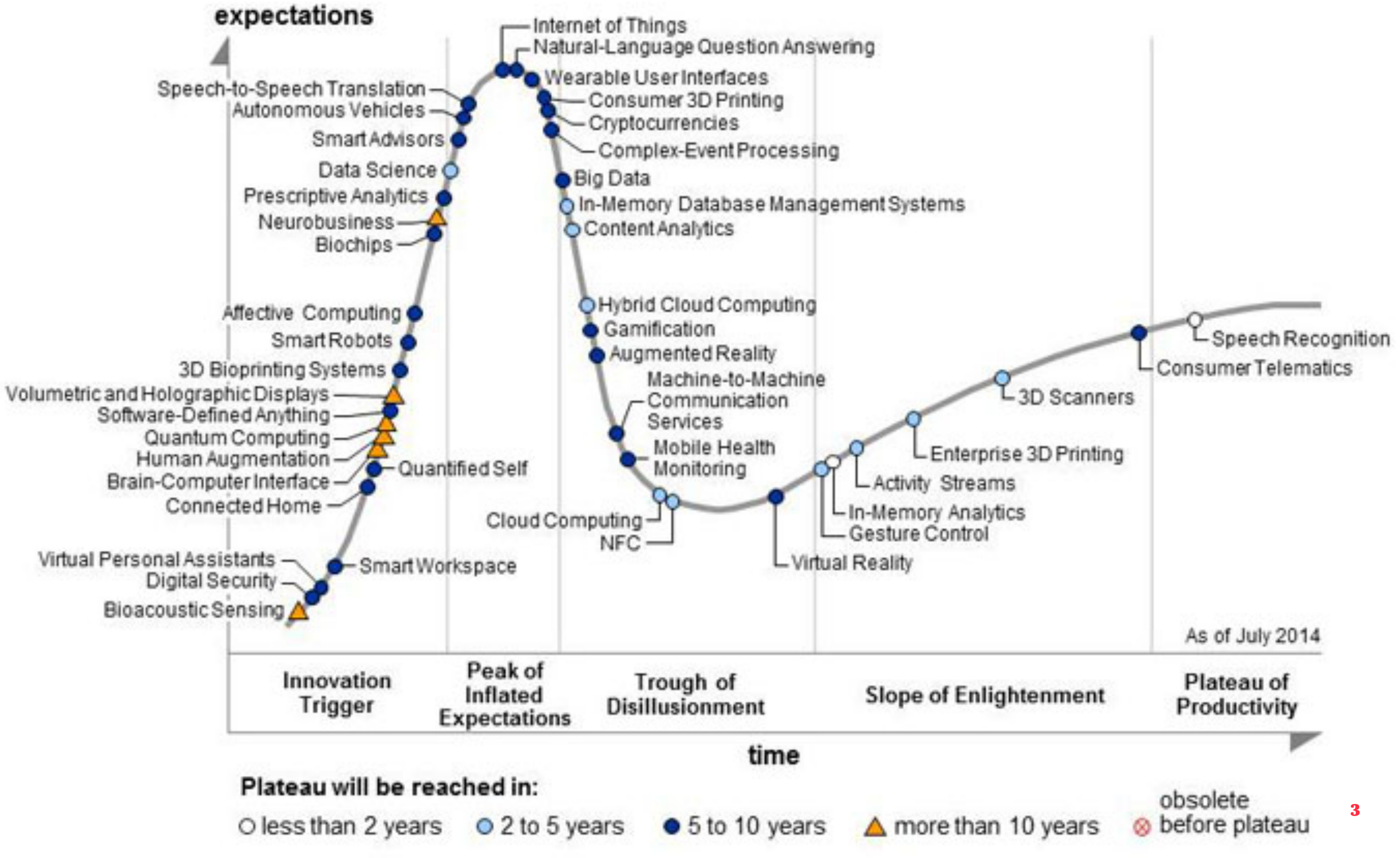
Routing protocol evaluation for the IoT

challenges and opportunities

Outline

- ☞ Simulation vs Experimentation
- ☞ Network characterization & evaluation metrics
- ☞ Setup & execution
- ☞ Measurements & evaluation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Natural-Language Question Answering
Wearable User Interfaces
Consumer 3D Printing
Cryptocurrencies
Complex-Event Processing
Big Data
In-Memory Database Management Systems
Content Analytics
Hybrid Cloud Computing
Gamification
Augmented Reality
Machine-to-Machine Communication Services
Mobile Health Monitoring
Cloud Computing
NFC
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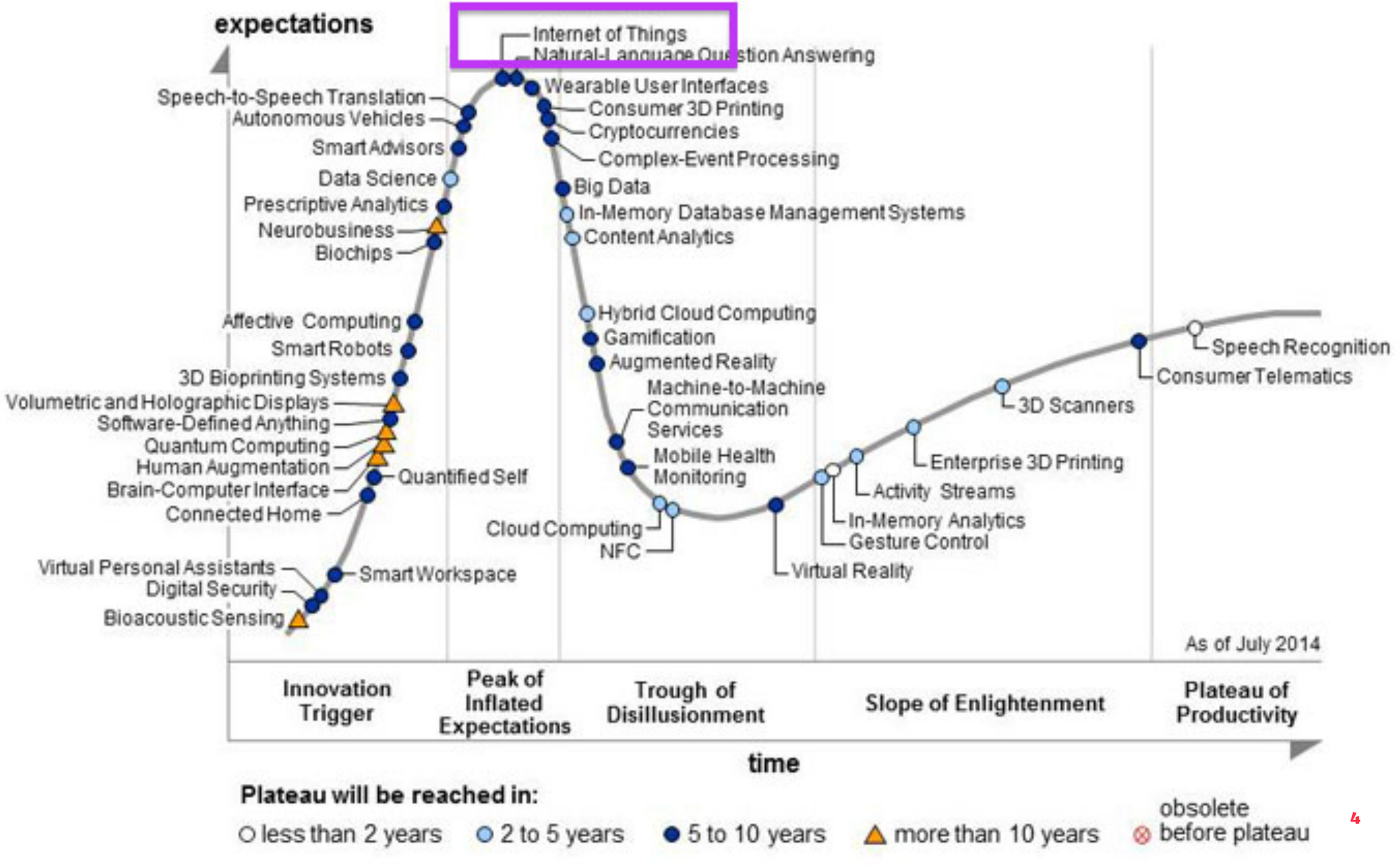
As of July 2014
Innovation Trigger
Peak of Inflated Expectations
Trough of Disillusionment
Slope of Enlightenment
Plateau of Productivity
time
Plateau will be reached in:
less than 2 years
2 to 5 years
5 to 10 years
more than 10 years
obsolete before plateau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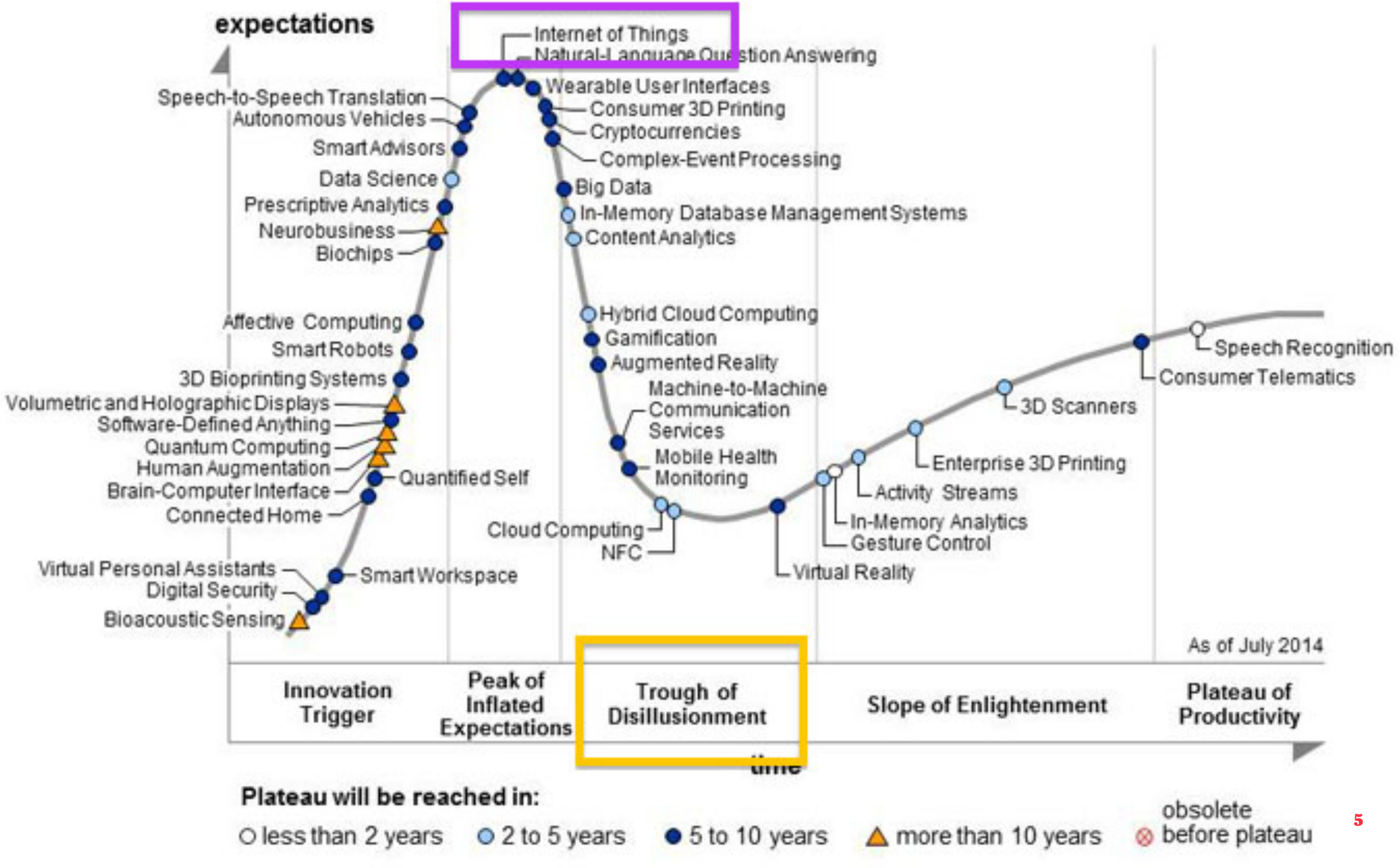
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Simulation is great.

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☞ cheap

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- ☞ cheap
- ☞ controllable

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- ☞ reproducible

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- ☞ reproducible
- ☞ scalable

Simulation is not enough.

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☞ unverified models

Simulation is not enough.

- ☞ unverified models
- ☞ unrealistic network behavior

Experimentation on testbeds.

Getting our ducks in a row:

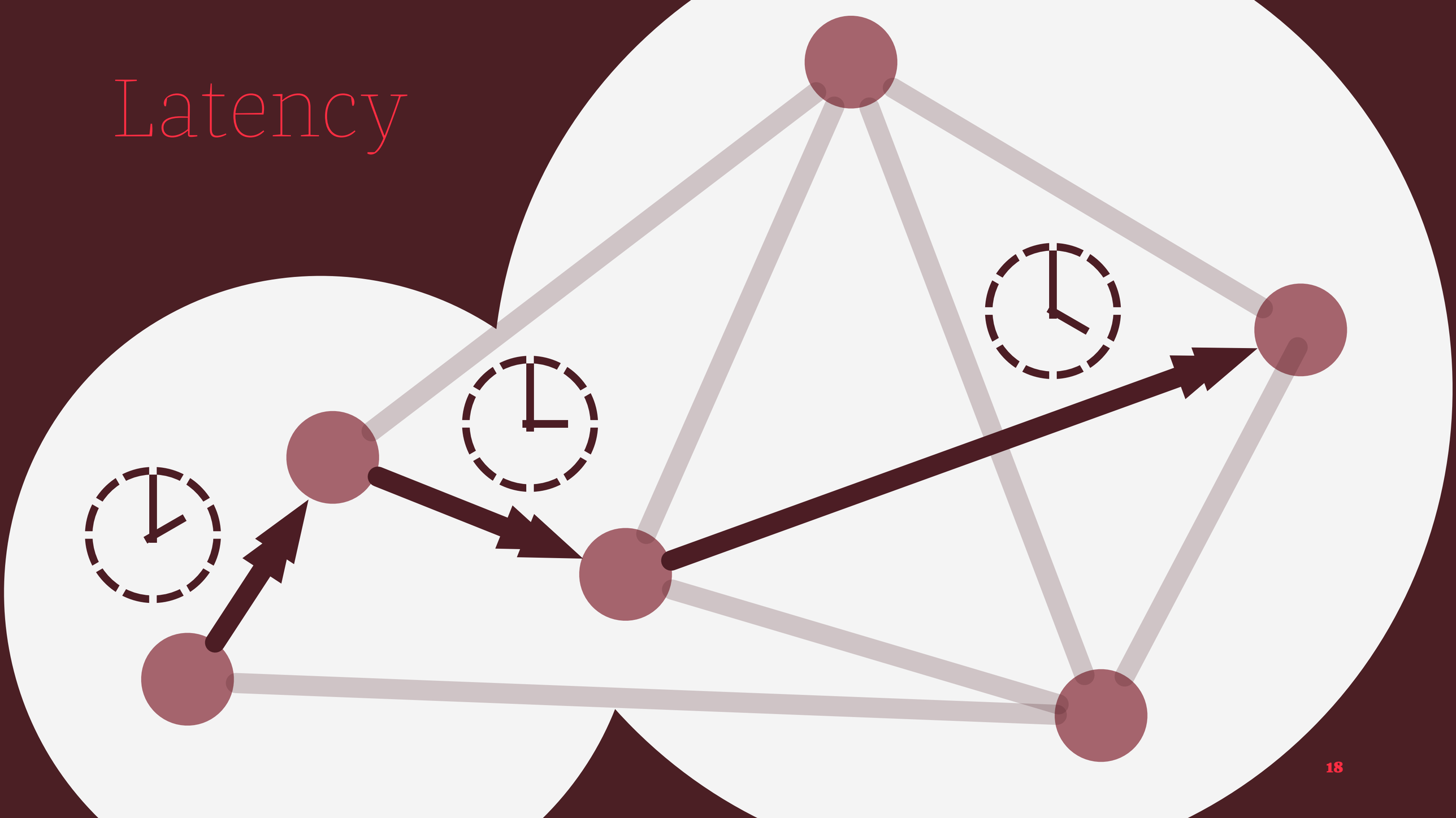
Network characterization & performance metrics

Network Characteristics

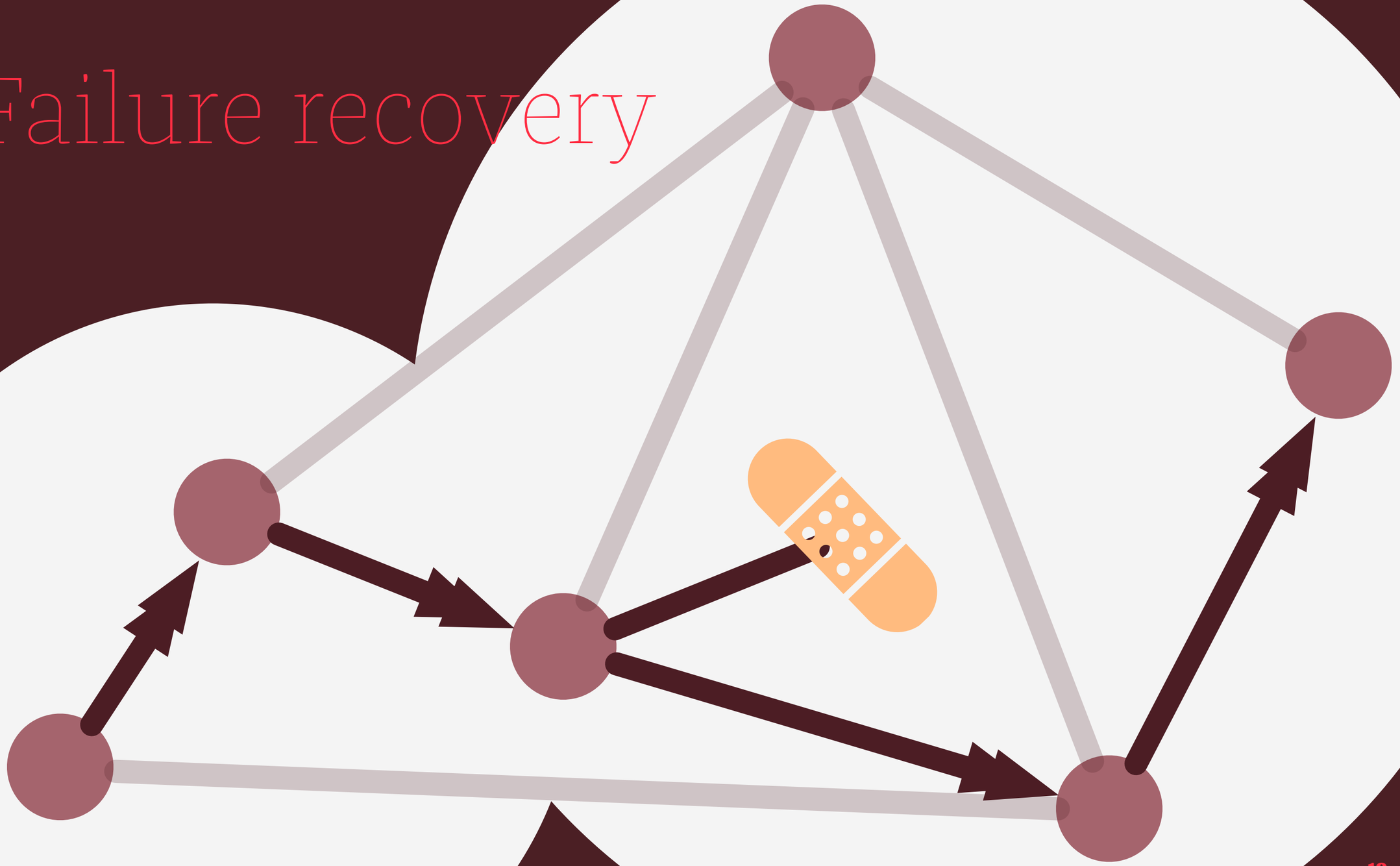
- ☞ Traffic patterns
- ☞ Mobility
- ☞ Energy consumption
- ☞ Network size
- ☞ Physical environment

Performance Metrics

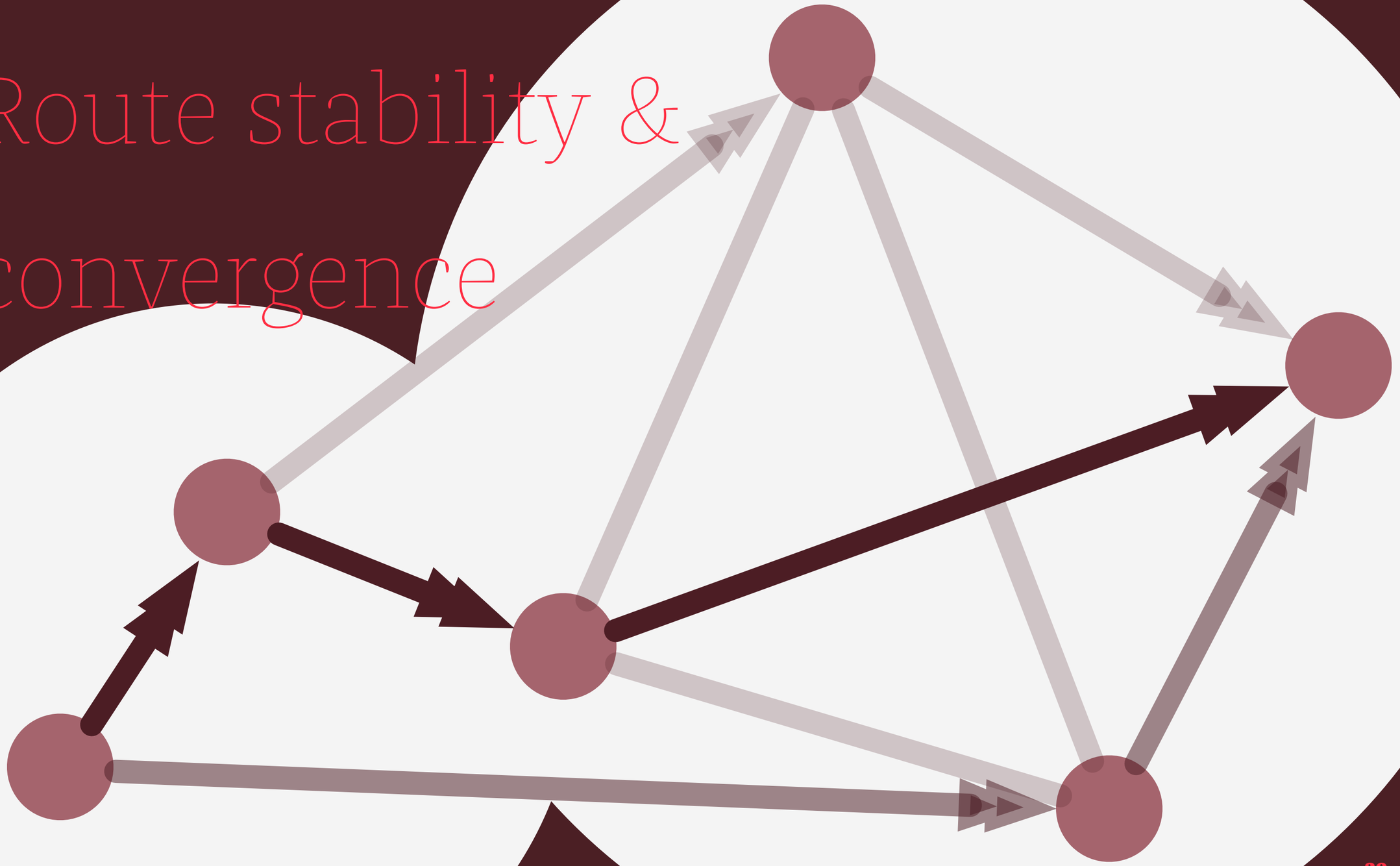
Latency



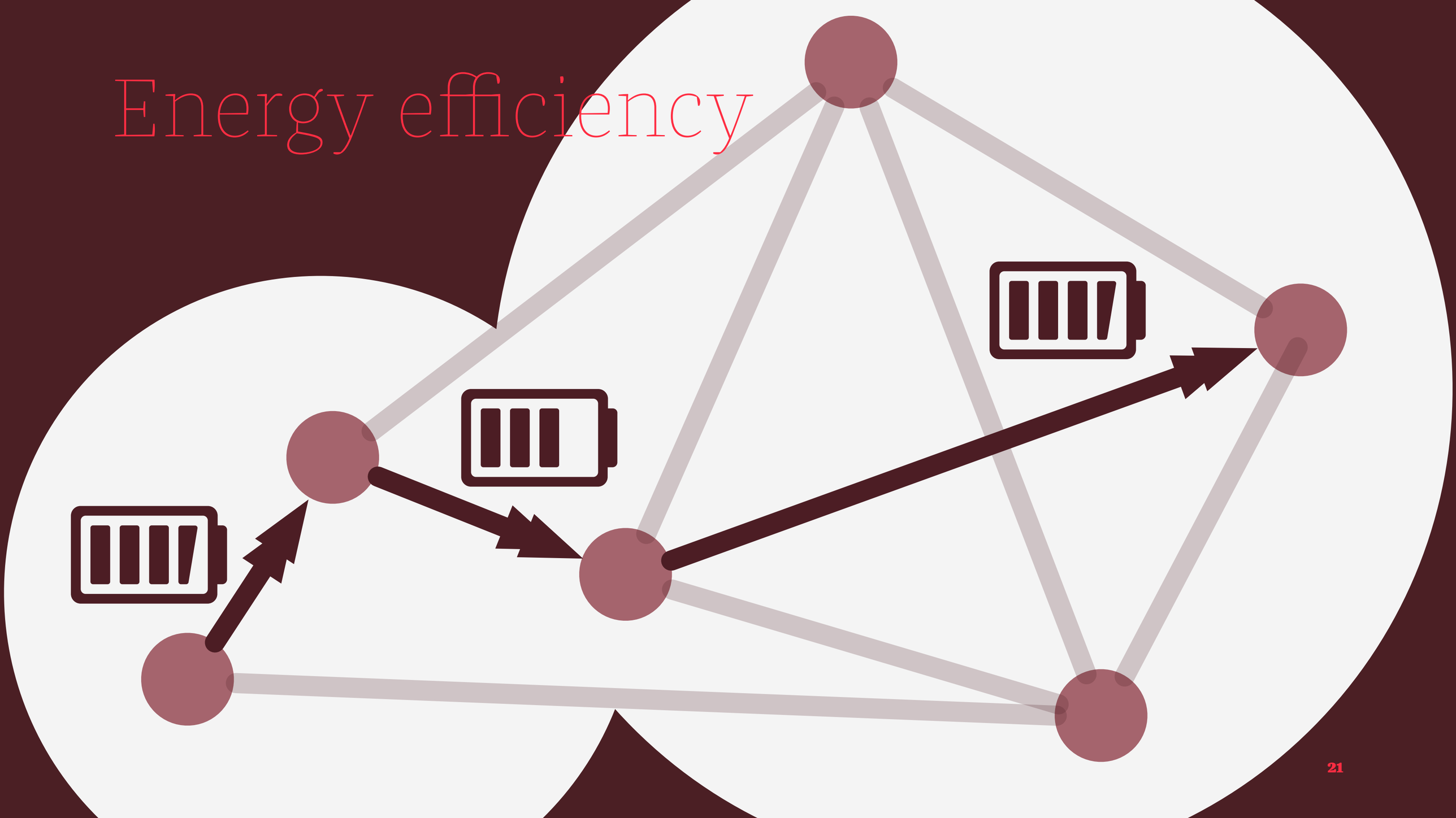
Failure recovery



Route stability & convergence



Energy efficiency



Code & storage size

```
    print_routingtable();
    ^
1 warning generated.
"make" -C /home/lotte/riot/RIOT/boards/native
"make" -C /home/lotte/riot/RIOT/boards/native/drivers
"make" -C /home/lotte/riot/RIOT/core
"make" -C /home/lotte/riot/RIOT/cpu/native
"make" -C /home/lotte/riot/RIOT/cpu/native/net
"make" -C /home/lotte/riot/RIOT/cpu/native/periph
"make" -C /home/lotte/riot/RIOT/drivers
"make" -C /home/lotte/riot/RIOT/sys
"make" -C /home/lotte/riot/RIOT/sys/auto_init
"make" -C /home/lotte/riot/RIOT/sys/config
"make" -C /home/lotte/riot/RIOT/sys/hashes
"make" -C /home/lotte/riot/RIOT/sys/net/crosslayer/net_help
"make" -C /home/lotte/riot/RIOT/sys/net/link_layer/ieee802154
"make" -C /home/lotte/riot/RIOT/sys/net/link_layer/net_if
"make" -C /home/lotte/riot/RIOT/sys/net/network_layer/sixlowpan
"make" -C /home/lotte/riot/RIOT/sys/net/routing/aodvv2
"make" -C /home/lotte/riot/RIOT/sys/net/transport_layer/socket_base
"make" -C /home/lotte/riot/RIOT/sys/net/transport_layer/udp
"make" -C /home/lotte/riot/RIOT/sys/posix
"make" -C /home/lotte/riot/RIOT/sys/ps
"make" -C /home/lotte/riot/RIOT/sys/shell
"make" -C /home/lotte/riot/RIOT/sys/shell/commands
"make" -C /home/lotte/riot/RIOT/sys/timex
"make" -C /home/lotte/riot/RIOT/sys/transceiver
"make" -C /home/lotte/riot/RIOT/sys/uart0
"make" -C /home/lotte/riot/RIOT/sys/vtimer
   text    data     bss     dec     hex filename
 227086    2680  227408  457174    6f9d6 /home/lotte/aodvv2/aodvv2_demo/bin/native/aodvv2_demo.elf
λ (/home/lotte/aodvv2/aodvv2) (master)
```

Setup & execution.

Protocols

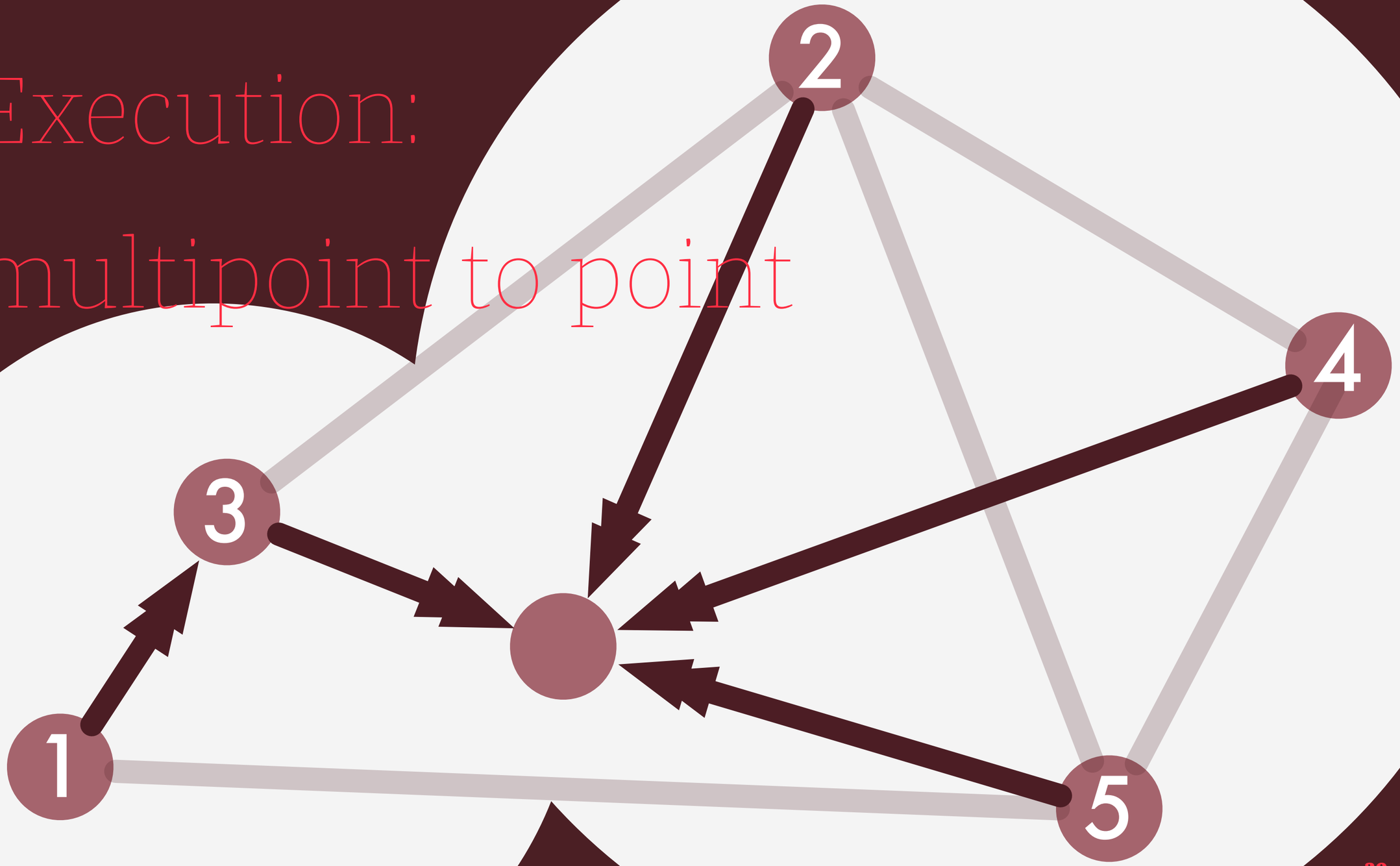

AODV
:L5
HP:
RPL
:L5
HP:
19/ 19
KILL
PETA
FOOD
FLEE

Network model

Characteristic	Default	Alternative
Traffic Pattern	Multipoint-to-point, with most traffic traversing several hops. Scheduled data transmissions.	point-to-point across the network. Scheduled data transmissions.
Mobility	None, but occasionally failing nodes.	–
Energy efficiency reqs.	None	–
Network size	100	500
Physical environment	IoT-Lab testbed	–

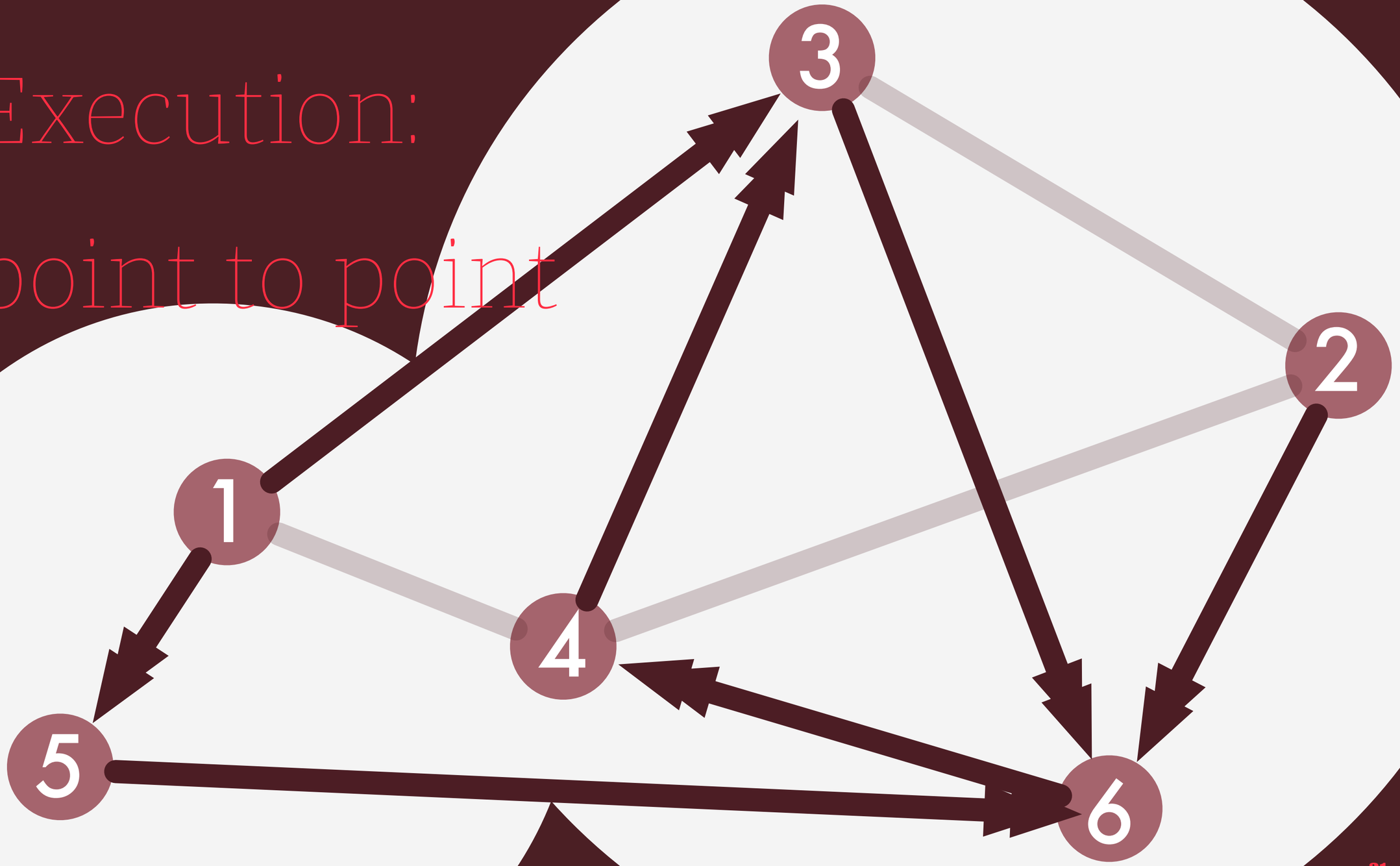
Execution

Execution: multipoint to point



Execution:

point to point



Measurements & evaluation.

Measurements & evaluation.

- ☞ **Latency**: dispatch time - arrival time
- ☞ **Failure recovery**: shutdown time - changes in routing table
- ☞ **Energy efficiency**: overall energy consumption
- ☞ **Reliability**: packet loss

Conclusion

Thank You!

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