Interplay of mmWave based wireless access and ICN

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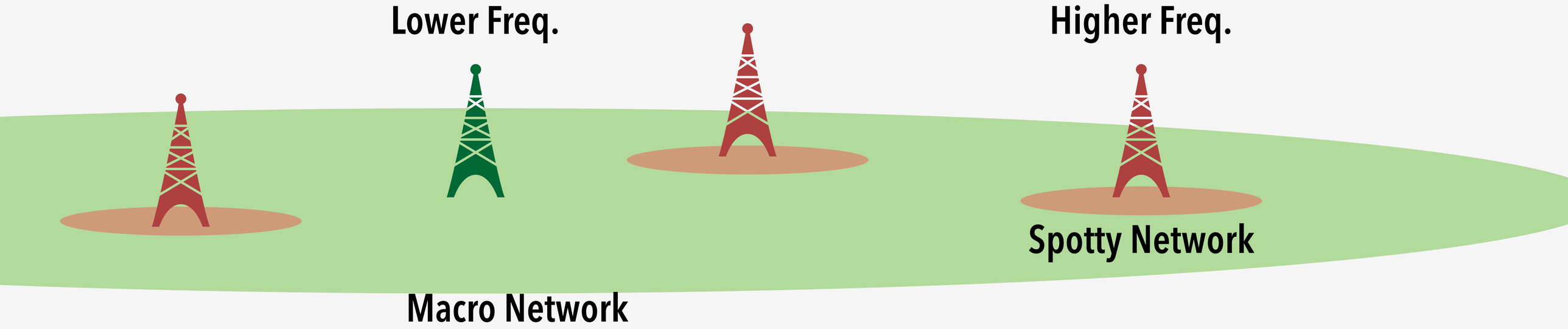
IMT2020 Features

- **Higher frequency bands** are allocated for mobile services
  - CAN provide wide bandwidth (1Gbps -)
  - CANNOT provide wide coverage area (less than tens meter)
- Mobile Edge Computing provides a **storage** at an edge device

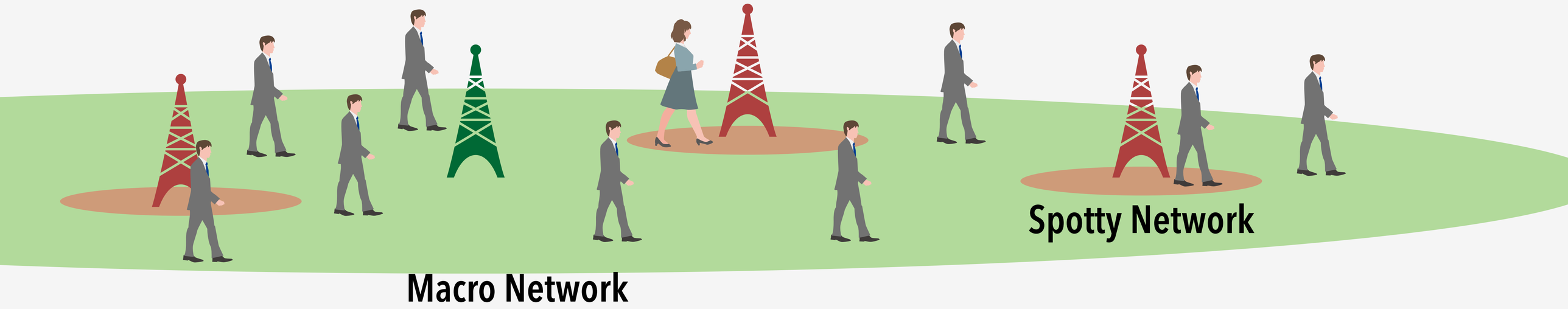
Heterogeneous Network

- **Higher frequency bands** leads Heterogeneous network
  - Future mobile network consists of
    - **Macro Network** provides a wide coverage area
    - **Spotty Networks** provide small coverage areas



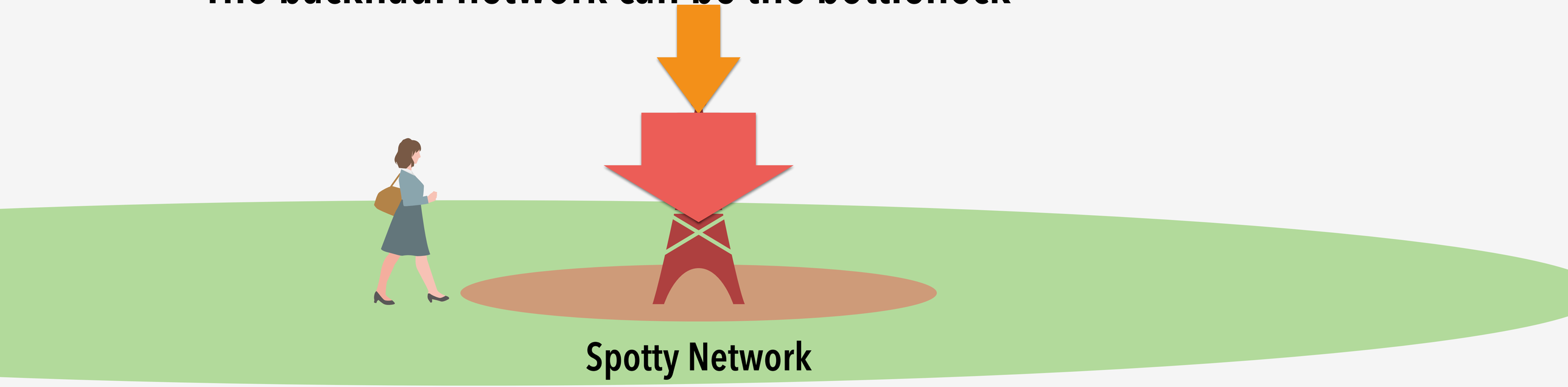
Spotty Network : Small Area

- **Advantage**
  - A user can monopolize a high-speed wireless link since the number of users in the same area is very small
- **Disadvantage**
  - A user passes through the small area in a very short time



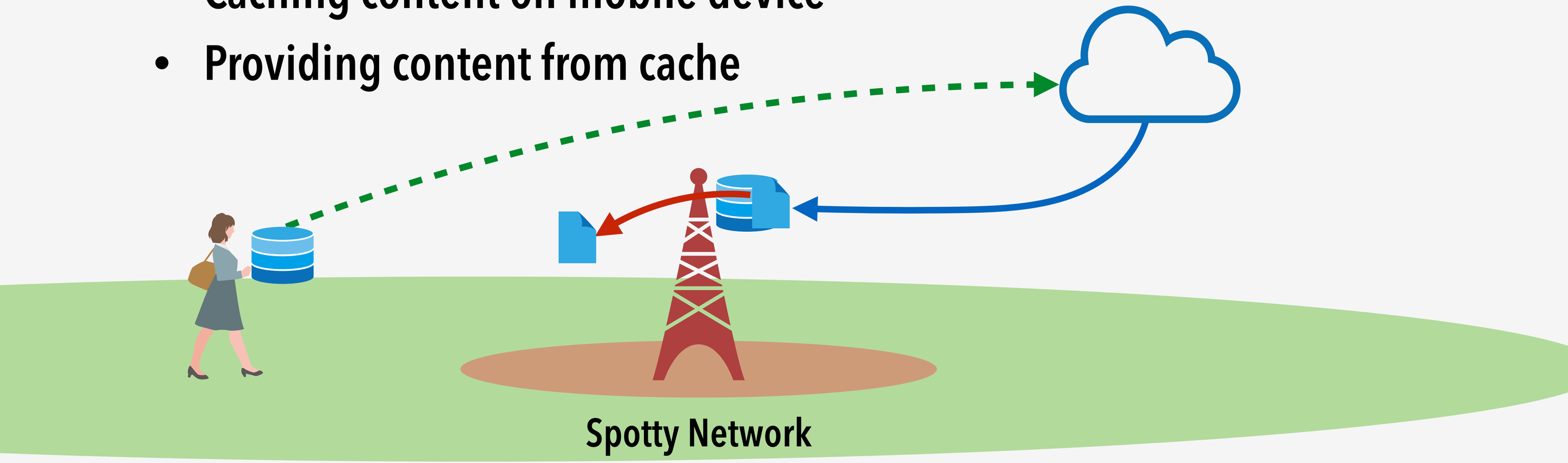
Spotty Network : High Speed Link

- **Advantage**
  - Transferring a large amount of data in a short time
- **Disadvantage**
  - The backhaul network can be the bottleneck



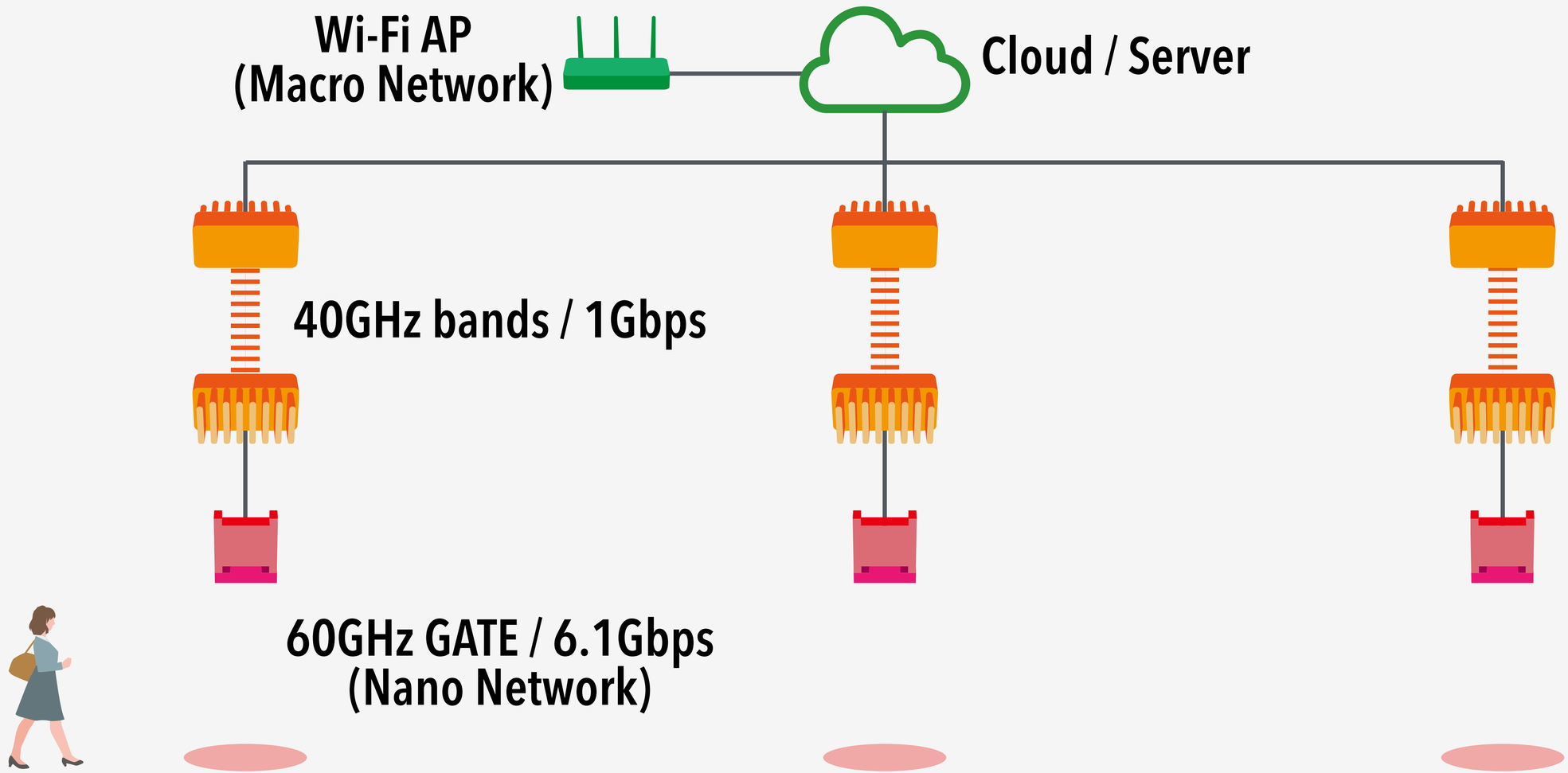
Concept of mmWave based Wireless Access Network

- Leveraging the storage of each device
  - Prefetching content into base station on spotty network
  - Caching content on mobile device
  - Providing content from cache



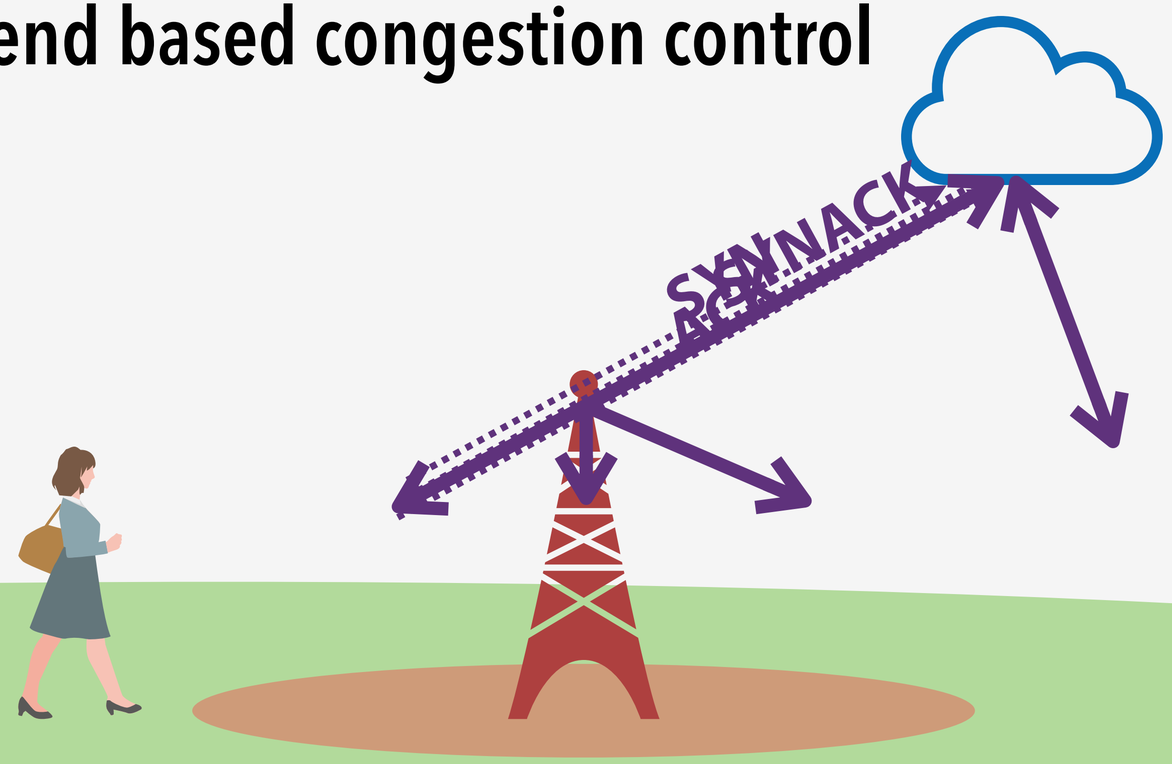
Experiment of mmWave based Wireless Access Network

- We developed a 40GHz and 60GHz wave-based access network



Techical Problem for mmWave based Access Network

- Current Internet technology is based on an end-to-end “connection”
  - Need to establish a connection between a client and a server
  - Need to keep the connection for the continuous service
  - End-to-end based congestion control



Benefits of Information-centric Networking

- **Information-centric paradigm** can solve them natively
  - Users are primarily interested in **content/information**
  - and **NOT from where** and **how** they get the content

Features of Information-centric Networking

- ICN is suitable to develop this content delivery scheme
  - **Name the data**
    - Every piece of network data is named
  - **Transfer the data**
    - the data is transferred to interested recipients
  - **Secure the data**
    - every piece of network data is secured

Name the data

- Content is separated into small pieces and every piece is **named**
  - Network can know which pieces are downloaded
  - Network can decide which pieces are prefetched

Content#1/1

Content#1/2

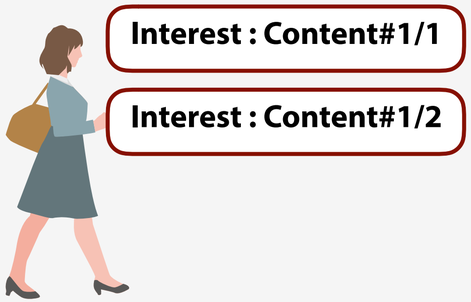
Content#1/3

Content#1/4

Content#1/5

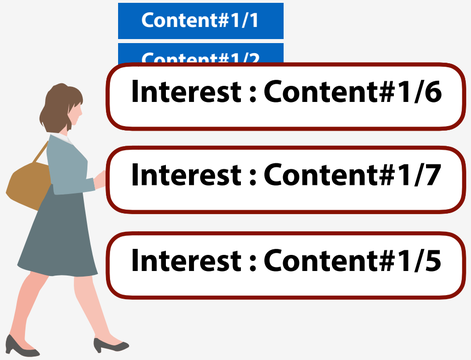
Content#1/6

Content#1/7



Transfer the data

- Network forces on only data transferring,
  - It is not unaware **from where** to get it
  - Also the same even a cache on the mobile terminal

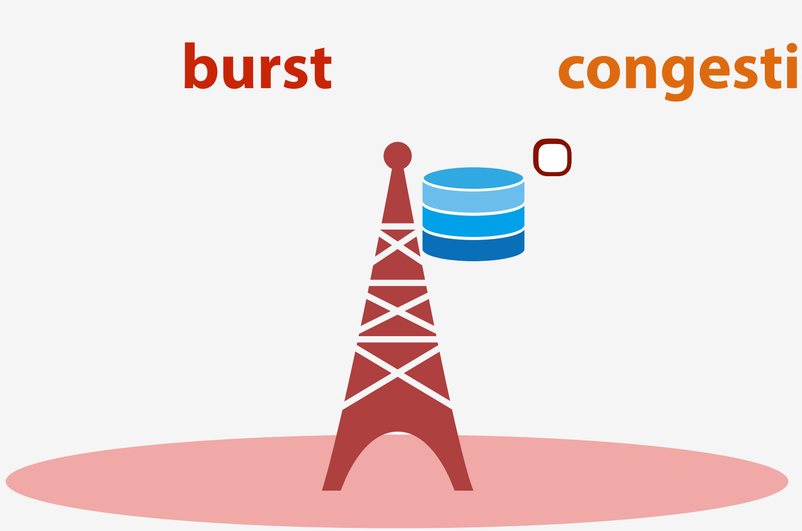


Content#1/3
Content#1/4
Content#1/5

Content#1/6
Content#1/7

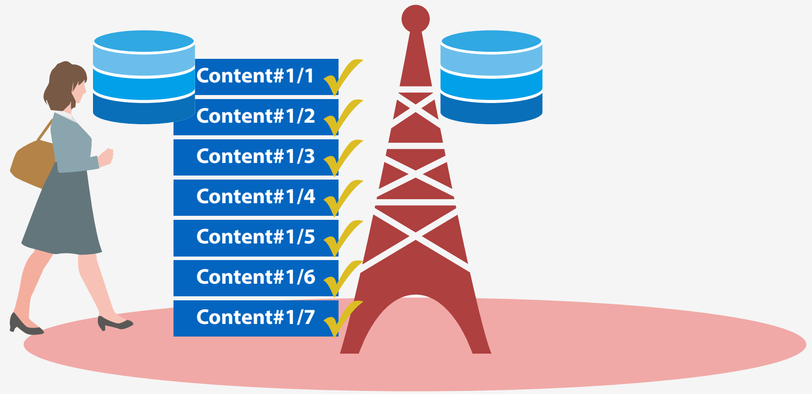
Transfer the data

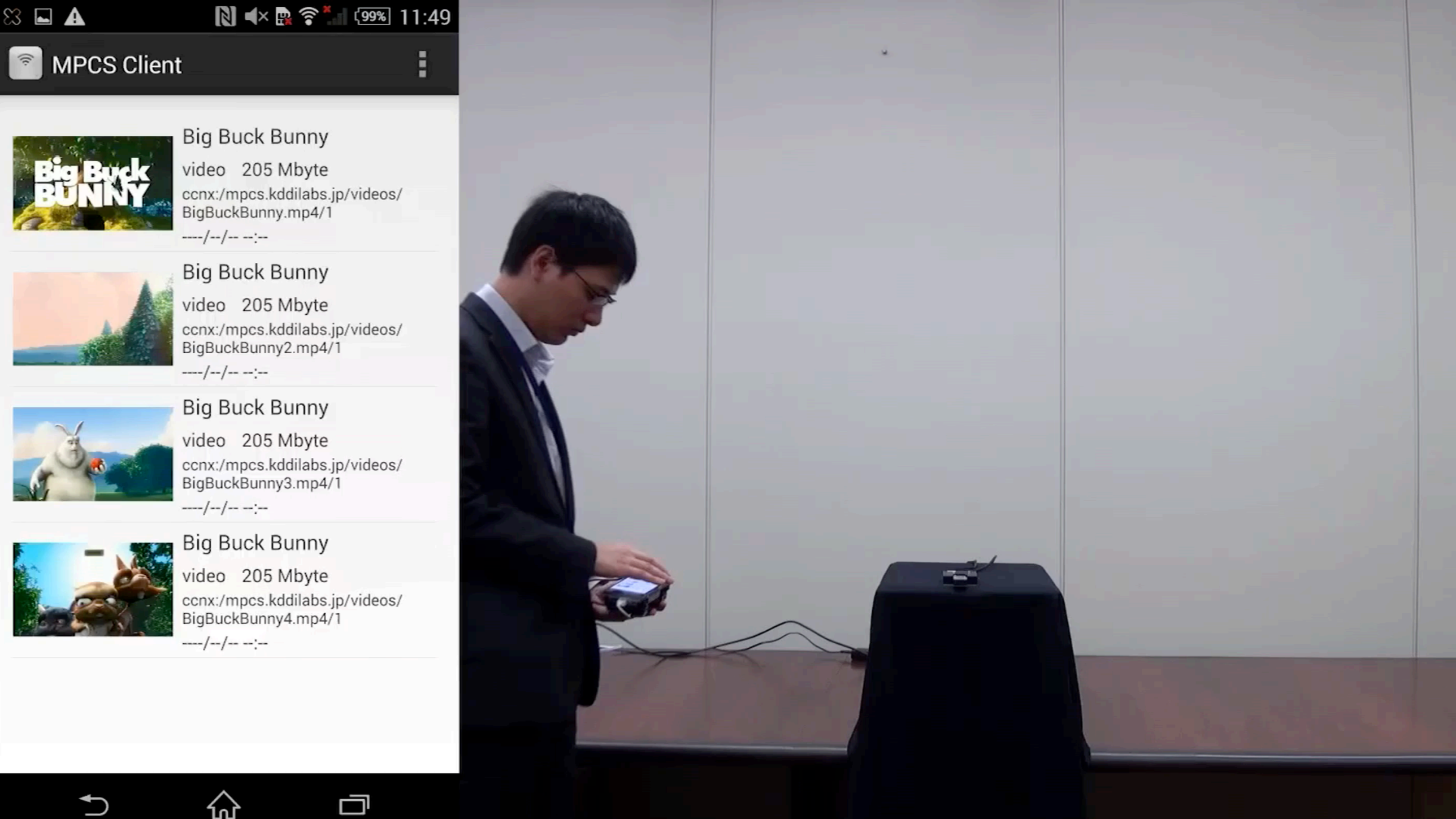
- Network forces on only data transferring,
  - It is not unaware **how** to transfer it
  - It is easy to aggregate the different transmissions



Secure the data

- Each piece has signature of publisher and is encrypted
  - A user can trust downloaded content without certification of spotty network




99% 11:49
MPCS Client
Big Buck Bunny
video 205 Mbyte
ccnx:/mpcs.kddilabs.jp/videos/
BigBuckBunny.mp4/1
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Big Buck Bunny
video 205 Mbyte
ccnx:/mpcs.kddilabs.jp/videos/
BigBuckBunny2.mp4/1
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Big Buck Bunny
video 205 Mbyte
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BigBuckBunny4.mp4/1
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Conclusion

- Interplay of mmWave based wireless access and ICN
  - to avoid disadvantages of mmWave bands
    - Small coverage area
  - to leverage benefits of mmWave / IMT-2020
    - Diversity of access networks
    - Storage at edge/end devices

- We showed an application of mmWave and ICN for IMT-2020