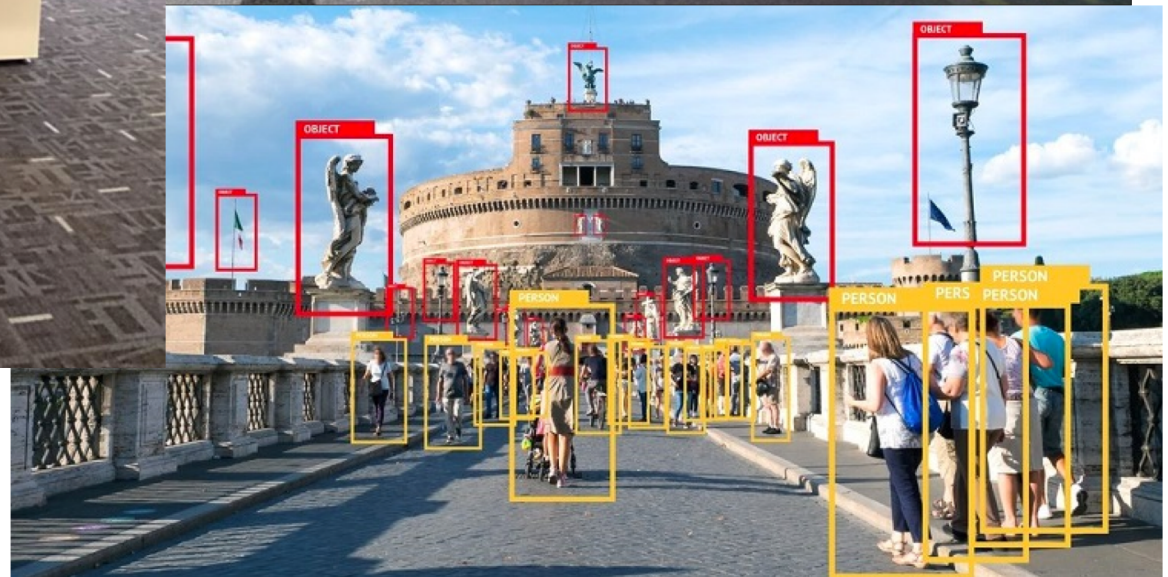
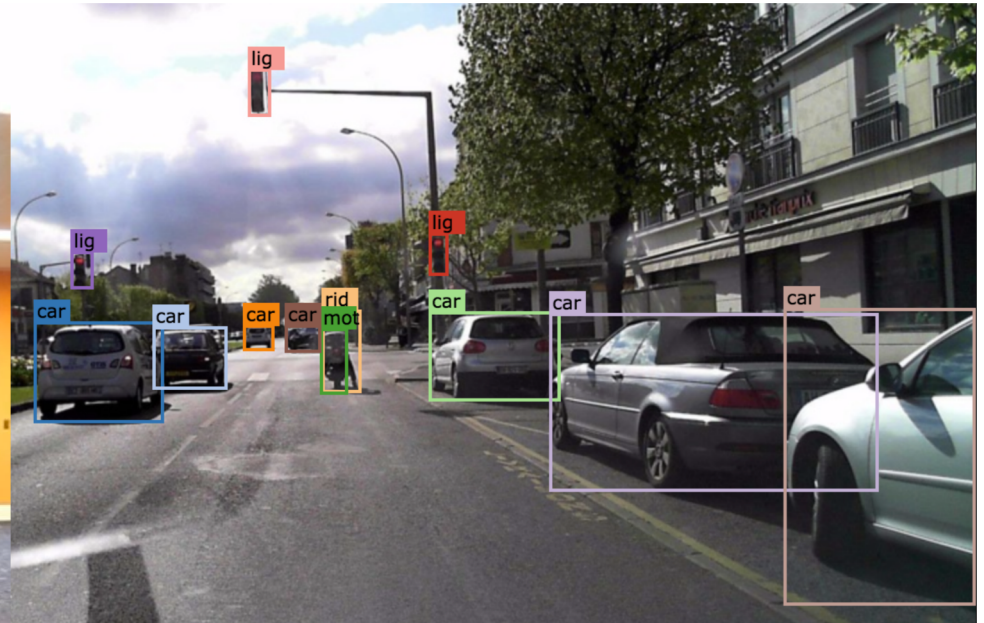
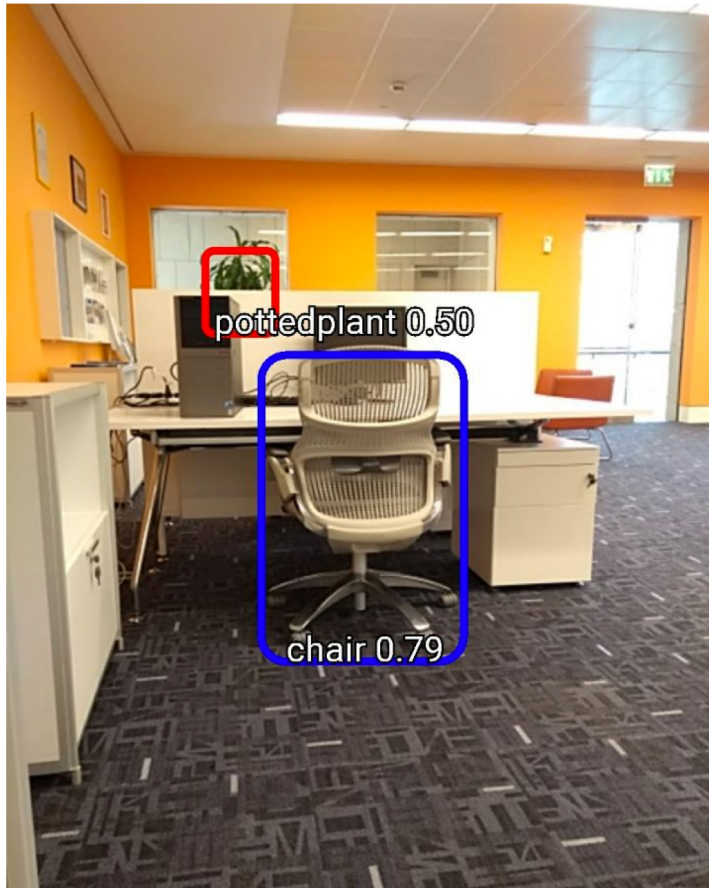


EDGE COMPUTING OVER NAMED DATA NETWORKING: DESIGN & CHALLENGES

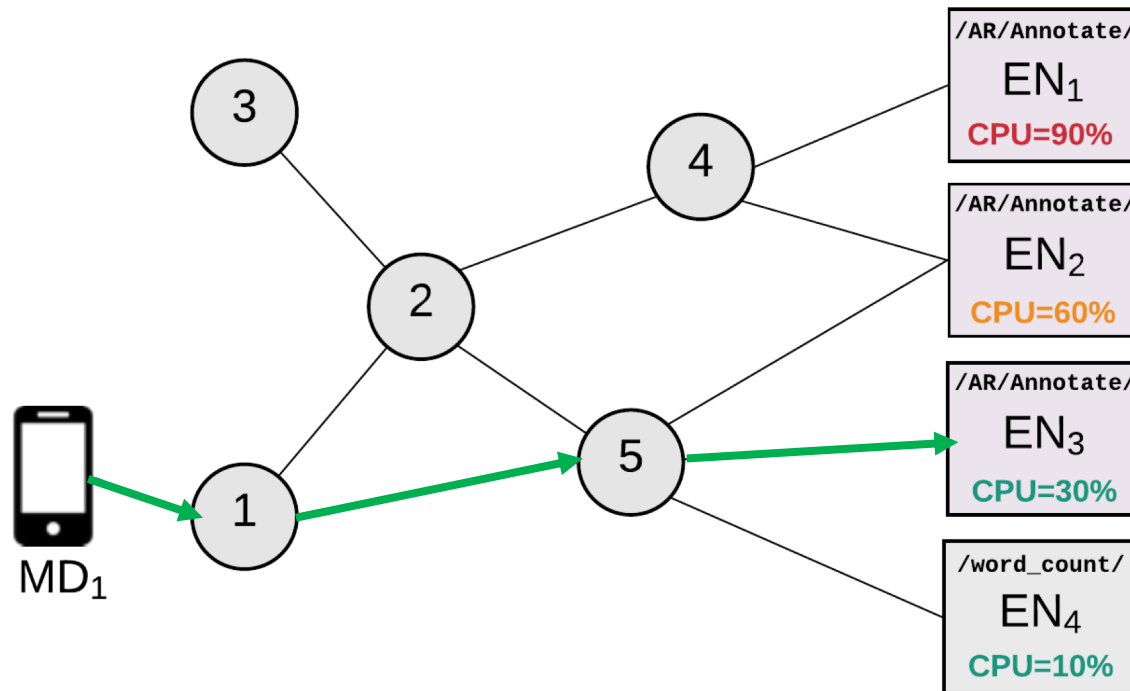
Abde Mtibaa, Reza Tourani, Jay Misra (NMSU)

Lixia Zhang, and Jeff Burke (UCLA)

USE-CASE: AR/VR



WHY NDN?



Using IP

- Routes, decisions, scheduling happening at **application layer**
- Using schedulers/proxies to make efficient decisions

Goals using NDN

- Pushing decisions to the networking layer (using names)
- Seamless and efficient offloading decisions

OUTLINE

- Edge Computing Over NDN: the case of AR/VR
 - Why NDN?
- **Challenges & Potential Solutions**
 - Resource Discovery
 - Proactive, On-Demand, and Reactive Approaches
 - Compute Re-use
 - Mobility Management
 - Security & Privacy
- **Conclusion & Future Work**
 - Why Edge Computing over NDN?
 - What's missing?

RESOURCE DISCOVERY

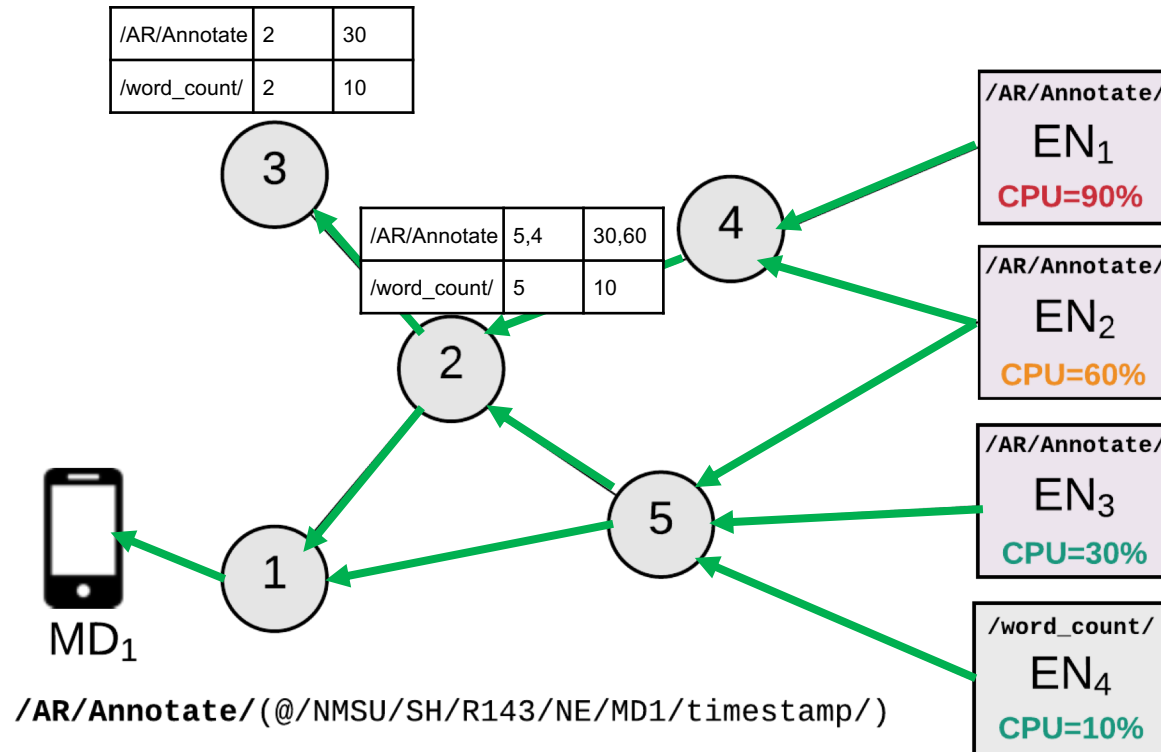
Service Discovery

- Which service is running on the ENs?
- What are the capabilities of each node?
- 😊 Changes infrequently

Resource Utilization

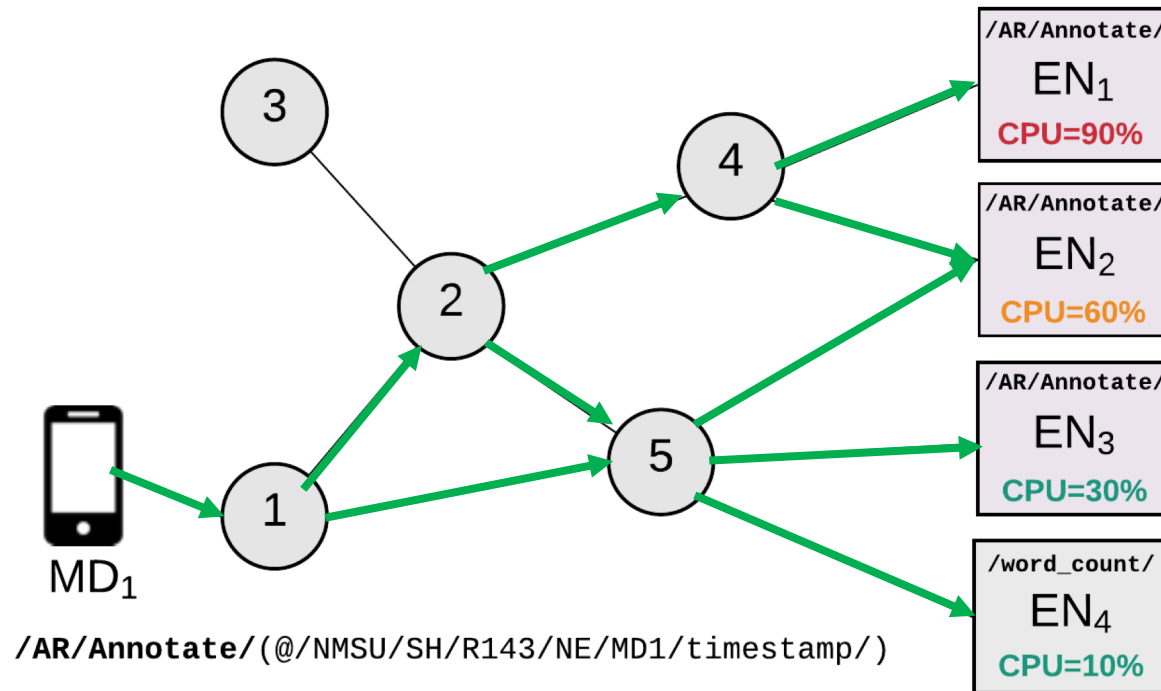
- What's the current load at the ENs?
- Which node is more suitable to execute my task?
- 😞 Frequent changes in the load (e.g., cpu, gpu, ram)
- 3 Approaches
 - Proactive,
 - On-Demand
 - Reactive

PROACTIVE RESOURCE DISCOVERY



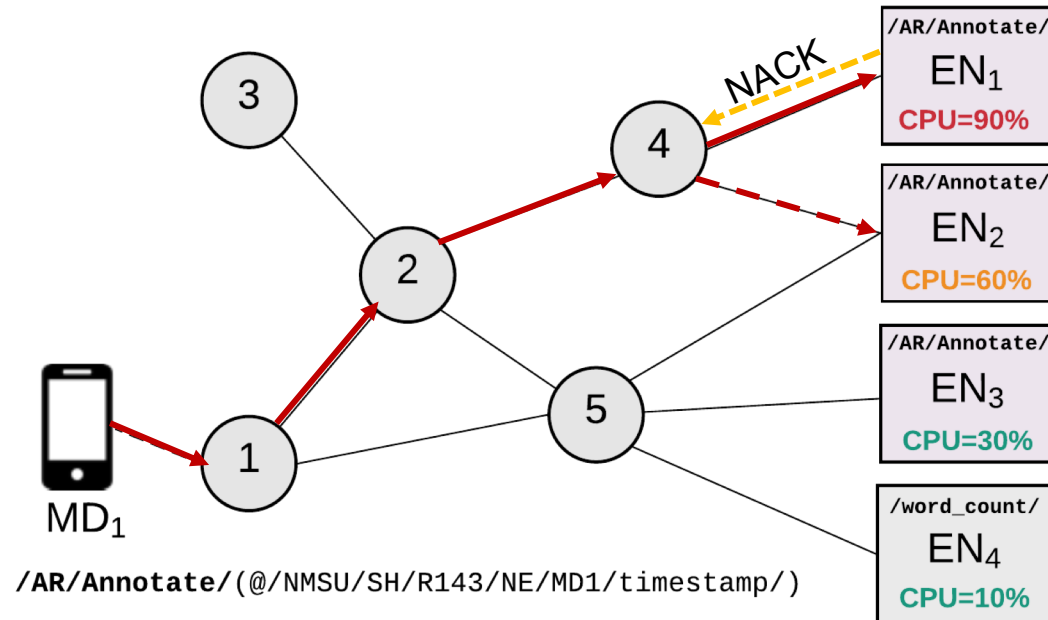
- 😊 Fast forwarding
- 😊 Unified view
- 😞 Stale information
- 😞 Large overhead

ON-DEMAND RESOURCE DISCOVERY



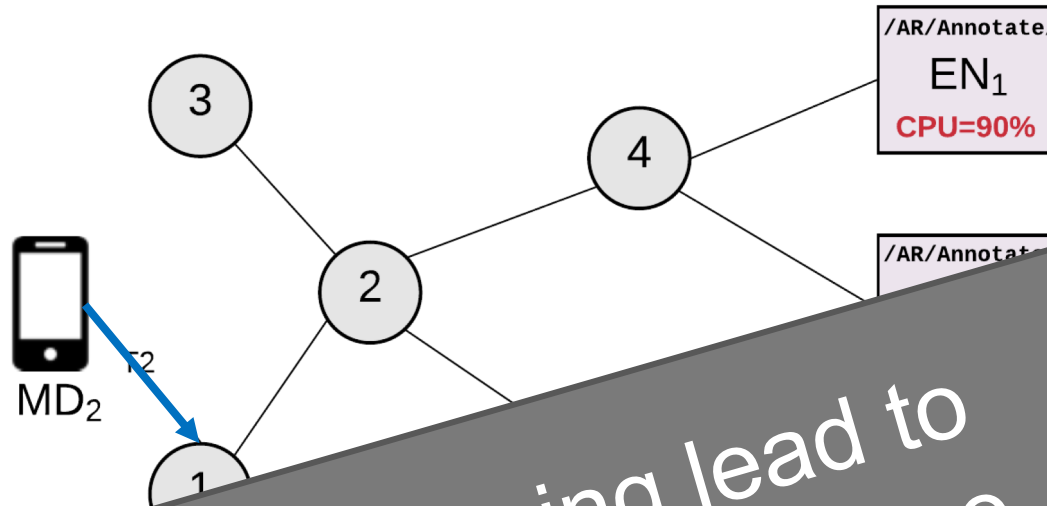
- 😊 Lower overhead
- ☹ Slow (extra RTT)
- ☹ DoS/DDoS

REACTIVE RESOURCE DISCOVERY



- 😊 Best overhead
- 😊 Fast (if underload)
- 😞 No load balancing
- 😞 Slow (if overload)

COMPUTE RE-USE

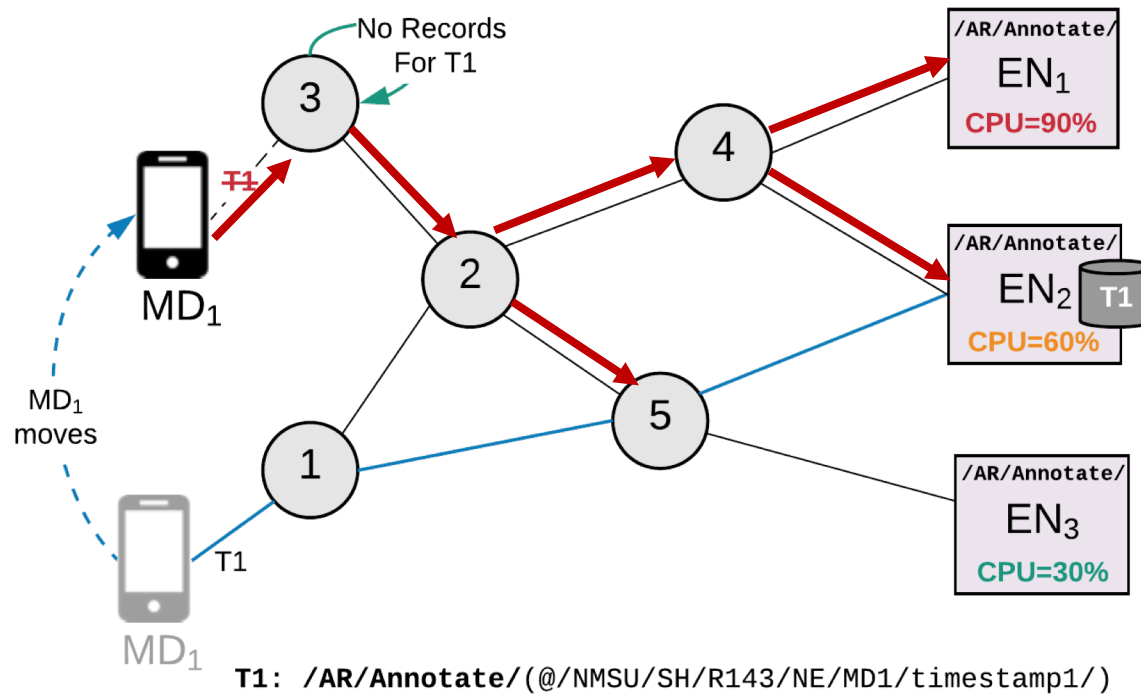


Efficient naming lead to
efficient compute re-use

Intermediate nodes forward potential overlapping tasks?

- Forwarding strategy: tradeoff between similarity and load
- ENs forward tasks to best candidate
- Requires synchronization

MOBILITY MANAGEMENT



Goal: Ensure efficient delivery when MDs move

- For data packets, NDN uses re-transmission upon timeouts
- For tasks, re-executions can be very expensive

A Reactive Approach:

- MDs, upon disconnection, advertise new route

A Proactive Approach:

- ENs share their names with the requesting MD

SECURITY & PRIVACY

Privacy

- Exposing the location via names
- Exposing users' information
- Tradeoff between sharing (re-use) and privacy

DoS/DDoS

- Broadcast mechanisms may be used for DoS/DDoS
- Blackhole/sinkhole attack by EN(s)

CONCLUSION & FUTURE WORK

NDN as a facilitator for edge computing:

- Naming enables sharing
- In-network forwarding and efficient discovery
 - e.g., stateful forwarding
- Built-in security and mobility support

Challenges:

- Efficient resource discovery
- Seamless mobility support
- Efficient compute Re-use

Future Work:

- Design & implement a prototype solution
- Generalize beyond AR/VR

THANK YOU!

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