Multicast in Information-Centric Networking

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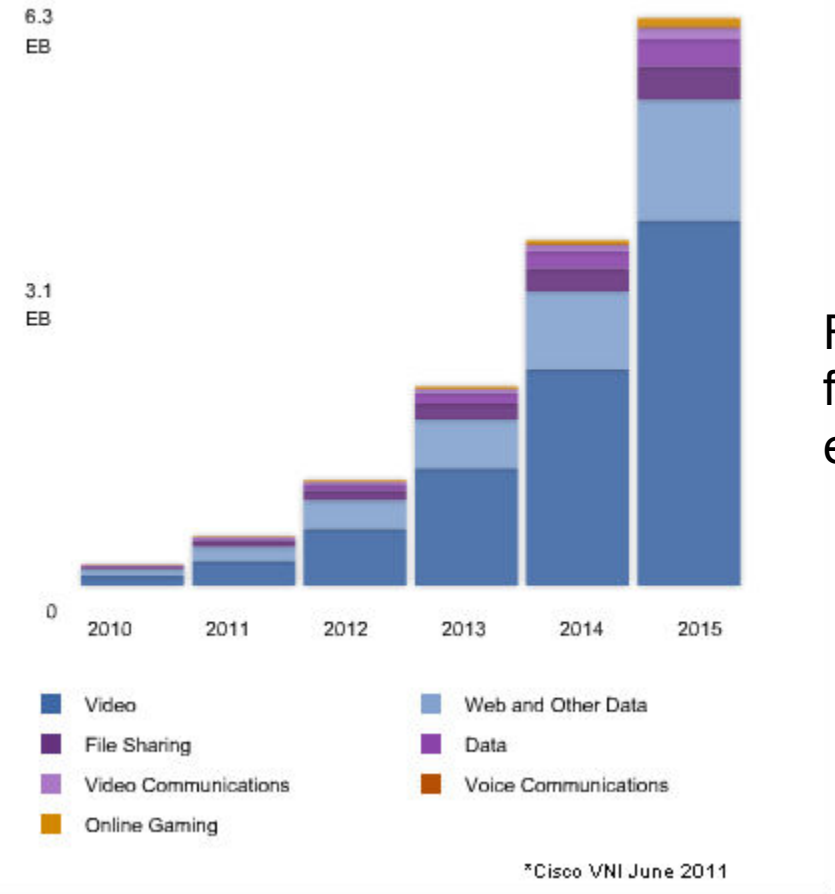
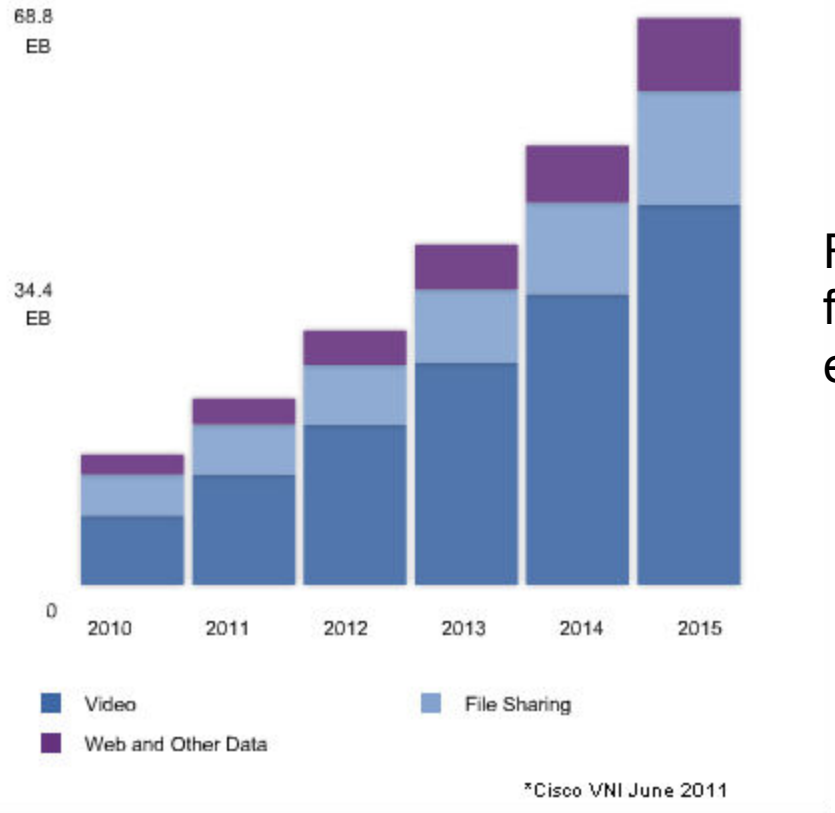
Mobile Data Traffic Prediction



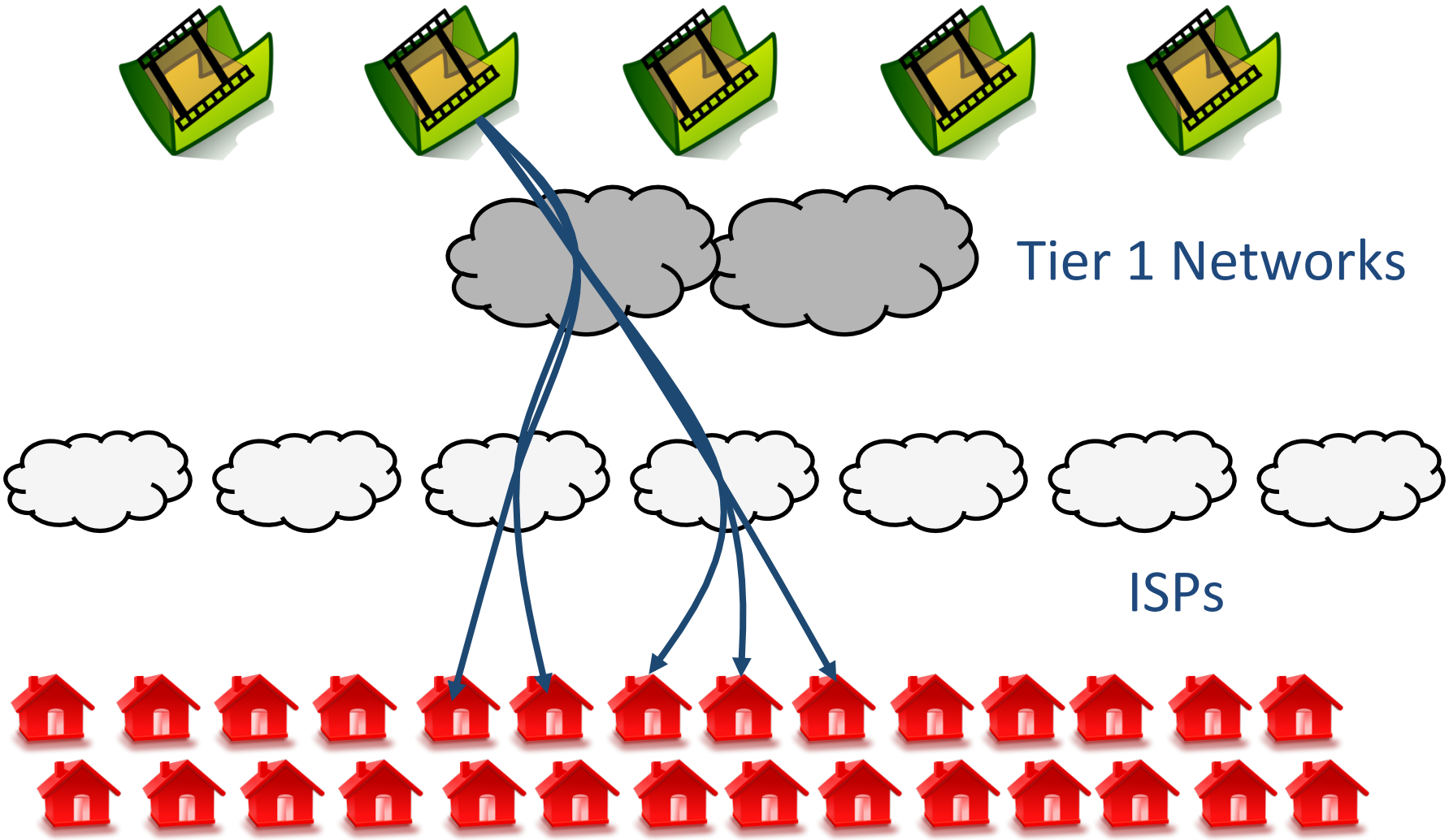
From 2010 to 2015: factor 26 increase expected

Video Data Traffic Prediction



From 2010 to 2015: factor 5 increase expected

Popular Conception:
Content Distribution Over the Internet Does Not Scale



Attempts to Mitigate

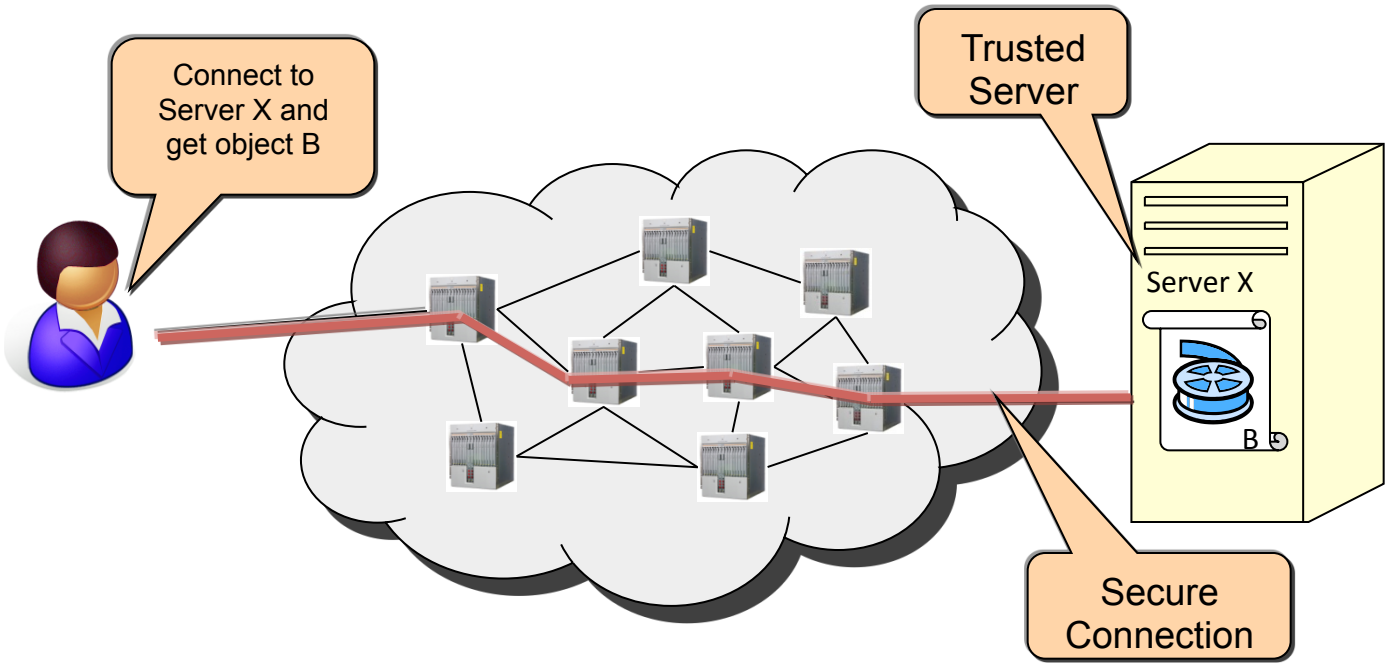
- IP-Multicast
  - Packet-level one-to-many and many-to-many communication
  - Mostly used in controlled environments (e.g., IPTV distribution)
- P2P
  - Enhancing scalability by distributing serving load
  - But: traffic management and peer selection control deemed necessary
  - Also: combining P2P w dedicated in-network storage (DECADE)
- CDN
  - Enhancing scalability and performance by operating dedicated caches close to access networks
  - But: proprietary, standalone networks – increasing demand for interconnect: CDNI
- Evolving specific system architectures
  - 3GPP EPS: mobile data offload

Summary

- Massive deployment of P2P, CDN
- Represents a need for
  - **Accessing named resources – not hosts**
  - **Scalable distribution through replication and caching**
  - **Good control of resolution/routing and access**
- But
  - We are engineering a lot of overlay infrastructure to make it happen
  - Using DNS, HTTP in creative ways
  - Still unresolved problems

Problems

- Security
  - Can't trust a copy received from an untrusted server
  - Trust on object authenticity today based on transport layer security (based on host name certificates)
  - CDN: 'proxy TLS' for enabling HTTPS with DNS rewriting



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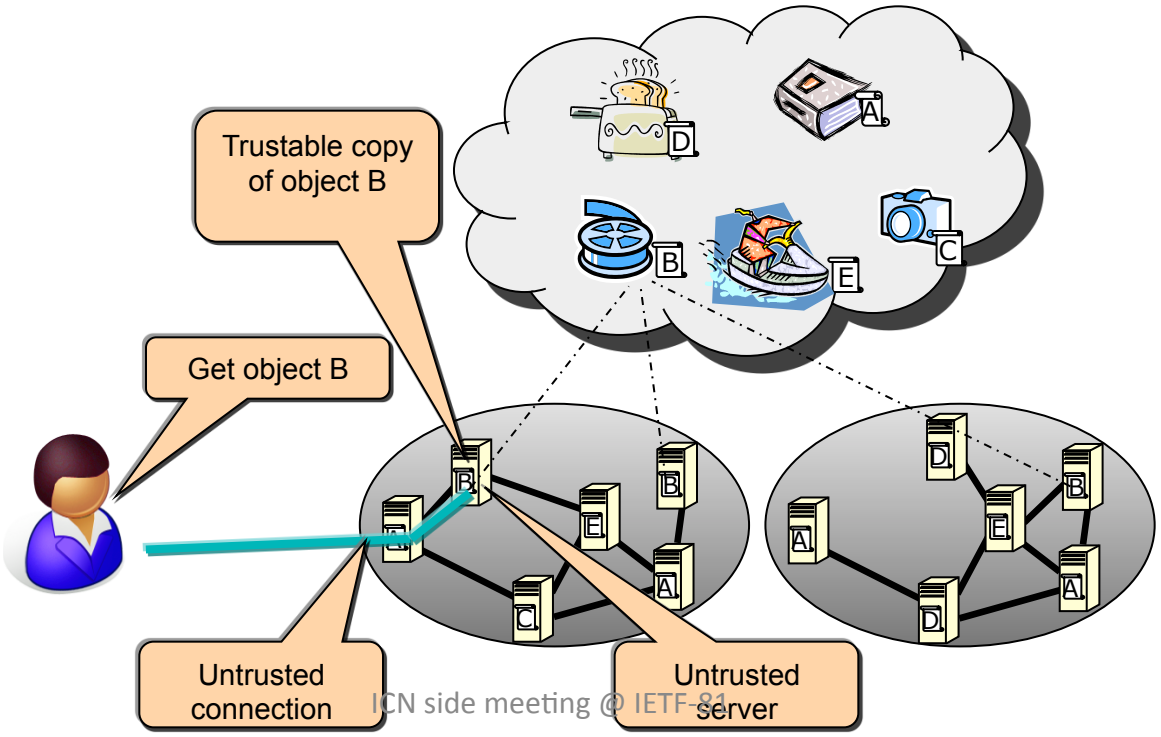

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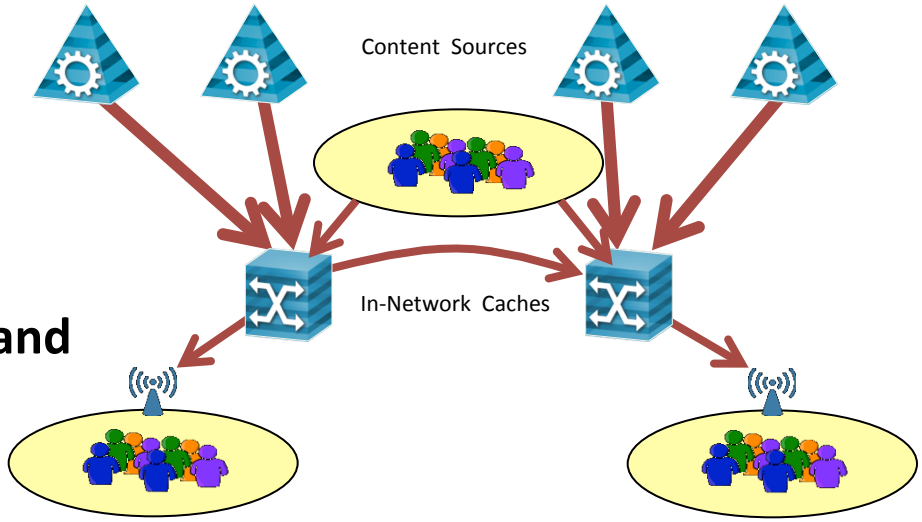
- Application and content provider independence
  - CDNs focus on web content distributions for major players
  - What about other applications and other players?

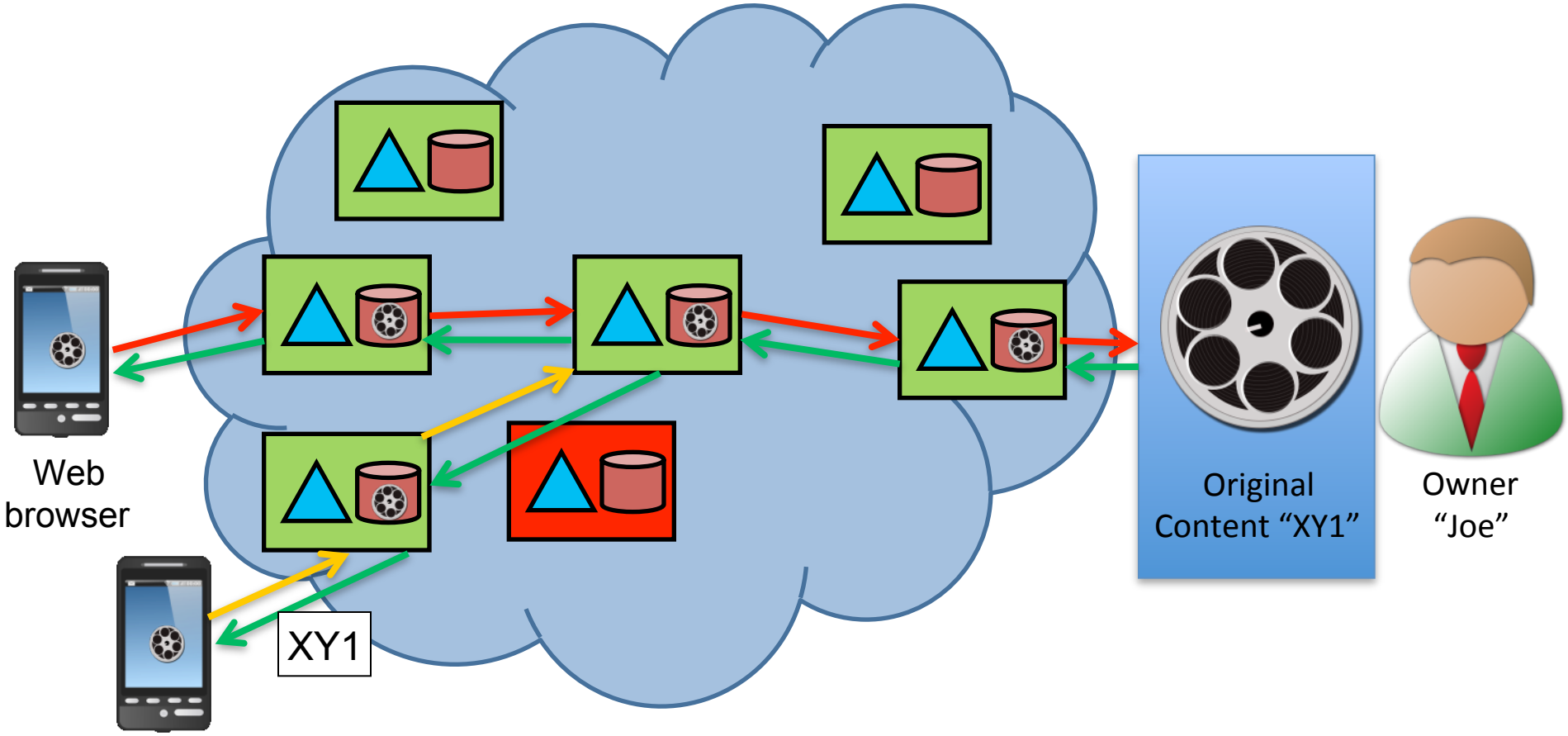
- Inefficient information dissemination
  - Can't benefit from existing copies (e.g. local copy on client)
  - No "anycast": e.g., get "nearest" copy
  - Flash-crowd effects, disruptions not well tolerated
  - Names can depend on location => 404 Not Found

Information-Centric Networking

- Since we are mostly accessing named resources anyway
  - Design the network so that this is optimally supported
- Considering important requirements
  - **Accessing named data objects – not hosts**
  - **Scalable distribution through replication and caching**
  - **Good control of resolution/routing and access**
- With ubiquitous caching
  - But for all applications
  - And for all users and content/service providers

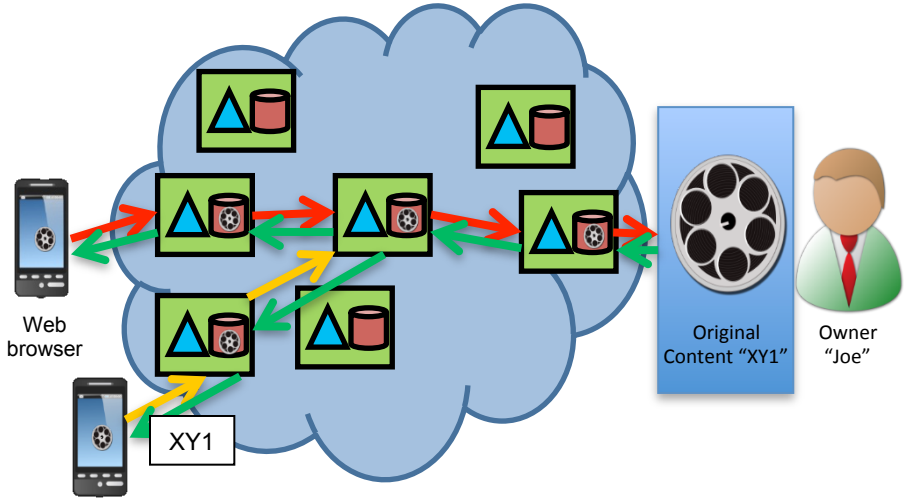


Information-Centric Networking (ICN)



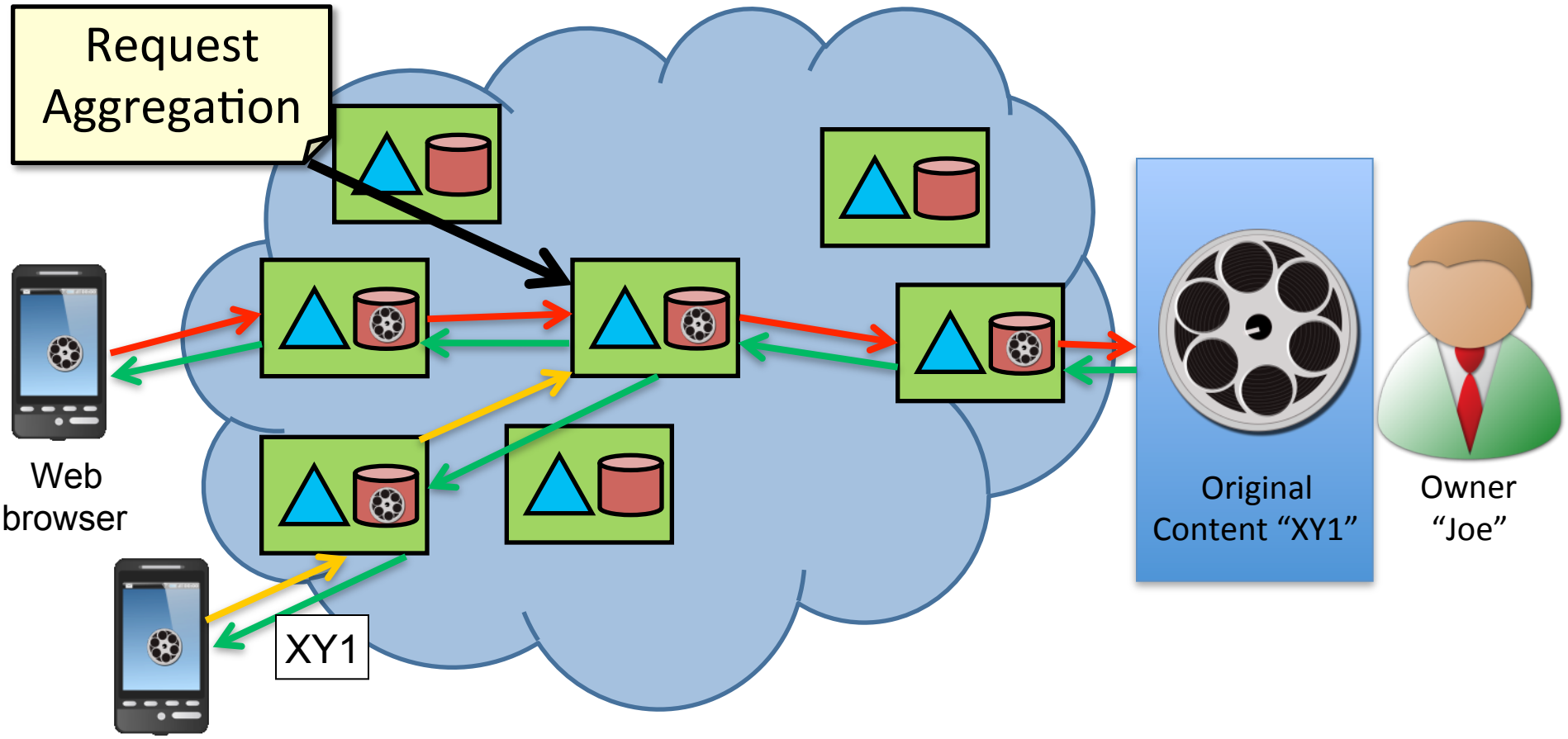
ICN Technical Topics

- **Naming of information objects**
  - Unique object identification
  - Names as keys for request/content routing
- **Routing and Name Resolution**
  - Want to locate “best” copy of named objects
  - Need a mapping/link between named objects and underlying network topology
- **Transport**
  - Reliable, congestion- and flow-controlled transport of objects from a given location to interested receiver
  - Receiver-oriented transport – End-to-end vs. hop-by-hop
- **Security / Trust**
  - Host-based e2e security no longer applies
  - Receiver is agnostic to object location



1) ICN Multicast Service

- Multipoint communication as an implicit feature



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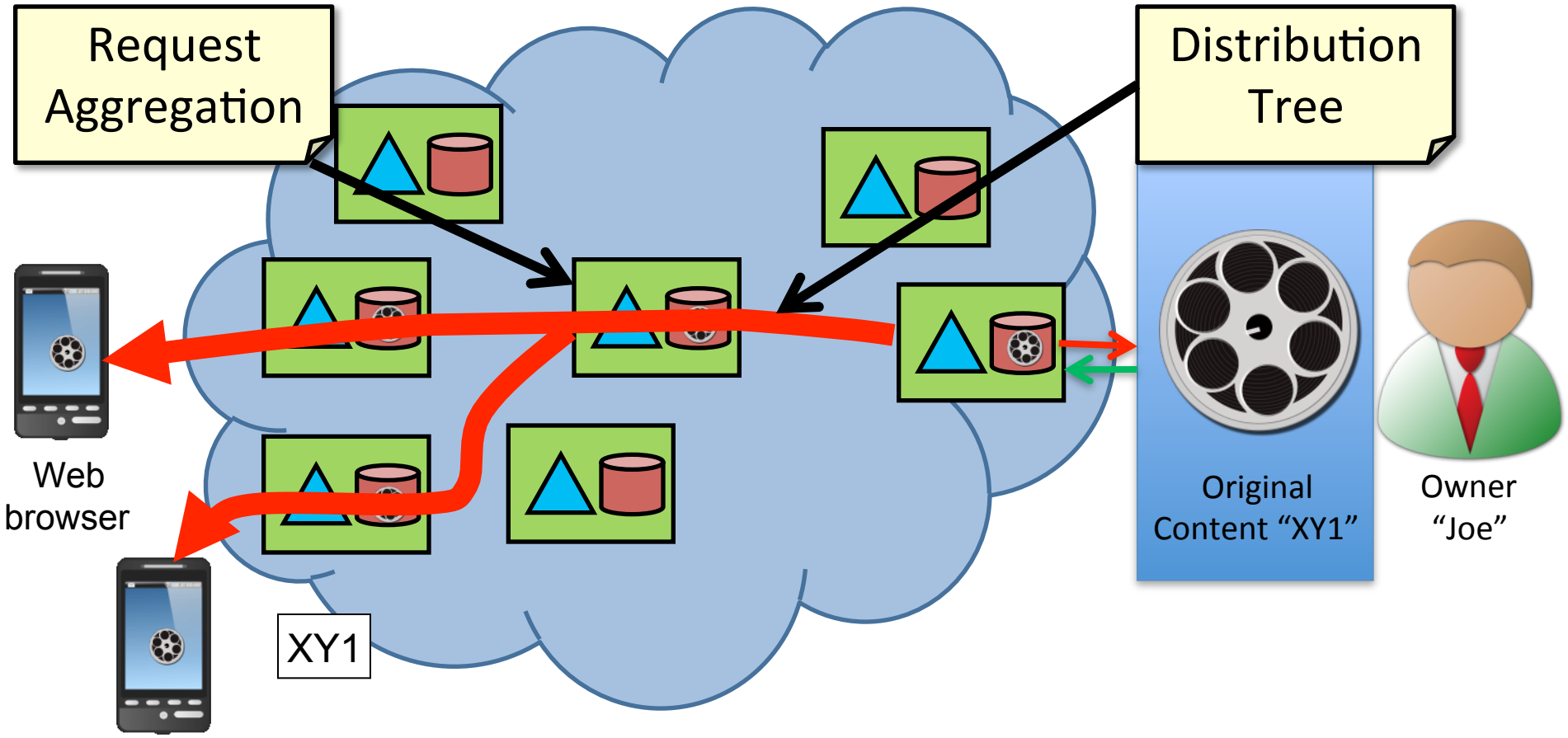
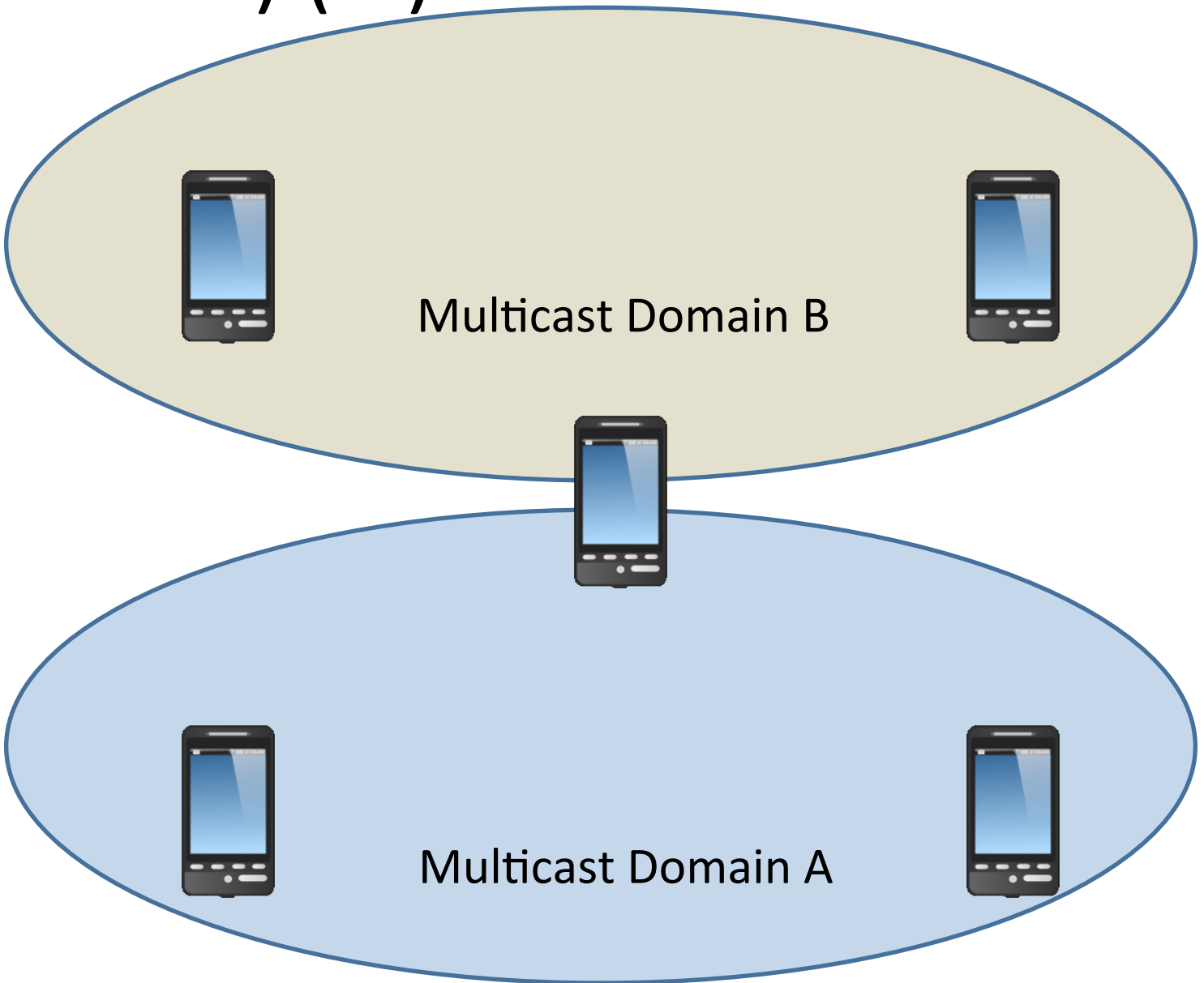


2) (IP) Multicast for ICN



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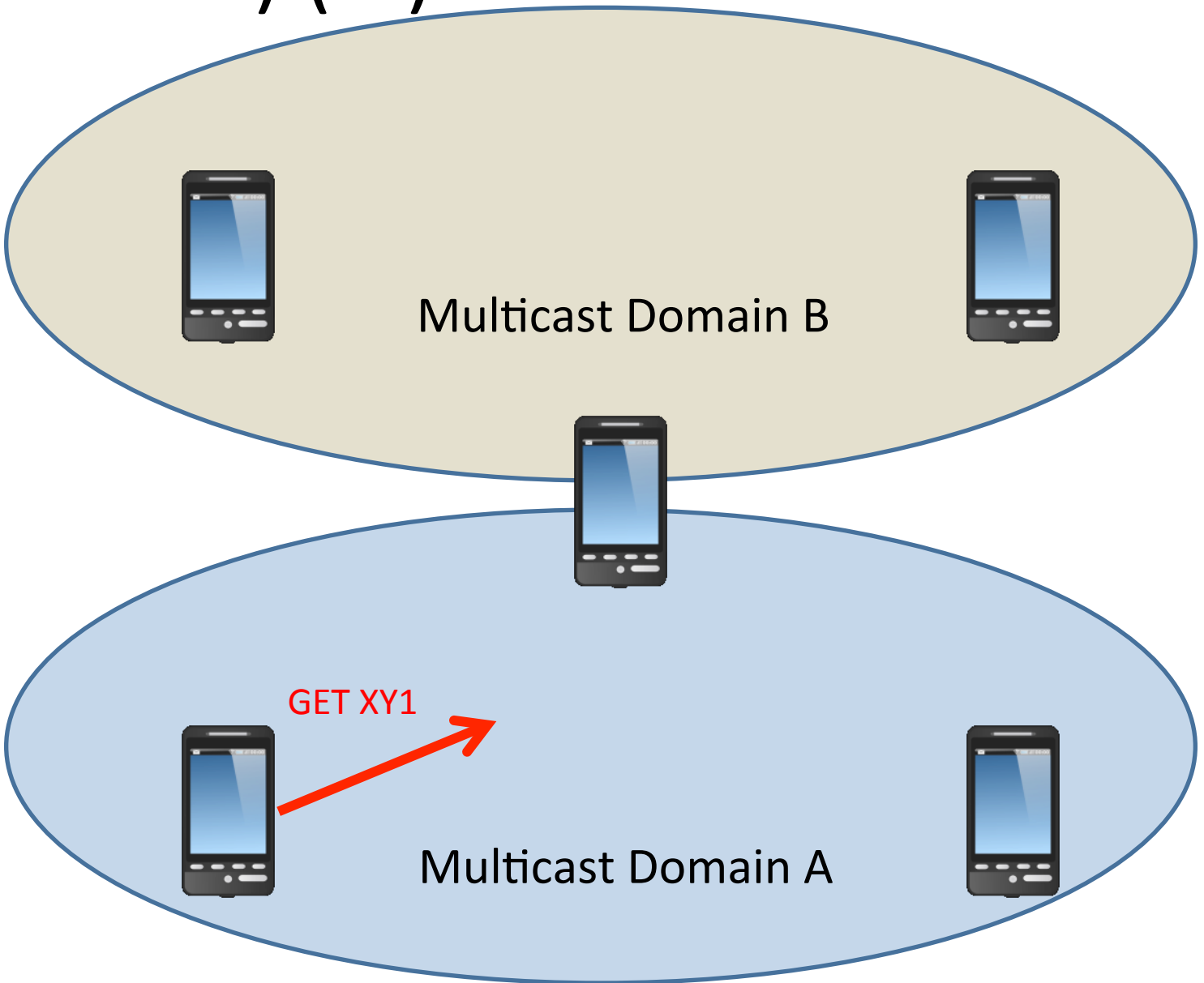

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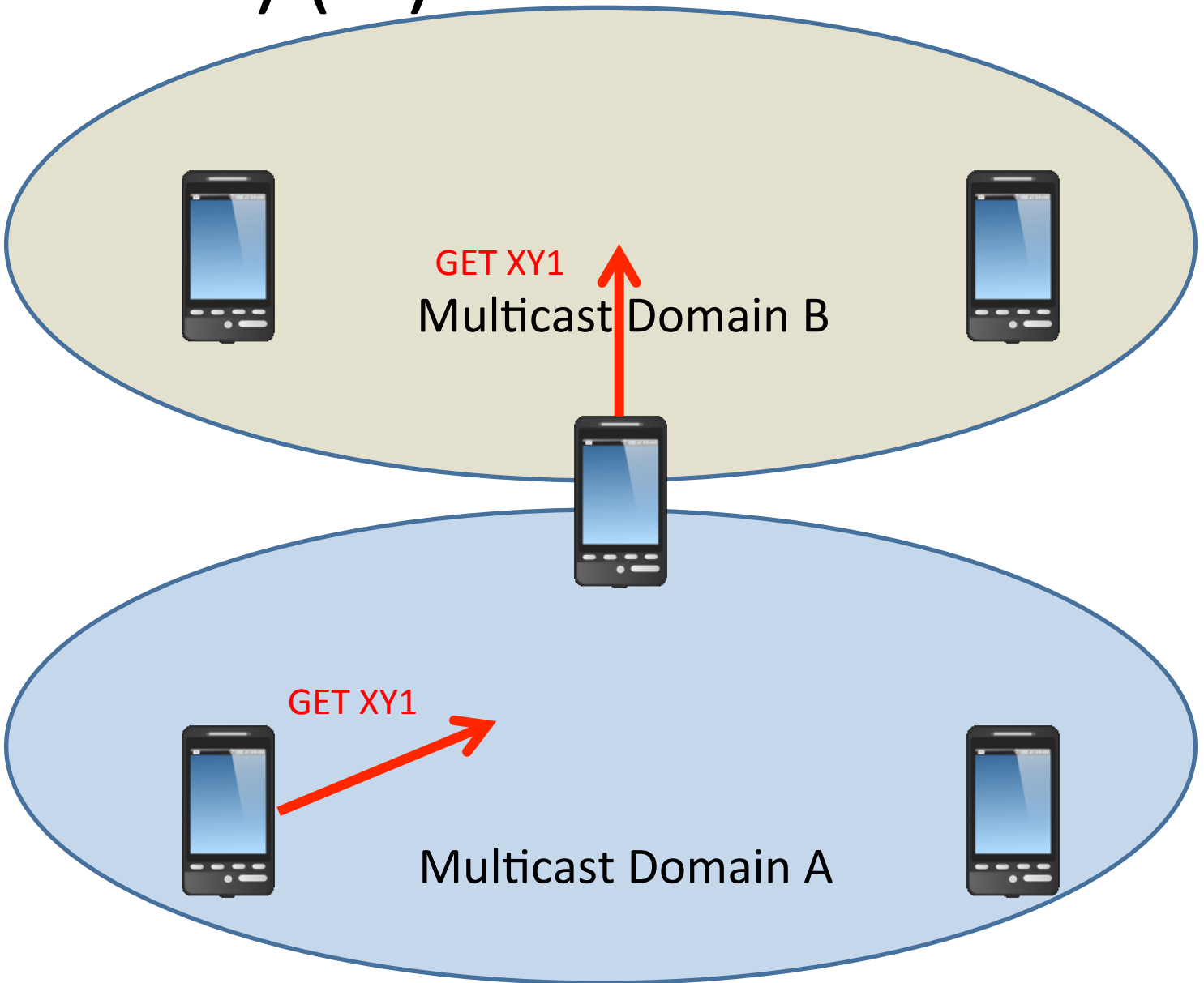

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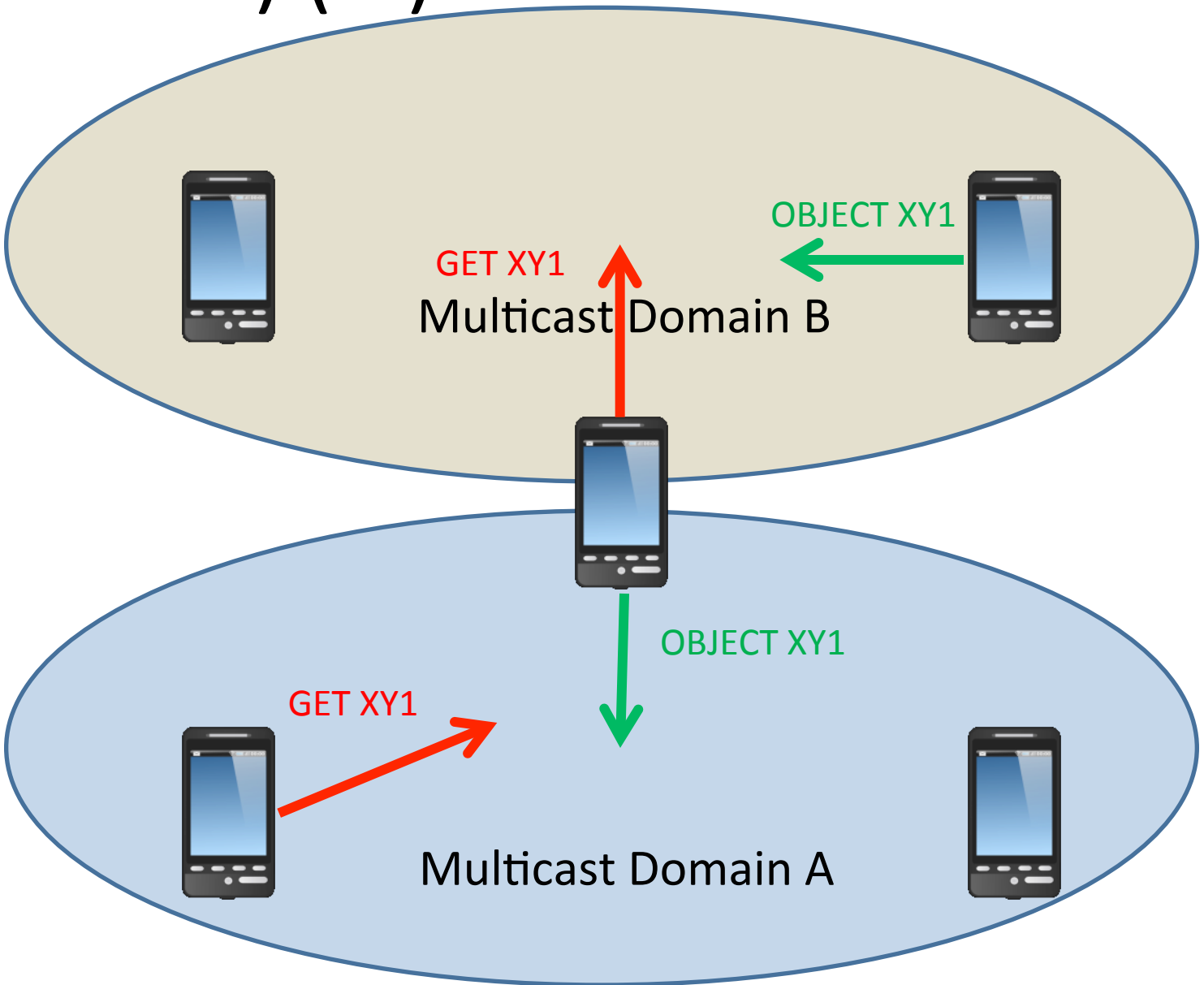

Other Possible Multicast Employments

- Carrousel-like data object distribution
  - FLUTE (RFC 3926)

- Name resolution (think Multicast DNS)
  - Resolve data object name to lower layer locator
  - Locator can be IP address, group communication session specification etc.

Current IETF/IRTF Work on ICN

- DECADE
  - URI format for Named Information
  - draft-farrell-decade-ni
  - draft-hallambaker-decade-ni-params
- DTNRG
  - Bundle Protocol Query Extension Block
  - draft-farrell-dtnrg-bpq
- ICN in IRTF
  - http://trac.tools.ietf.org/group/irtf/trac/wiki/icnrg

URI Format for Named Information

- Motivation: enabling naming of data objects with name-data integrity validation
- Internet Draft draft-farrell-decade-ni
- Flexible approach: common name format enabling different forms of name resolution and name-based routing
- Basic idea: generic URIs for hash function outputs
  - Naming the hash function and an optional authority
  - Extensibility mechanism to include locators, decryption keys etc.
- Currently text-based URI fomat – working on additional binary representation

```
ni://example.com/sha-256-32;B_K97zTtFuOhug27fke4_Q
```

```
ni://example.com/sha-256-32;
B_K97zTtFuOhug27fke4_Q?alt=ni.example.net
```

Running Code

- https://sourceforge.net/projects/netinf/