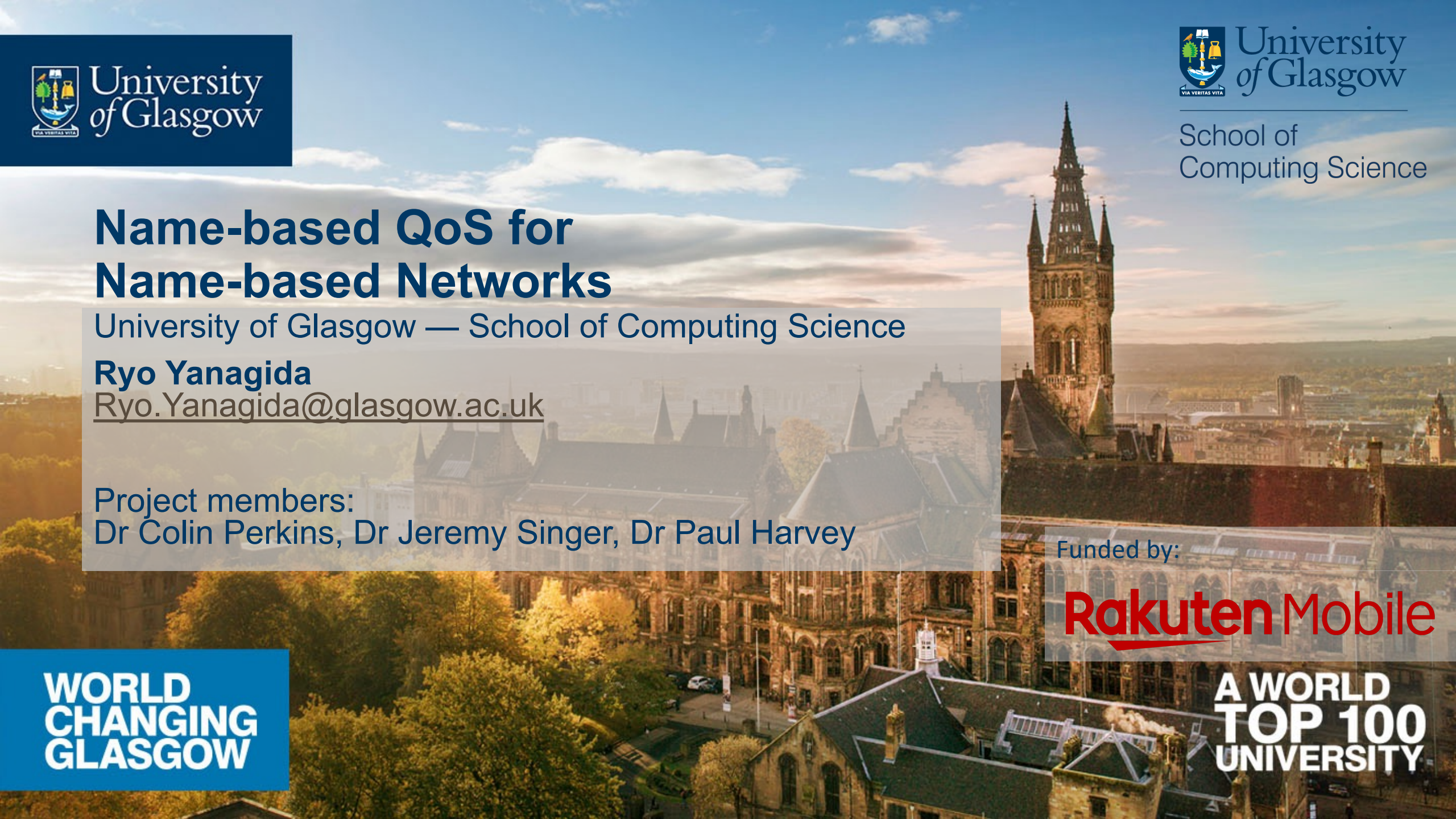


# Name-based QoS for Name-based Networks

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Funded by:
Rakuten Mobile

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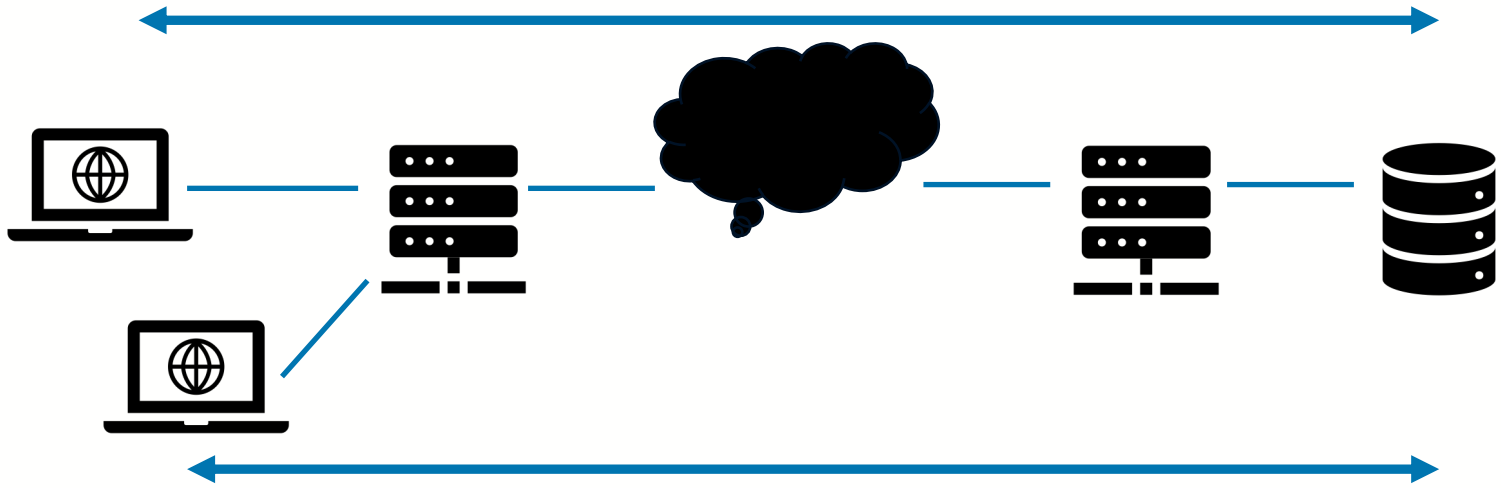
# Background — Information Centric Networking

- The Internet today is converging towards request-response structure
- Scaling and improving performance is complex
  - AnyCast
  - CDN
  - Complex proxying and indirections
- ICN routes packets using name and name-prefixes hosts can offer

# Background — Information Centric Networking

- Current Internet sets up individual flows between the two hosts



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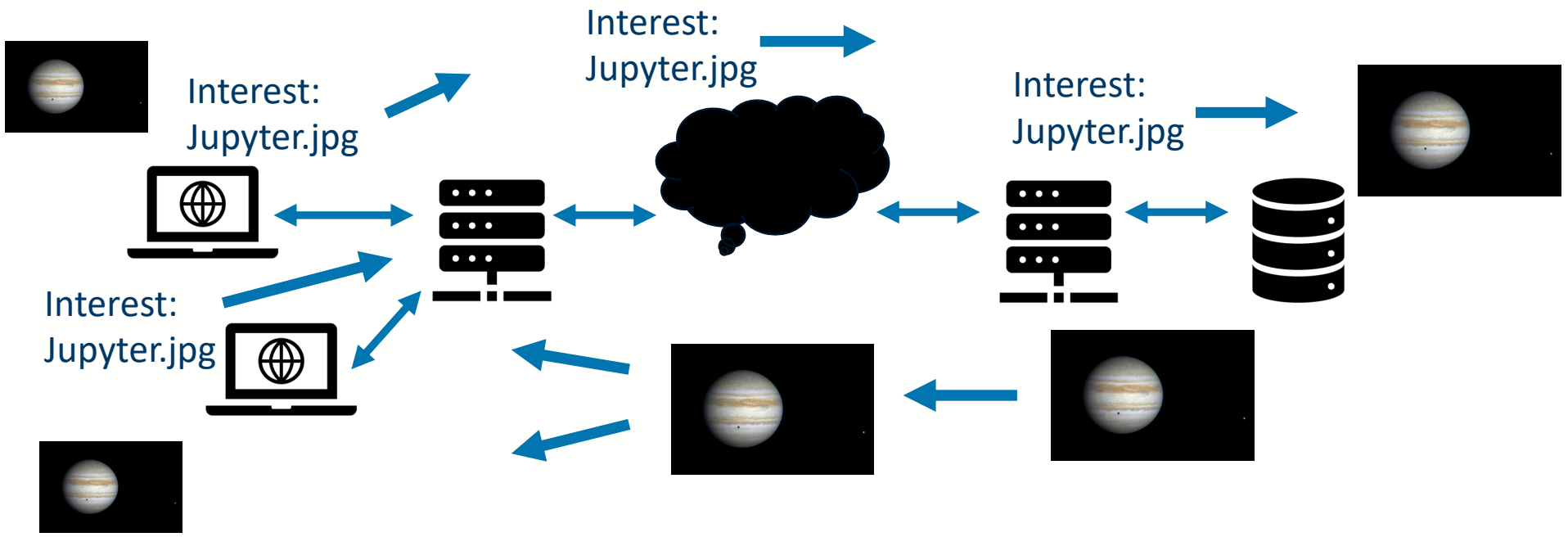
# Background — Information Centric Networking

- Current Internet sets up individual flows between the two hosts



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# Background — Information Centric Networking

- Routing over names:
  - Brings **key information** about the data
  - Requests can be **aggregated**
  - Data can be **cached on-path**
  - **Lightweight Mobility support** (the data delivery traces Interest packet path)
  - **No IP address** management

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# Name and Name-prefix

- ICN data have names:
  - Consumers use **names** to request data from Producer
  - Forwarder forwards interest packets using **name-prefixes**
- **Names** can be flat but structured/hierarchical approach seems to make sense:
  - We see this in URL paths today
  - /<domain>/<URI-esque path>/<segmenting>
  - `/netflix/live/football/2024-04-12-ManU_vs_City.mp4/24`
  - Prefix: `/netflix/live/*`

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# Quality of Service mechanisms today

- DiffServ
  - Relative prioritisation/de-prioritisation
  - Scheduling mechanisms to enable certain characteristics — Per-hop Behaviours (PHBs)
    - Best Effort
    - Assured Forwarding
    - Expedited Forwarding
    - Lower effort
  - PHBs in a packet field as DSCP
    - Often ‘bleached’ at the network boundaries
  - Set by application or traffic classifier node
- IntServ + RSVP
  - Explicit resource reservation
  - Negotiates across the whole path
  - Heavy weight
  - Difficult to deploy

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# Current QoS proposals for ICN protocols

- Many are:
  - IntServ+RSVP style
  - Explicit approach
  - Resource reservation type
- Similar downside/challenges follows
  - Deployability
  - Scalability
  - Requires consensus amongst all parties on the path
  - Requires specific knowledge about the data in advance
  - Some proposals are application specific

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# Name-based QoS for ICN

Name-prefix based approach for QoS

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# Name-based QoS — approach

- **Purely name-prefix based approach**
- Approach similar to Diffserv in terms of the prioritisation/scheduling
  - Relative prioritisation/de-prioritisation
  - Queueing/scheduling follows Diffserv code points (PHBs)
- Policy contains:
  - Name-prefix
  - **Forwarding Behaviours (FWBs)** — Equiv. PHBs
    - Code point and behaviours inherits Diffserv PHBs
    - Reuse as much of the scheduling/queueing behaviours of diffserv
  - Caching Behaviours (CBs) — New set of behaviours to bias caching behaviours

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# Name-based QoS — approach cont.

- Structured name:
  - URIs today already use a hierarchical naming structure
  - Logical to continue this in ICN
- Completely **name-based approach**:
  - **No markings on the packet** itself in transit — **forwarder holds the policy** and applies them
  - **No bleaching, no tampering on-path** (name is fundamental to forwarding)
  - **Incrementally deployable** — Not all nodes have to have the mechanism
  - The network operator has the full control over how a particular prefix receives the QoS policy treatment
  - No need to change applications

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# Current progress

- Simulation with ndnSIM
  - ns-3 based simulator with real NDN library + Forwarder code
  - The forwarder and the library modified to implement the QoS mechanism
    - **QoS policy table** in the modified forwarder
    - Table look-up operations in the modified forwarder to **identify prioritised prefix**
    - Ns-3 traffic control layer — priority queueing
    - **Marking the packet representation** for queue to identify traffic class (but marking is not in the packet itself)
  - **PoC** — hard-coded, very early work, on a single forwarder

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# Current progress

- Simulation with ndnSIM
  - PoC — hard-coded very early work on single forwarder
    - Link latency — 10ms
    - Two consumer hosts:
      - One requesting prioritised ‘/prio/*’ names
      - One requesting non-prioritised ‘/prefix/*’ names
      - 180 req./sec
    - One producer and one Forwarder

| | Min | 1st Qu. | Median | Mean | 3rd Qu. | Max |
|---|---|---|---|---|---|---|
| Prioritised (s) | 0.04587 | 0.11039 | 0.17627 | 0.17638 | 0.24216 | 0.30804 |
| Non-Prioritised (s) | 0.04873 | 0.11325 | 0.17914 | 0.17924 | 0.24502 | 0.31090 |

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# Next steps

- This work identifies the **‘knobs and the levers’**
- Develop an appropriate management protocol to manage the forwarder:
  - Distribute/manage policies
  - Dynamically update policies
- Consider what Caching Behaviour (CB) code-point should be
- Questions about how various states/complexity shifts:
  - Diffserv holds policy label on the packet, this Name-based QoS holds them in forwarders, how does this affect scalability against increasing flows, prefixes, etc.?

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