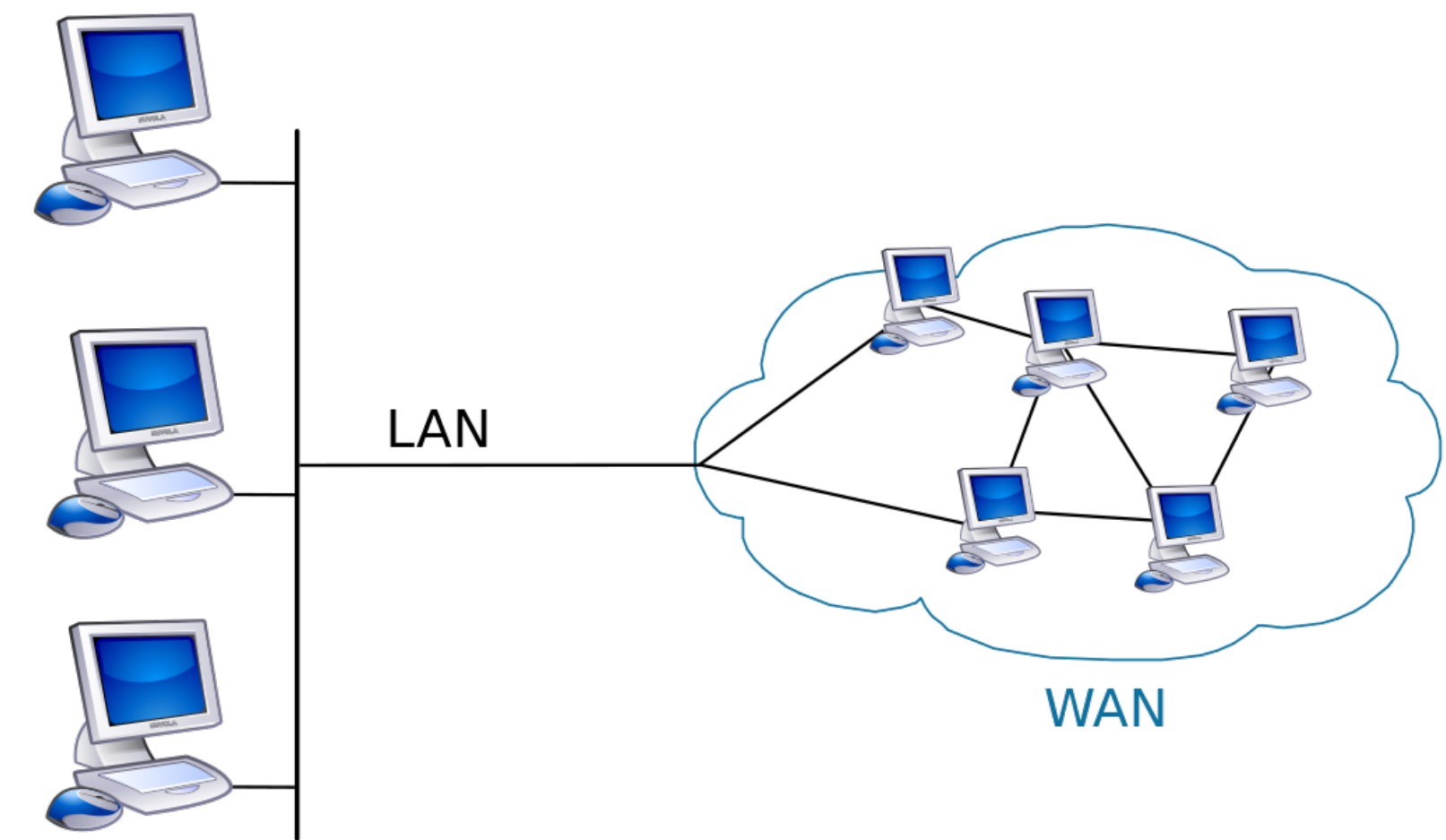


Internet traffic optimization using Reinforcement Learning

DSR Batch 29 Portfolio Project

Special thanks to:
Adam Green,
Tristan Behrens, and
The Data Science Retreat
Github Repo available at: https://github.com/khuss/RL_Network_Routing.git



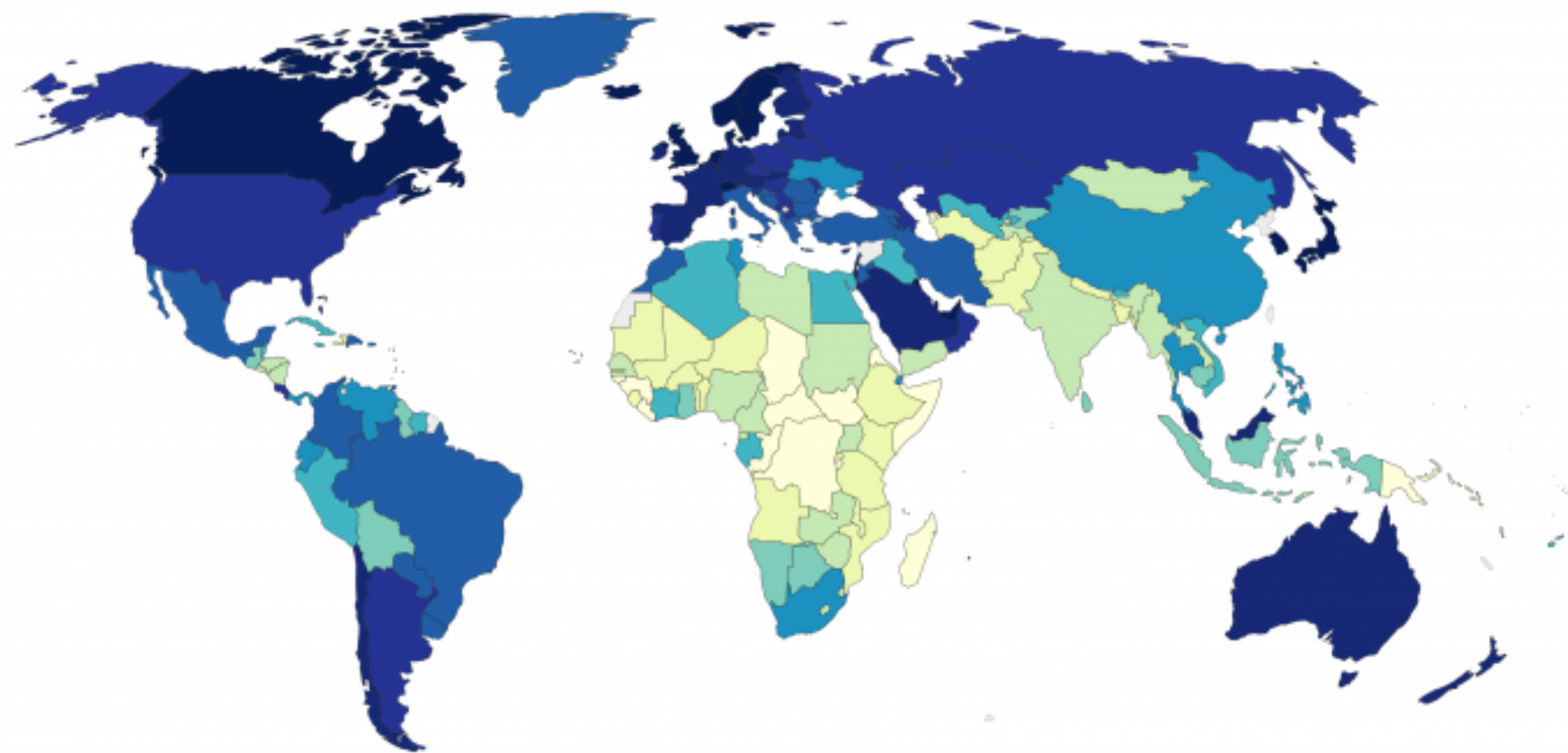
Karim Hussami
Naveen Korra

Current state of internet

Share of the population using the Internet, 2017

All individuals who have used the Internet in the last 3 months are counted as Internet users. The Internet can be used via a computer, mobile phone, personal digital assistant, games machine, digital TV etc.

Our World
in Data

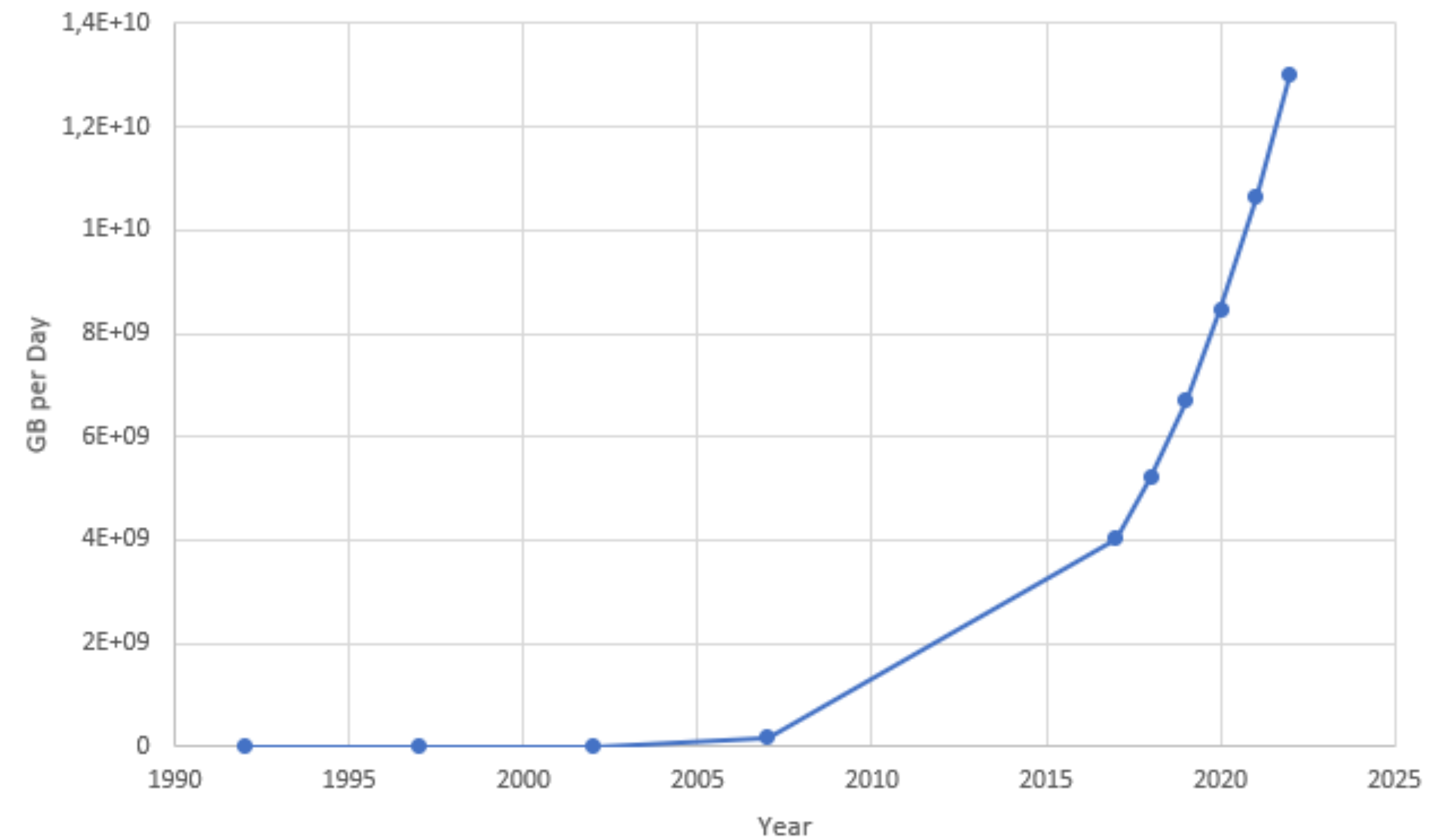


No data 0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

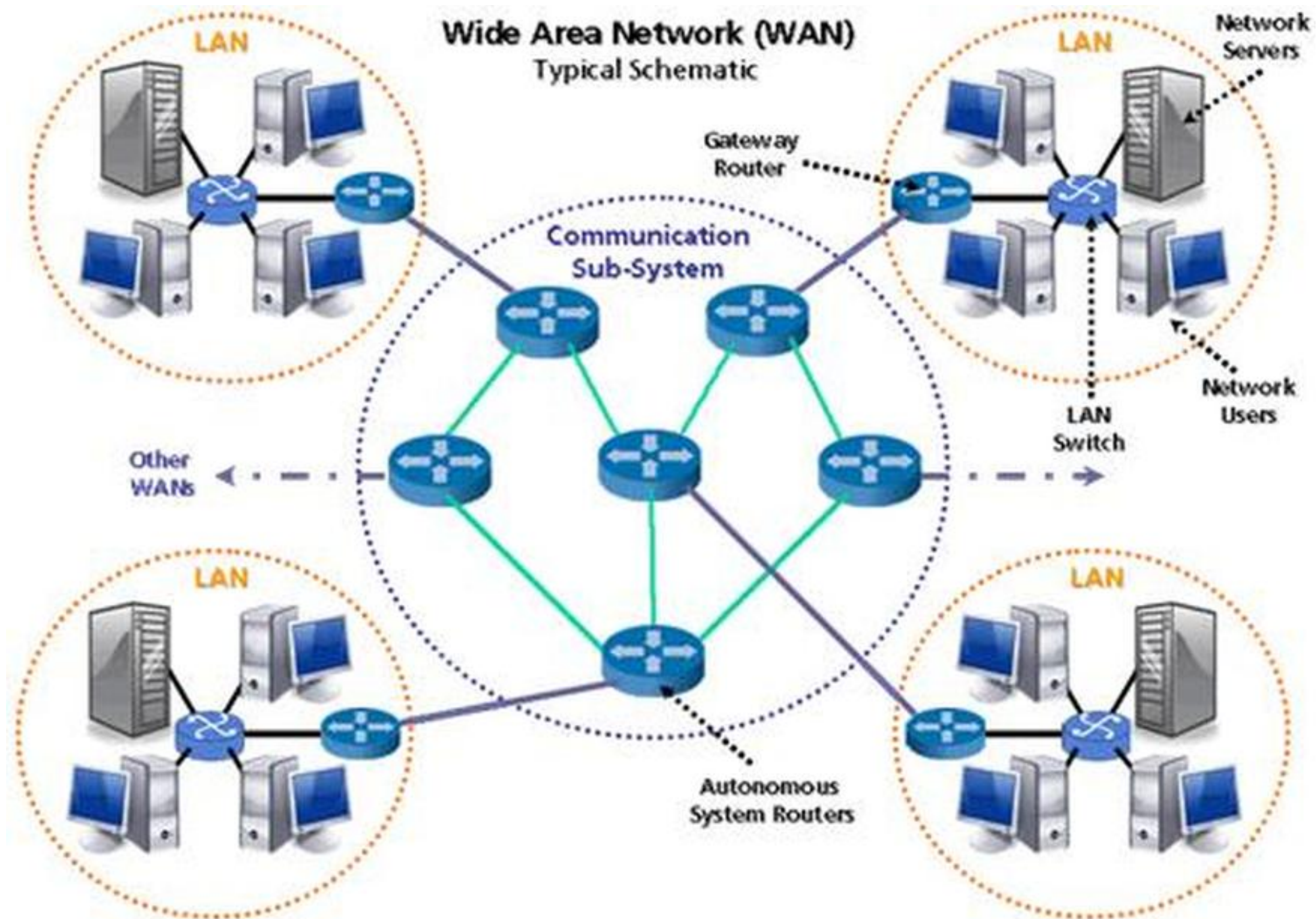
Source: World Bank

OurWorldInData.org/technology-adoption/ • CC BY

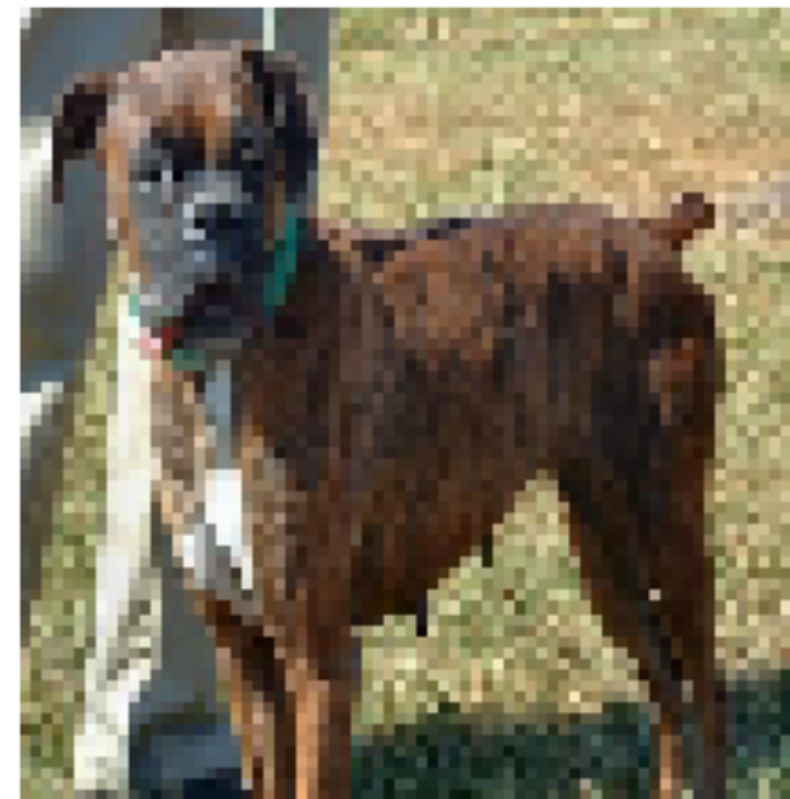
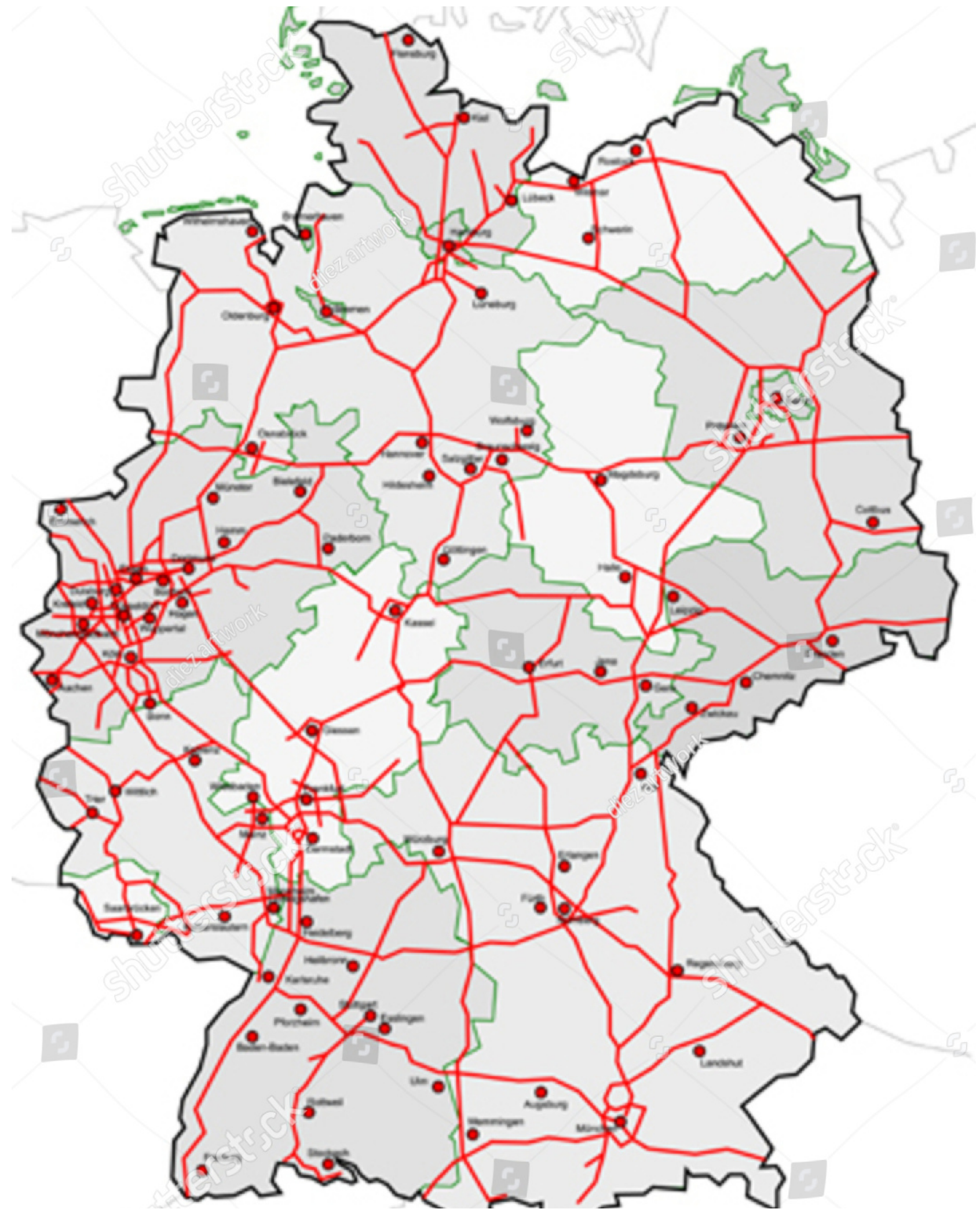
Global Internet Traffic



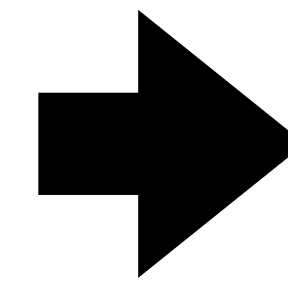
What is the internet



Analogy with regular traffic



Initial Image



Segmented Into Packets

Reinforcement Learning

Components:

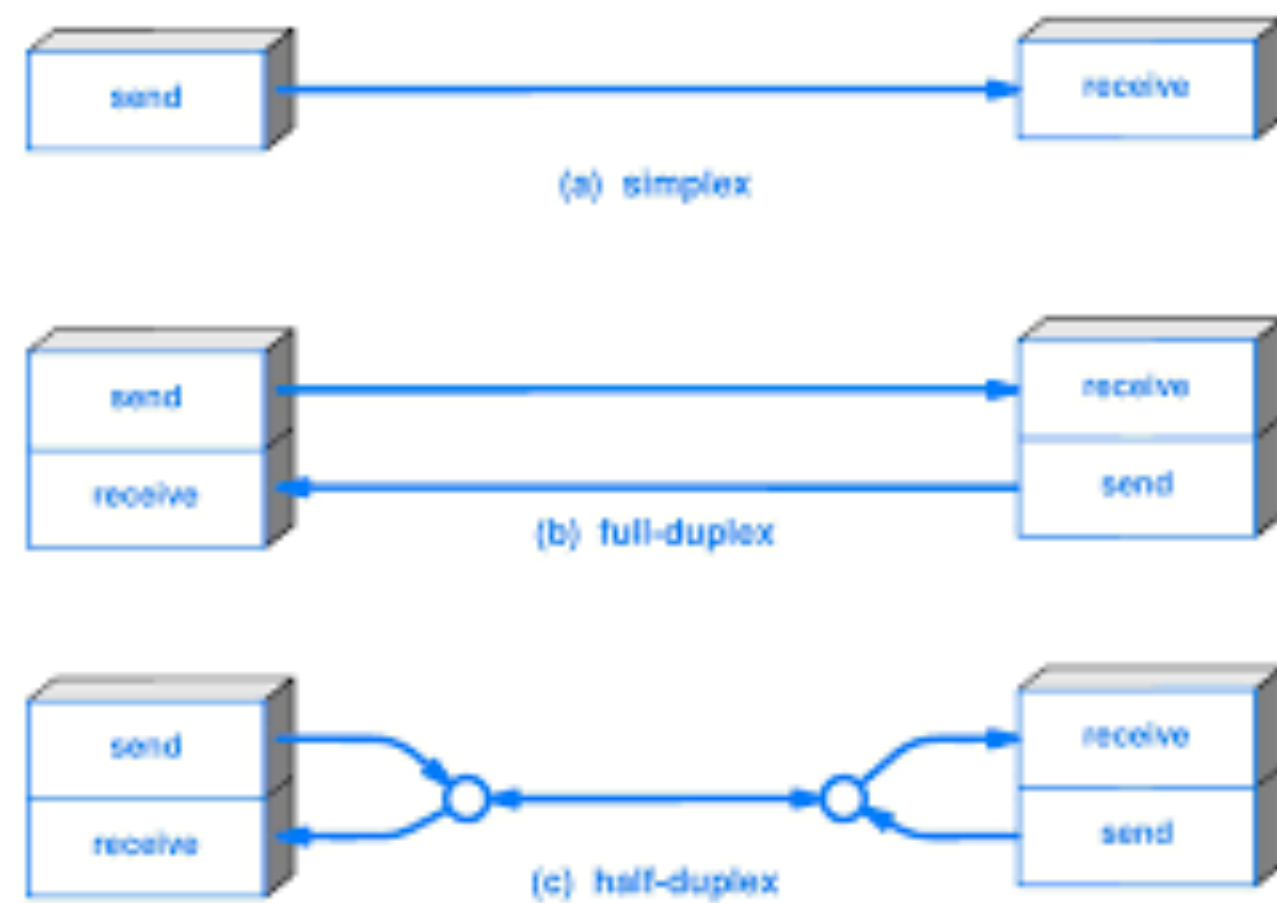
- The environment
- Traffic generation
- Agent
- Neural Network

The Environment

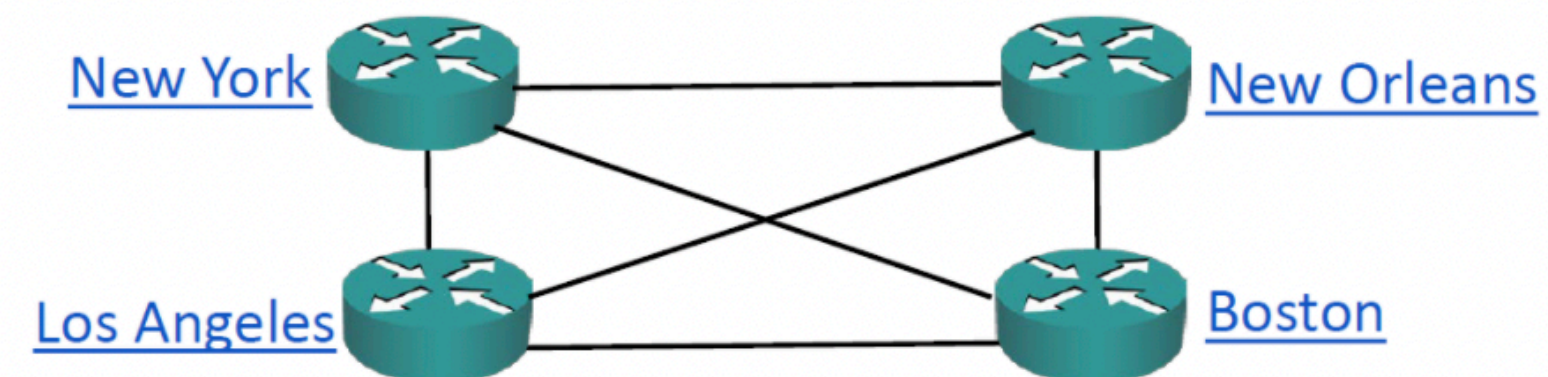
Type of network: LAN vs WAN?

Communication Links: one way vs two way?

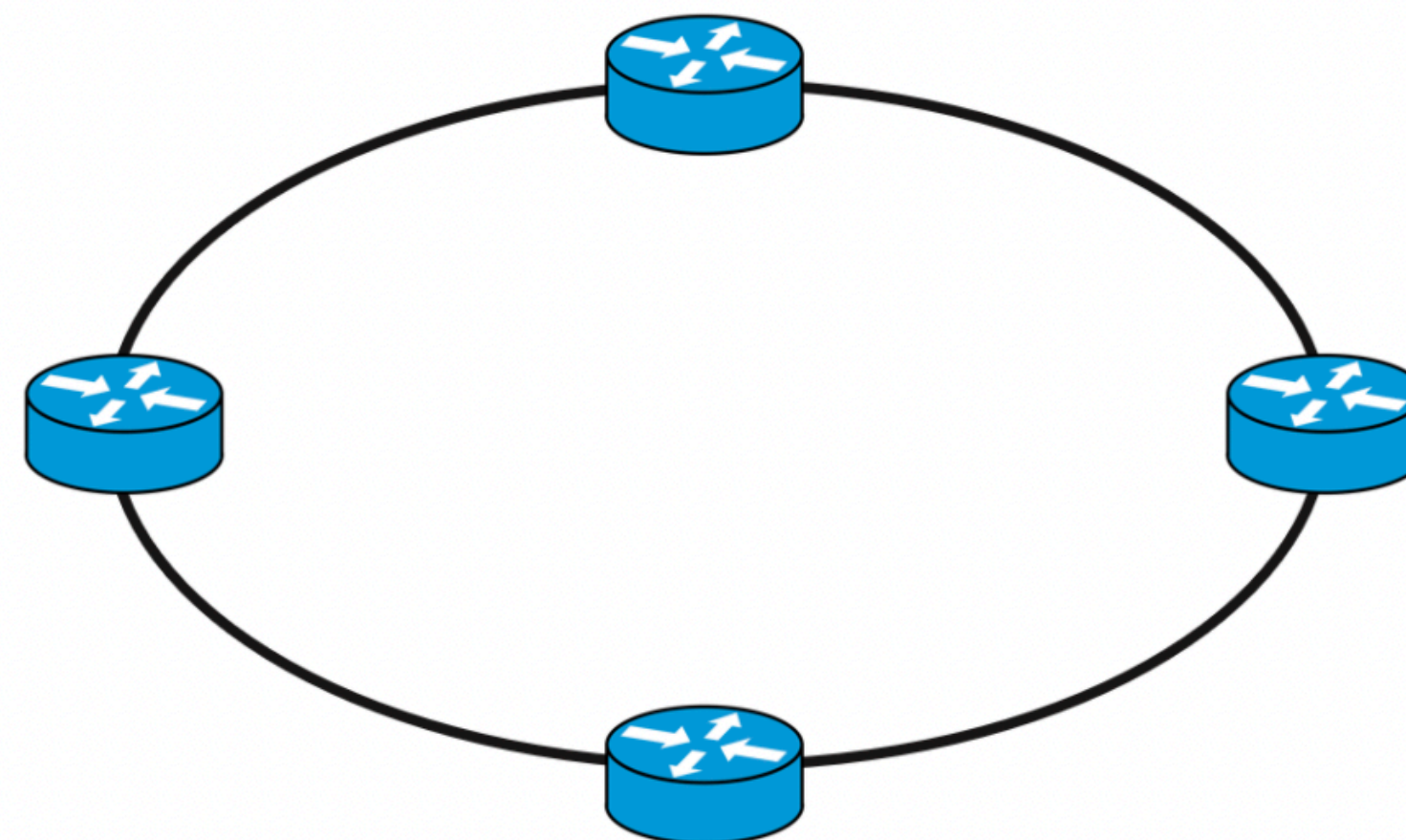
Network topology: Mesh, Tree, Ring, Star?



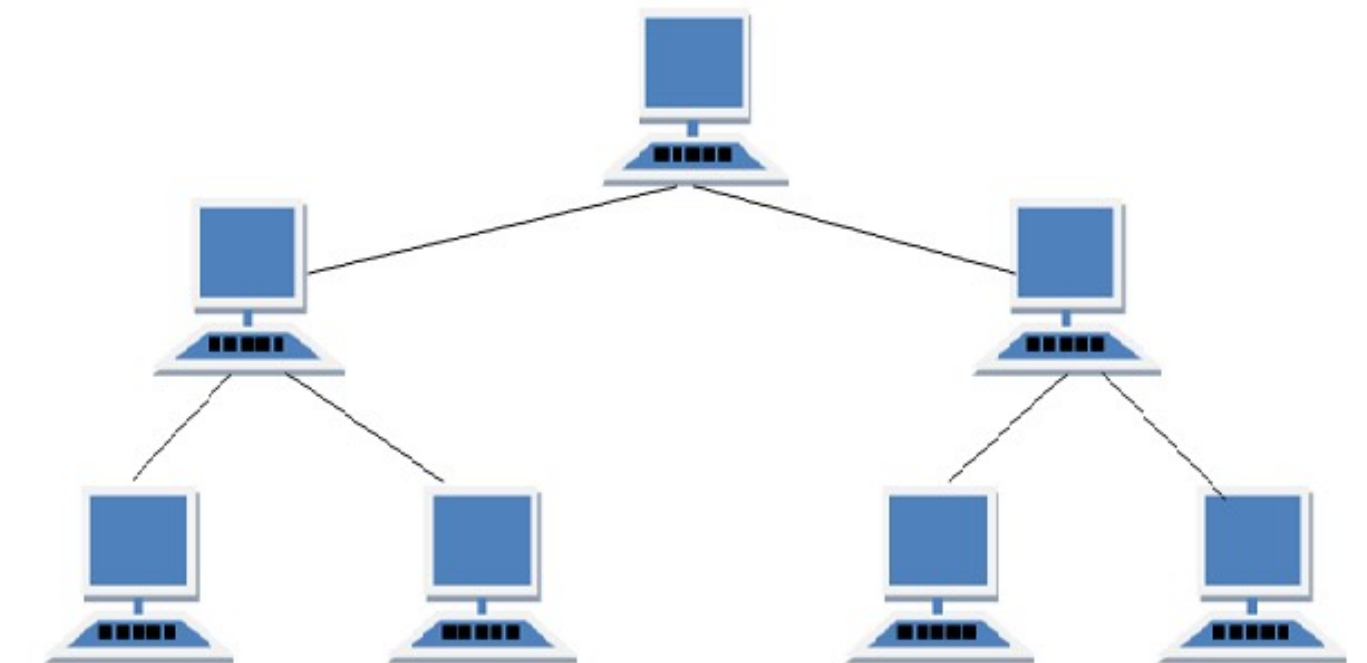
Communication Links



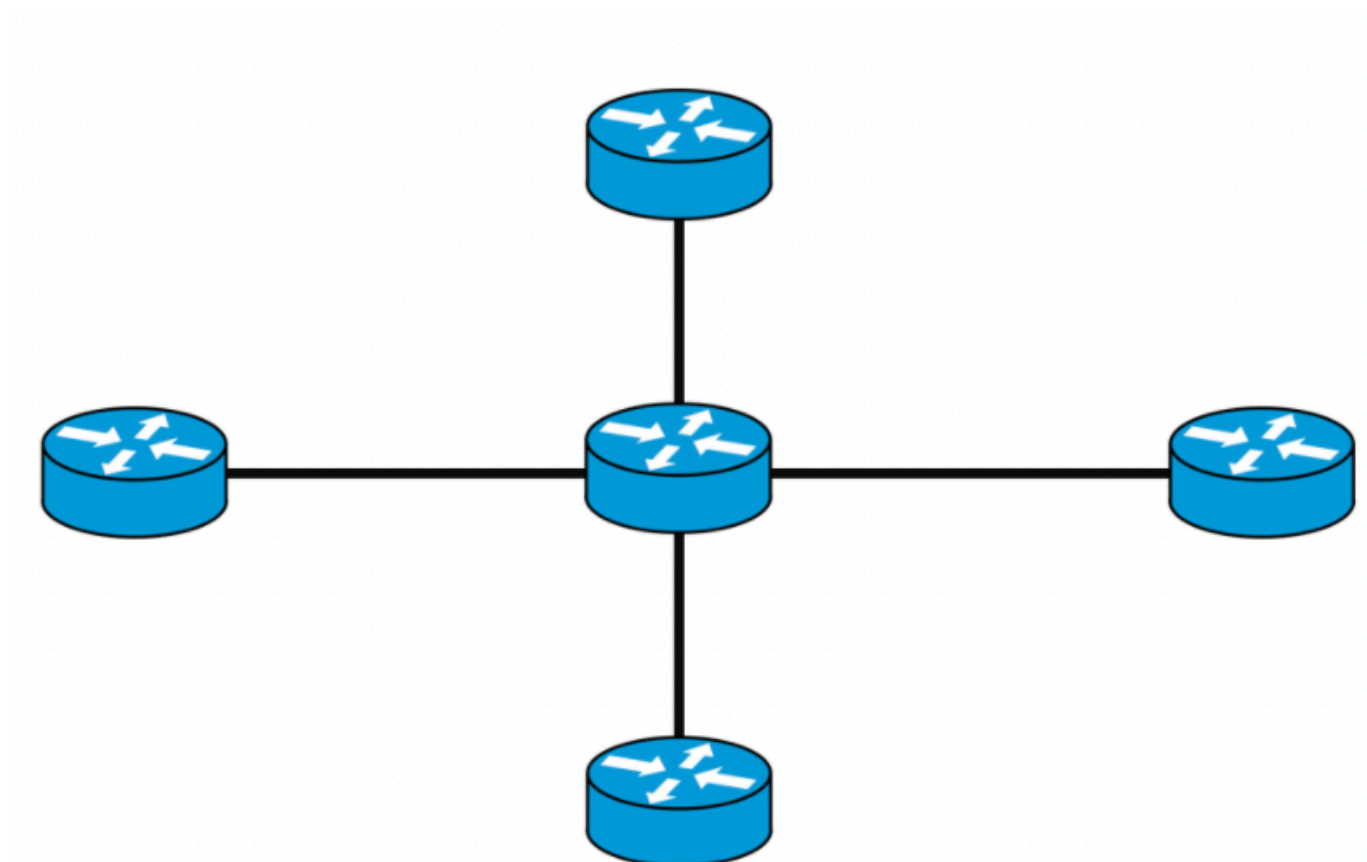
Mesh



Ring



Tree



Star

Network used

Queues:

Each NQ, contain packets/
messages with **NX**
Where node **NX**,
corresponds to the
destination of the packets.

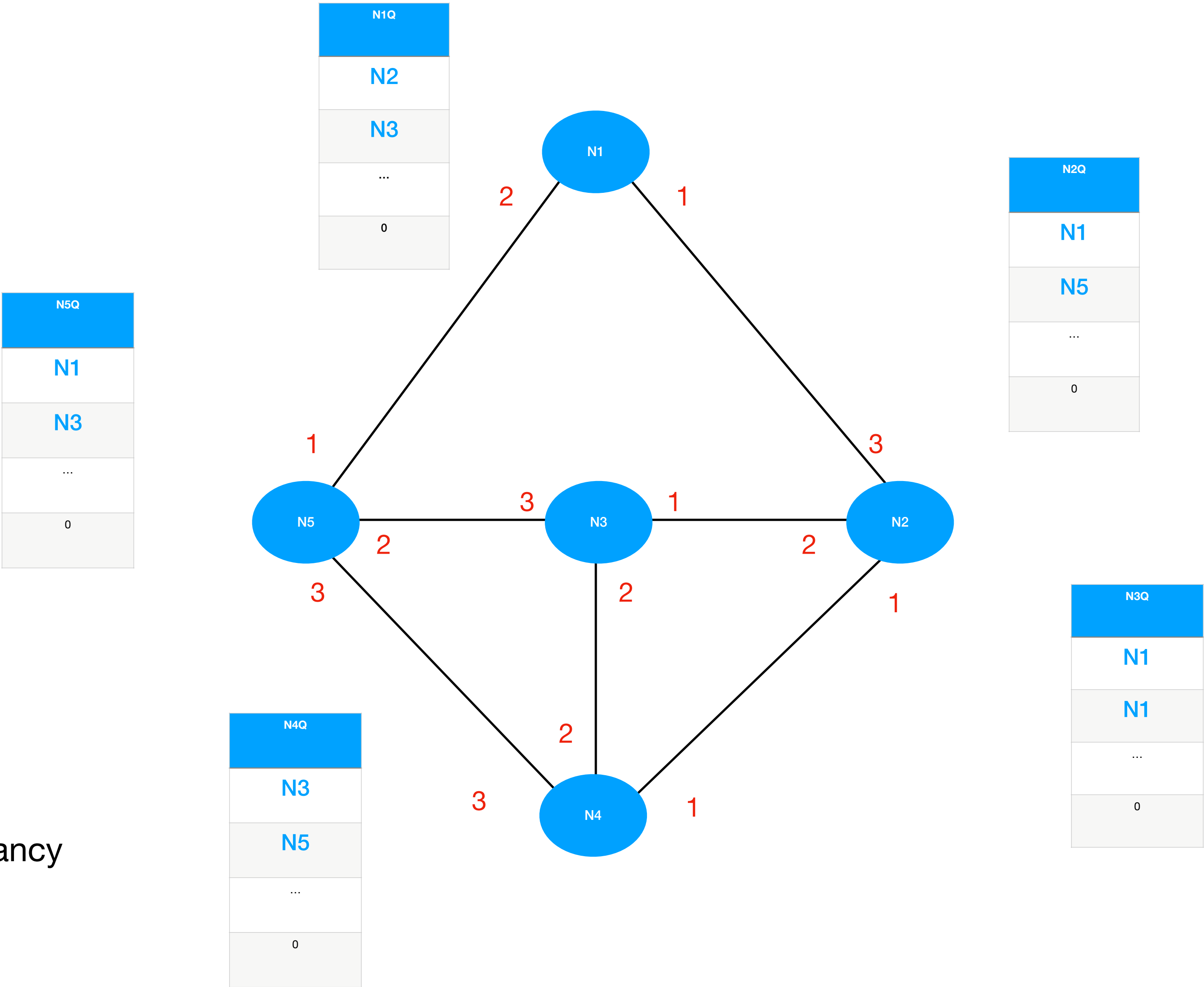
Available Actions:

N1: **1**: Route to N2, **2**: Route to N2
N2: **1**: Route to N4, **2**: Route to N3, **3**: Route to N1
N3: **1**: Route to N2, **2**: Route to N4, **3**: Route to N5
N4: **1**: Route to N2, **2**: Route to N3, **3**: Route to N5
N5: **1**: Route to N1, **2**: Route to N3, **3**: Route to N4

For all Nodes: **0**: Do nothing

Reward System:

- Message Routed to destination: +20
- Message routed somewhere else: - next_Q_Occupancy
- Action 0 taken while Queue is not empty: -10

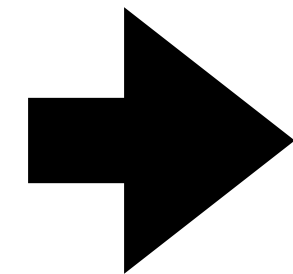


Environment Representation

- MultiDiscrete Action Space: [ActionN1, ActionN2, ActionN3, ActionN4, ActionN5] 5x1 array
- MultiDiscrete State Space: 10x5 array

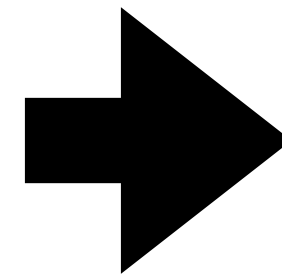
```
[ [2 5 5 5 2]
  [3 3 4 5 4]
  [3 4 4 2 4]
  [4 3 1 3 3]
  [0 4 0 1 2]
  [0 0 0 0 0]
  [0 0 0 0 0]
  [0 0 0 0 0]
  [0 0 0 0 0]
  [0 0 0 0 0] ]
```

Previous State



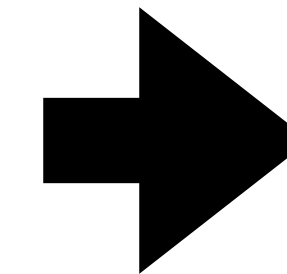
```
[ [1]
  [2]
  [2]
  [1]
  [1] ]
```

Action



```
[ [2 3 5 5 4]
  [3 4 4 5 4]
  [3 3 4 2 3]
  [4 4 1 3 2]
  [0 0 0 1 0]
  [0 0 0 0 0]
  [0 0 0 0 0]
  [0 0 0 0 0]
  [0 0 0 0 0]
  [0 0 0 0 0] ]
```

New State



Reward: 25
Score = Score+25