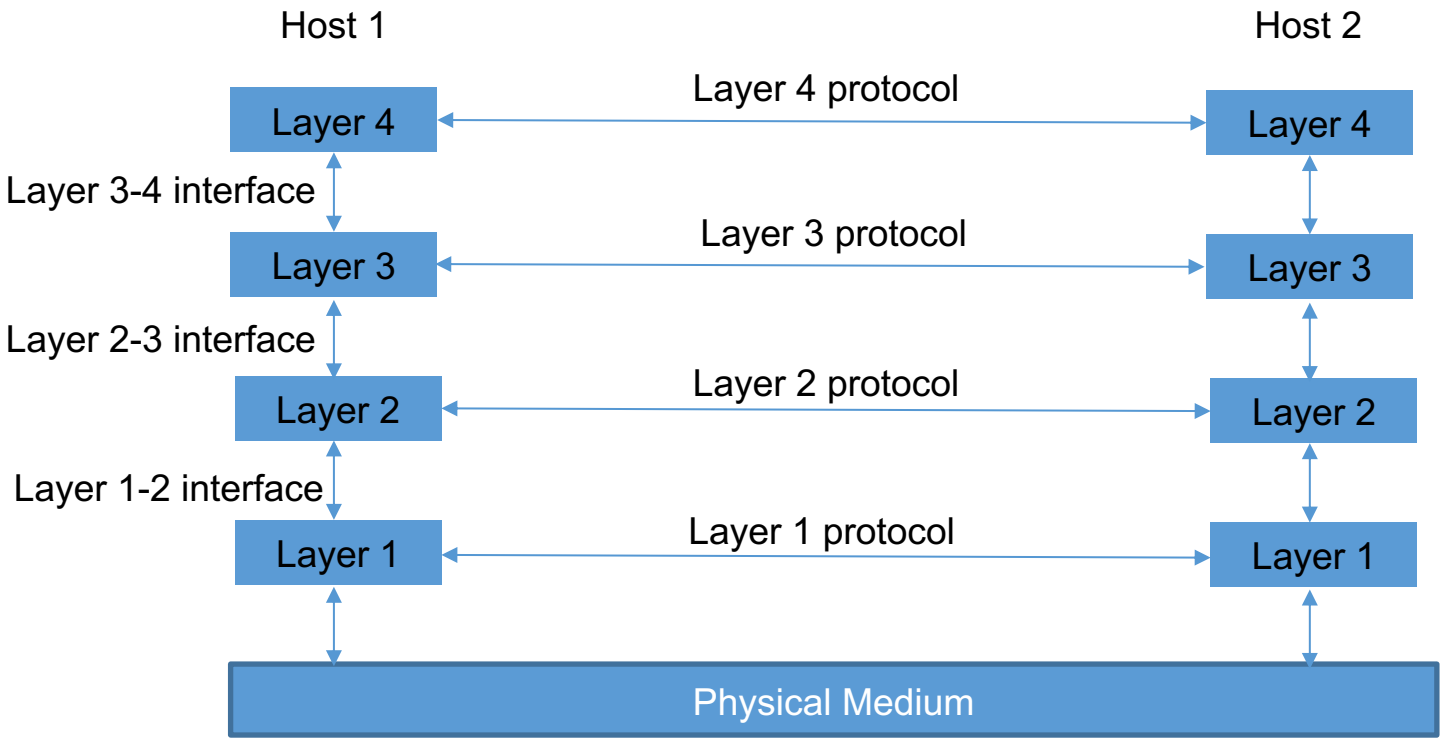
Examples


Internet
Client
Client
router
server
HUB
wifi router
HUB
server
Client
Printer
LANs

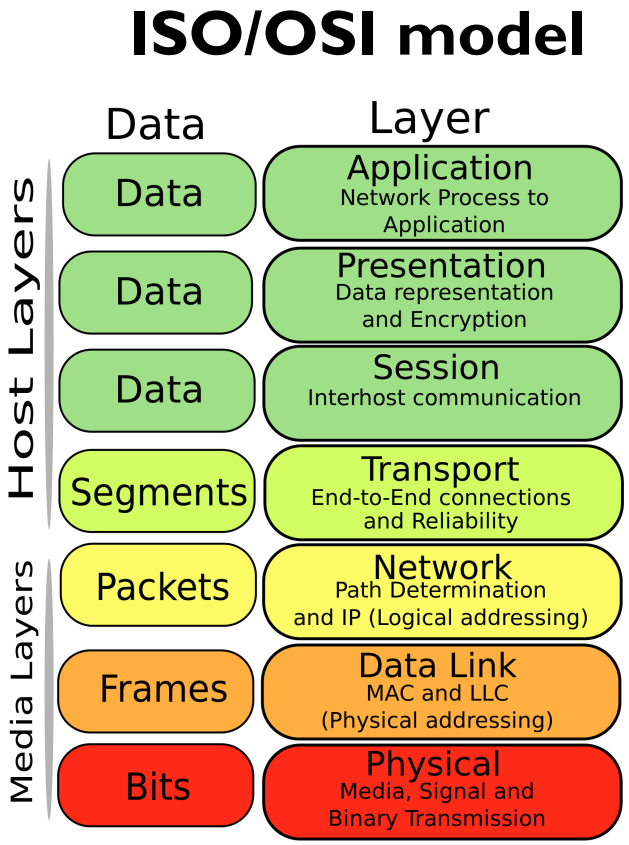

?

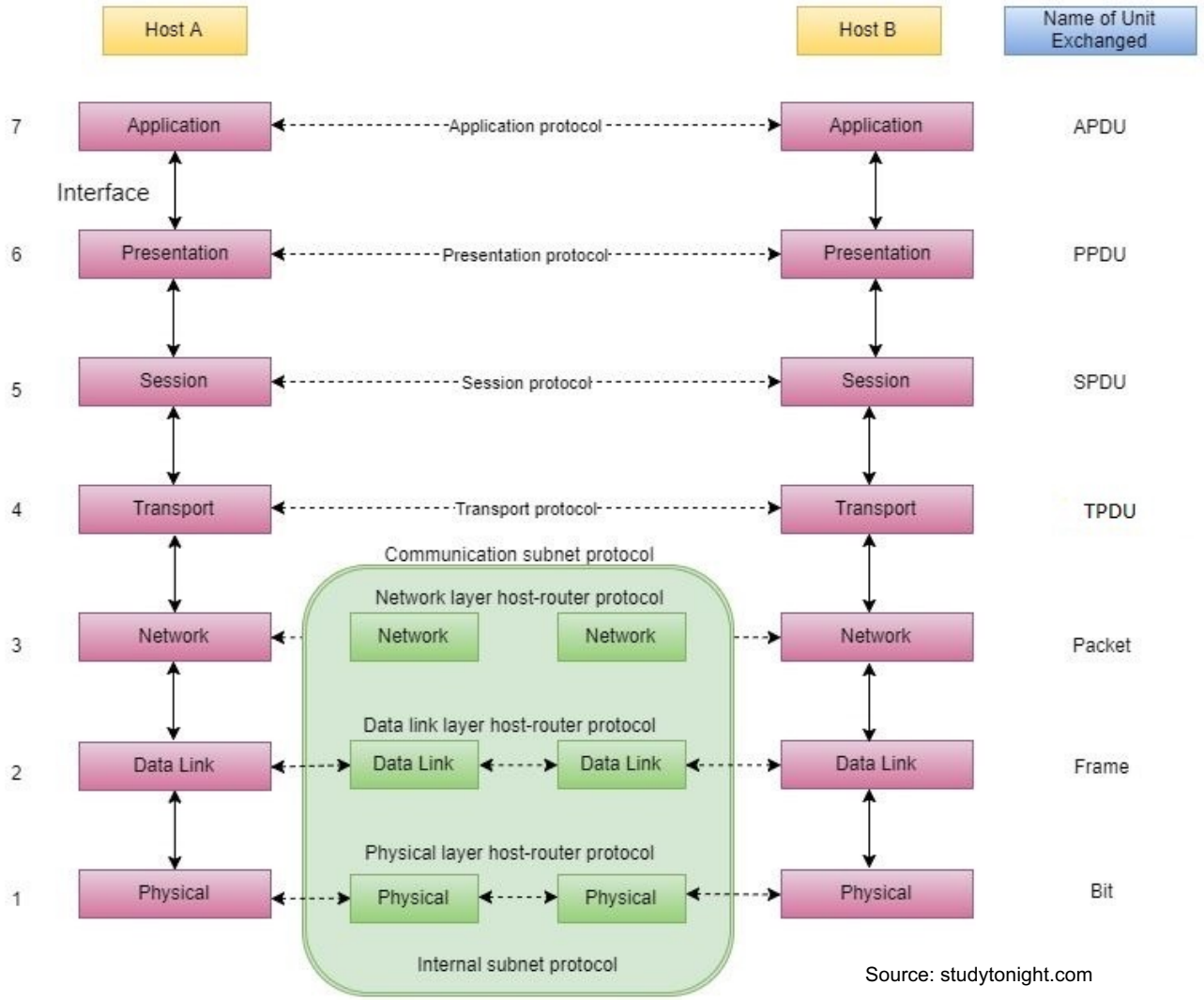
Computer Networks

- Network Software:
  - Layers, protocols and interfaces



Reference Model

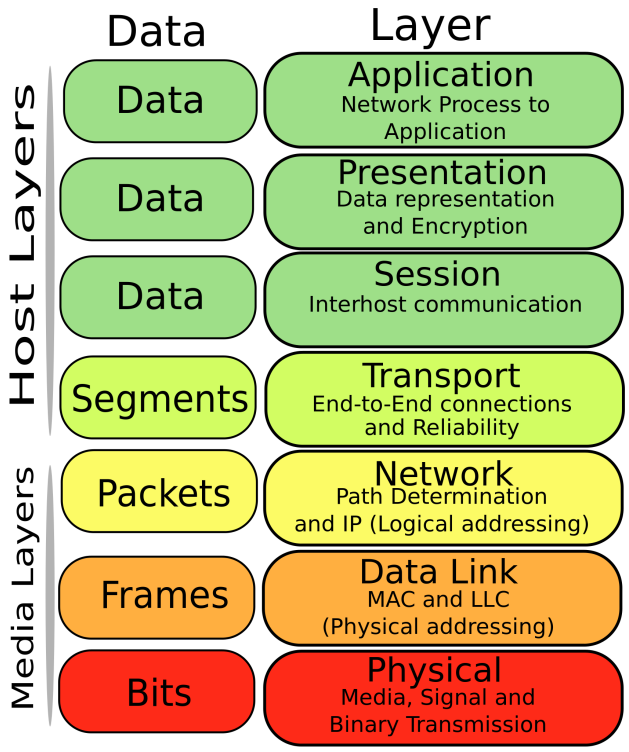




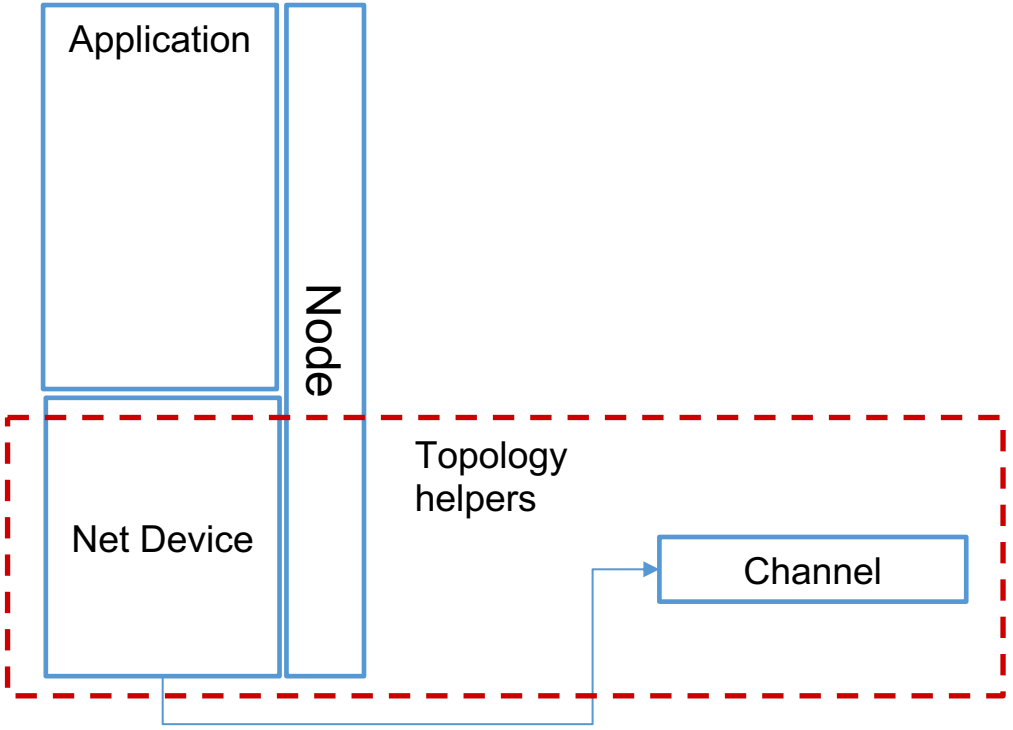
Source: studytonight.com

NS-3 Key Abstractions

OSI model



Classes in NS-3



The tool NS-3

- How to use?
  - NS-3 tutorial: https://www.nsnam.org/docs/release/3.32/tutorial/ns-3-tutorial.pdf
  - A C++ project

The tool NS-3

- Resources:
  - The Web: https://www.nsnam.org/documentation/
  - Source code management system: GitLab.com
  - Build system: Waf
  - Development Environment: Unix-like

Practical time

- Download and Install NS-3.39
- Run first.cc in tutorial

Practical time

- Download and Install NS-3.39
  - Prequisites:
    - Gcc/g++ 4.9 or greater or clang compiler
    - Python 3.5 or greater
  - Installation:
    - Using bake
    - Using Git (Manual installation):
      - git clone https://gitlab.com/nsnam/ns-3-allinone.git
      - Cd into ns-3-allinone and run ./download.py -n ns-3.39
      - Cd into ns-3.39, configure and build:
        - ./ns3 configure
        - ./ns3 build

    https://www.nsnam.org/wiki/Installation#Installation

Notes: suggestions for installation

- Ubuntu: follow tutorial
- Window:
  - install Ubuntu application
  - Install ns-3 on Ubuntu app
- MacOS:
  - Install Docker, pull Ubuntu image
  - Run Ubuntu container
  - Install ns-3 on a Ubuntu container
- Trouble shooting:
  - 'pybindgen(ns3 module antenna)' failed: https://www.nsnam.org/wiki/Ns-3.35_errata

Practical time

- Configuration and Run with ./ns3
  - Configuring: ./ns3 configure
  - Running the file ns-3.39/scratch/scratch-simulator.cc

    ./ns3 --run scratch-simulator

Practical time

- Labwork 1:

Consider a C program ../ns-3.34/example/tutorial/first.cc

1. Run the program
2. Explain the scenario
3. What protocols are implemented in the example?
4. What are the sender and receiver? How network traffic is generated?