Internet-wide Federation

-- for Data Sharing, with Layered Architecture

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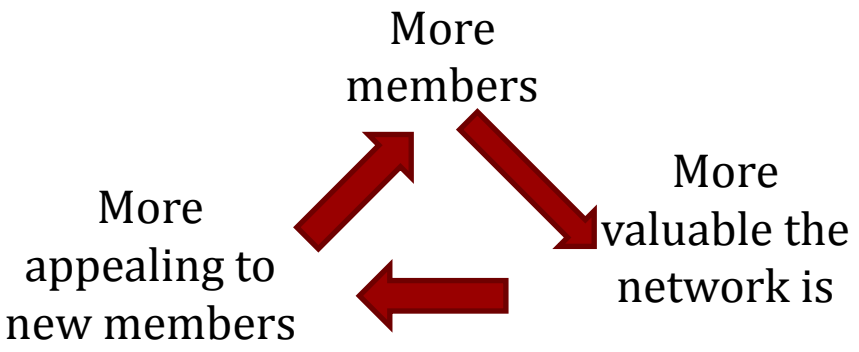
“Centralized Service Model” is good, but …

Problem #1: user relationships are locked in ASPs（=Application Service Provider）

Relationships between users or the **social graphs** become a fundamental function that most applications need.
But user relationships are easily locked in by specific application vendors.

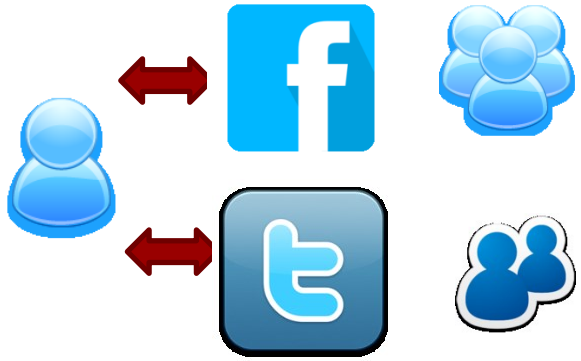


“Self-reinforcing” by “network effect” leads to “winner –takes-all”

Problem#2: UGC(=User Generated Contents) are controlled by ASPs

Cross platforms: users have to send several copies of the same content in different platforms, to reach all users; hard to manage(eg. delete) afterwards

Searching issue: by robot protocol, ASPs can block the searching robots whatever the willingness of publishers



Calls for Distributed Architecture

- European Work Programme Horizon 2020 (ICT-12b-2016)
  - "Current centralised platforms for big and social data management consolidate the dominance of existing incumbent actors, stifling innovation and allowing less and less control over the data by citizens. **Distributed architectures and decentralised platforms** have a huge potential to enable the creation of viable alternatives to current dominant models."
- Comments from an XMPP developer
  - "…an alternative to the current approach where a single provider holds all the cards. **A distributed model** would allow for much better access control and safety amongst other things"

Current Practices in Distributed Architecture: P2P and Federation

P2P : peers are both suppliers and consumers

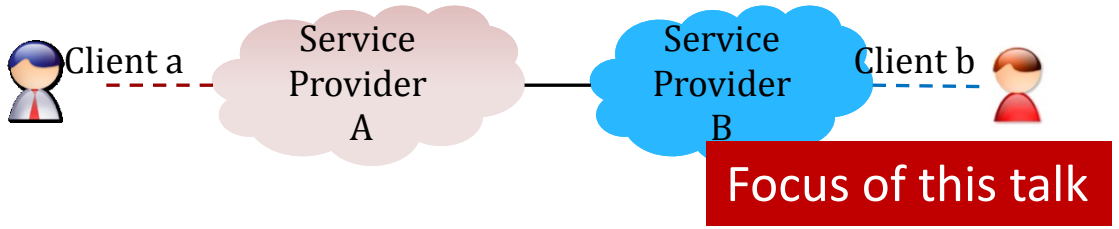
IPFS	-a content-addressable, peer-to-peer hypermedia distribution to connect all computing devices with the same system of files. -IPFS is an open source project developed by Interplanetary Networks.
SAFE (Secure Access For Everyone)	-A secure home for all your data. a new Secure way to access a world of existing apps where the security of your data is put above all else. -SAFE Network uses advanced peer-to-peer technology that joins together the spare computing capacity of all SAFE users, creating a global network. You can think of SAFE as a crowd-sourced Internet. It is on this network that everyone's data and applications reside.

- In mobile broadband era, users are less willing to join P2P due to: 1) battery power is limited 2) traffic volume caps in data plans
- The serious legal problems that have killed or driven underground typical P2P; need a very solid answer on copyright protection, spoofing, and privacy to make progress.

Federation : **a union of autonomous/peer domains**

XMPP	-It enables the near-real-time exchange of structured yet extensible data between any two or more network entities. XMPP features such as federation across domains, publish/subscribe, authentication are being used to implement the IoT.
Matrix.org	-Matrix is an open standard for interoperable, decentralised, real-time communication over IP. The aim is to provide an **analogous ecosystem to email**. a generic HTTP messaging and data sync system for the whole web.
RCS (Telco)	-Rich communication services of **inter-operator communication services** based on IP Multimedia Subsystem (IMS)

(Client a—server A—server B—client b)



- Examples of federated systems
  Telephone (mobile or fixed)
  Email

Federated Service Systems are Useful, for example

#1 : Collaboration tools for Enterprise

◆ “Communicator” project in a bank (real case)

* rigid security and privacy protection, something not-well-defined or unclear to public in today's social communication application.

* define the service in **a distributed fashion**, as opposed to the centralized approach used in facebook, where **each bank branch** may establish their own communicator-service and **operate it independently**

* **federated authentication and authorization** service

#2 : Federating of Data Silos

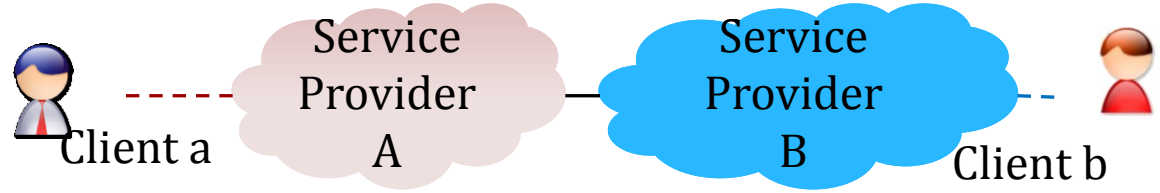
◆**IoT networks** are unlikely built/operated by a single global company.

- These IoT "silos" need be federated to share information in some ways.

◆Scientific data in different research institutes

But an Internet-wide Federation is challenging

- **Problem statement :** The challenge to build an Internet-wide federation, is not only to reach a consensus at the beginning, but also **how to avoid fragmentations**.

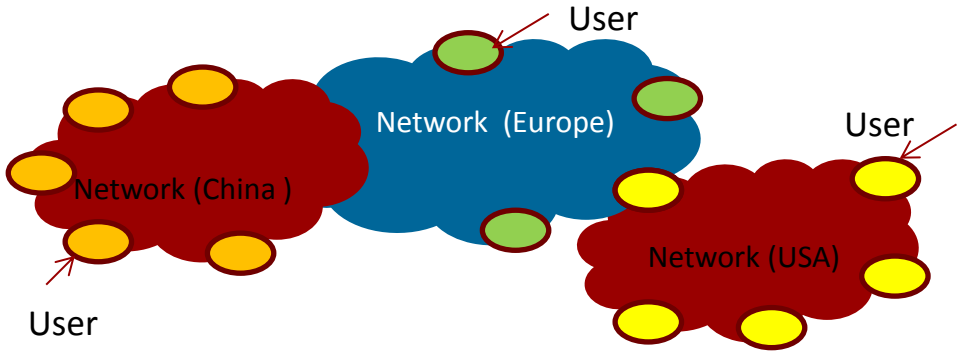


  - Service innovations will never end.
  - It is difficult to update an Internet-wide federation with thousands of domains, since the federating domains have to inter-operate with other domains with **a "standard" peering interface**.
  - While the "centralized service systems" can deploy new services overnight
- In my view, this is the essential reason why XMPP or RCS is so difficult to win in long term although they could catch attentions at the beginning.

"Baseline feature set (of XMPP) is so minimal that **fragmentation of features** between clients and servers is common, especially as interoperability profiles for features have fallen behind (as of July 2015)" –Comments on XMPP from "Matrix.org"

Internet as a Reference

- **Internet is a federation**
  - Different autonomous domains peering with BGP.



Users in different countries communicate with each other via Internet.

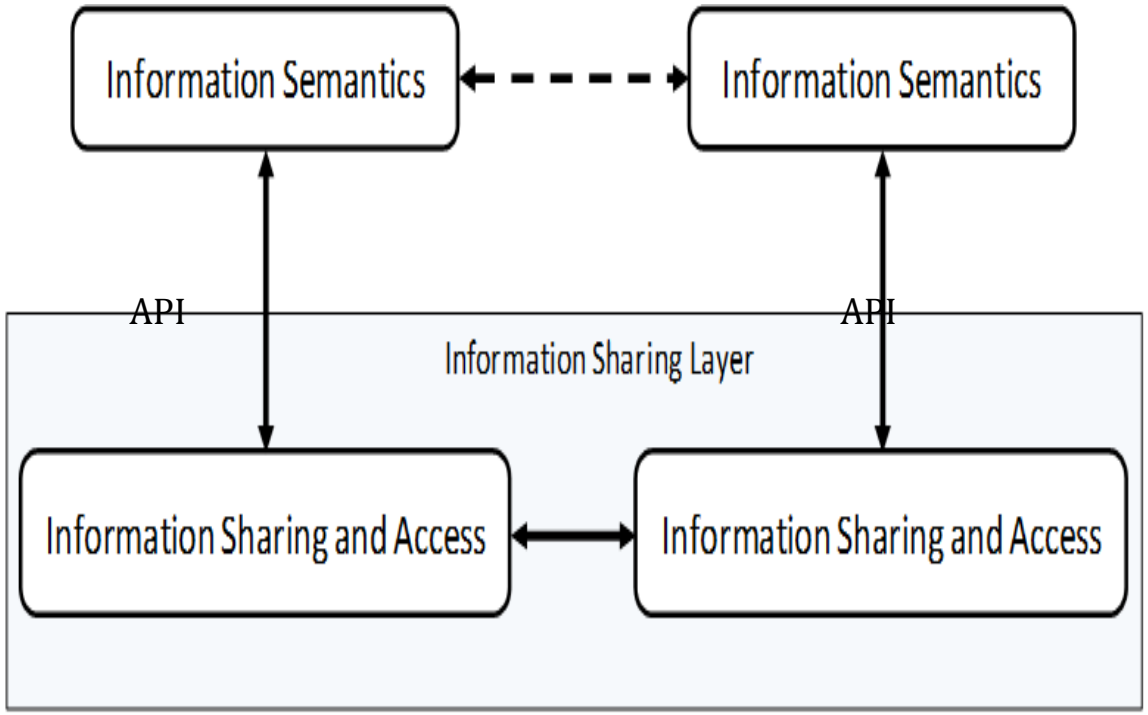
- **Design Principles of current Internet:**
  - **End to end argument:** a function or service should be carried out within a network layer only if it is needed by all clients of that layer, and it can be completely implemented in that layer.[1]
  - "A key concept of the Internet is that it was not designed for just one application, but **as a general infrastructure on which new applications could be conceived**, as illustrated later by the emergence of the World Wide Web"[2]

- **Internet is a federation based on "layered" architecture**
  - With TCP/IP provides a stable connectivity layer, all kinds of On-the-Top innovations can be conveyed on this "thin waist".

[1] B. Van Schewick, Internet architecture and innovation. MIT Press, 2012.
[2] B. M. Leiner, V. G. Cerf, D. D. Clark, R. E. Kahn, L. Kleinrock, D. C. Lynch, J. Postel, L. G. Roberts, and S. Wolff, "A brief history of the internet," ACM SIGCOMM Computer Communication Review, vol. 39, no. 5, pp. 22–31, 2009

Federation for Data Sharing with Layered Arch?

- **To separate two sets of functions in data sharing and implement with a layered architecture :**
  1) **How to share and access the data**
  2) **How to understand and process the data**



- **The first set :**
  - Functions: IDs for smart object/user/content, federated authentication and authorization for access control, publishing and subscribing in an online-social-network style, etc.
  - these functionalities could be stable according to our knowledge and practice of **primitives in file system and database**.
- **The second set:**
  - It is more sensitive to the information semantics and is dynamically evolving, by nature. New kinds of semantics and functions may come with new “things” such as sensors of new pollution metrics.
  - This function set should embrace the evolution and innovation of different **domain-specific protocols and languages** in different use cases. In the long term, the evolution may have a conclusion that whether one best solution dominates, or several alternatives coexist for different scenarios.

A little more formal statement

- **An Internet-wide federation for data sharing, above the TCP/IP connectivity layer, but underneath the semantics-sensitive applications layer;**
- **Two Decouples,** plus **Horizontal Openness**
  - The **relationships among users** and **User Generated Content (UGC) are decoupled from specific applications** and integrated into the infrastructure as necessary functionalities for data sharing
  - **Semantics of data** are decoupled from the infrastructure and left to Applications
  - **Horizontal Openness (==Federation of Autonomous System)**
    - **Global service, but locally provisioned**
    - Distributed/P2P technologies like DHT and blockchain could be used to publish and search data among domains

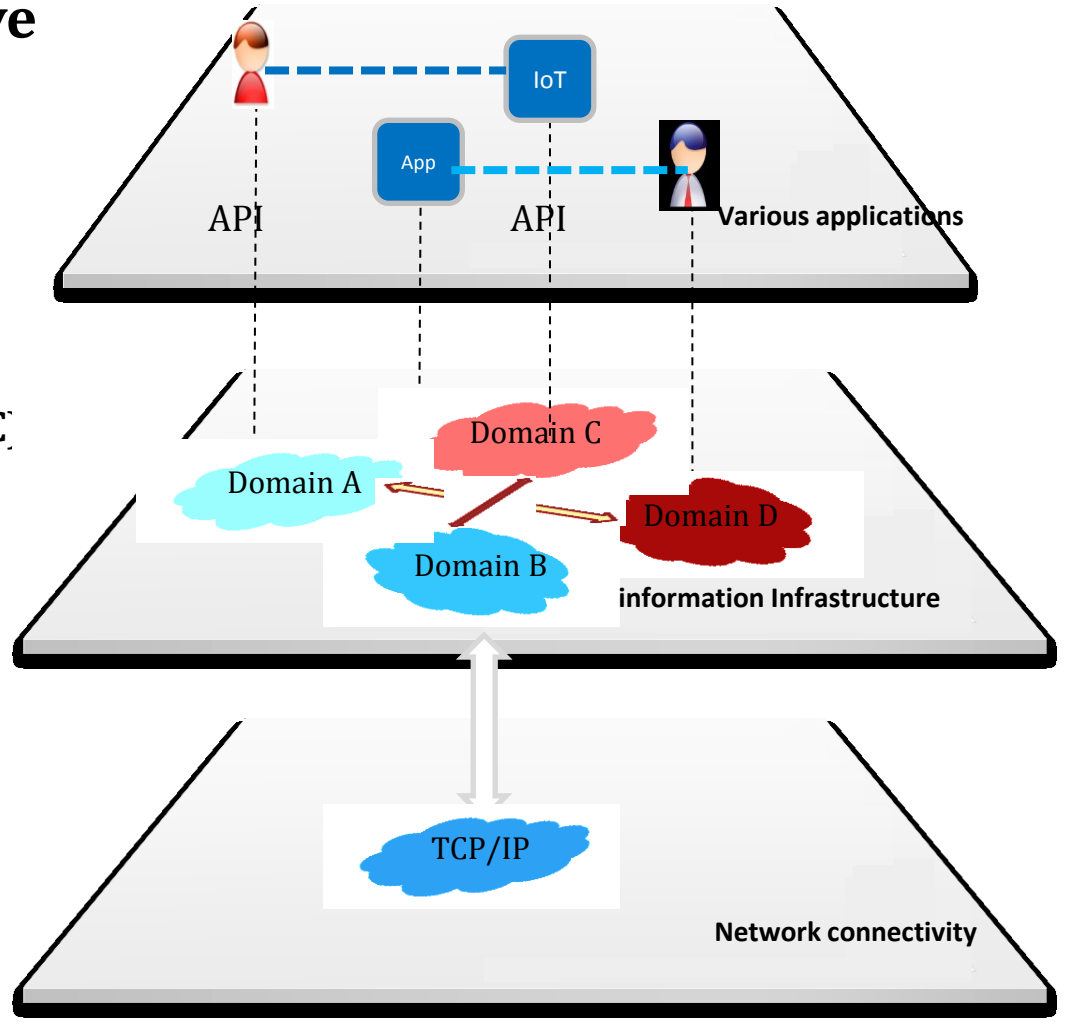
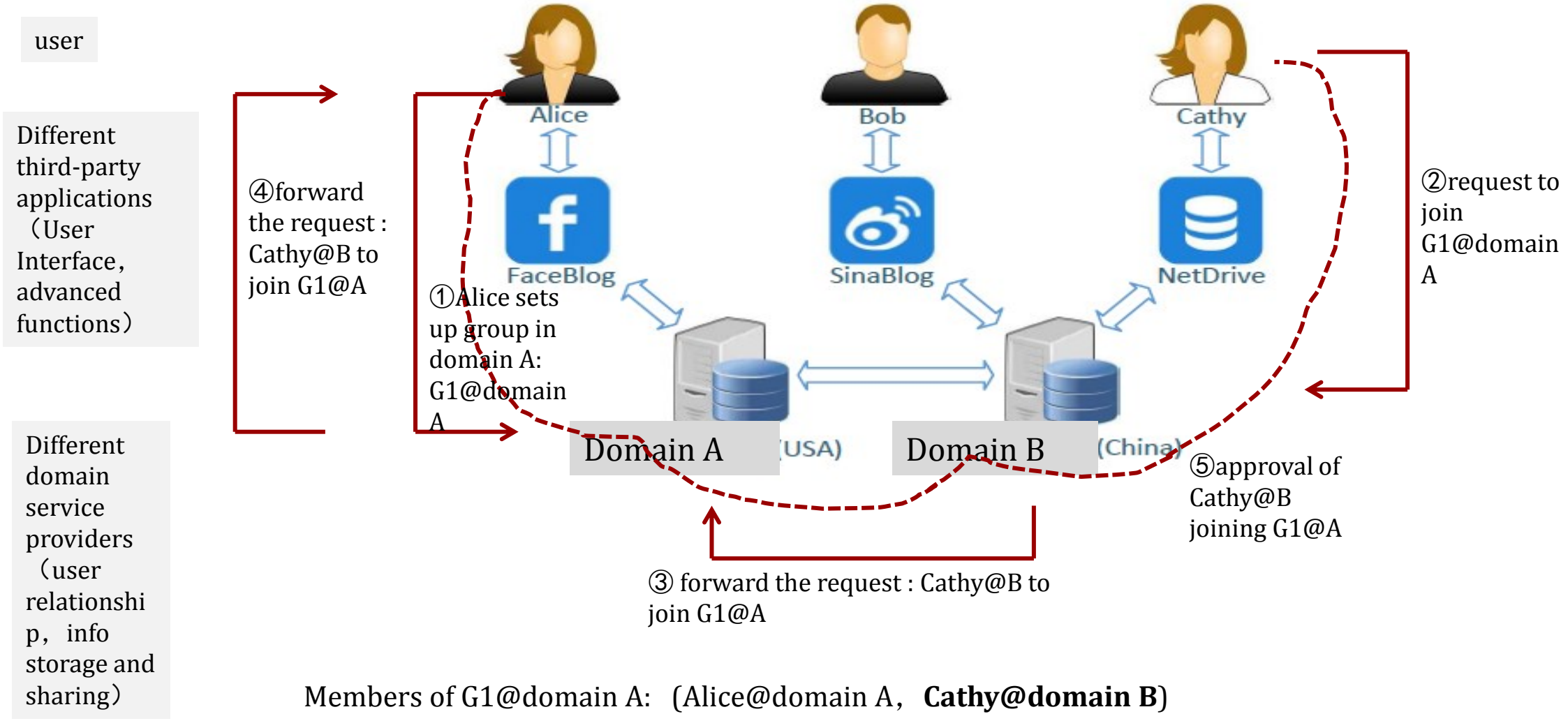
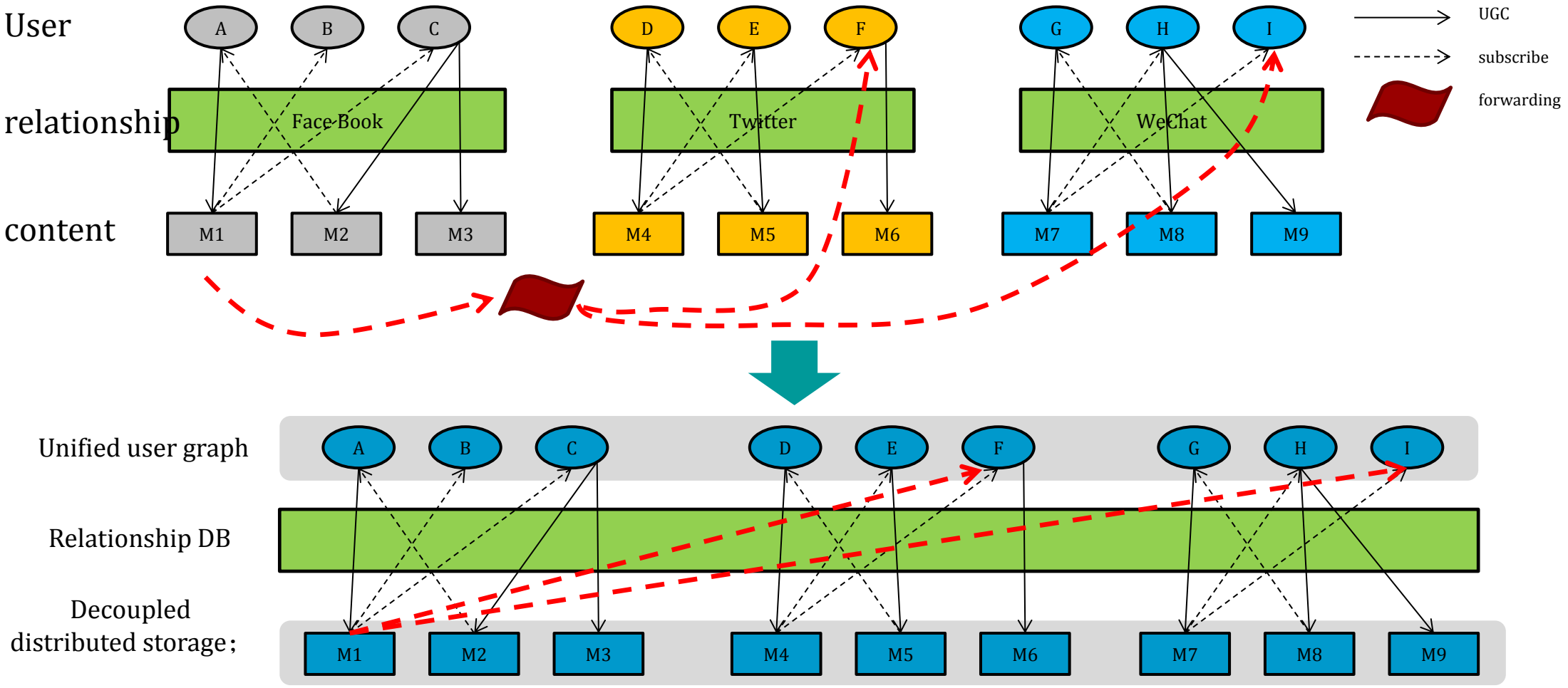


Illustration of Basic procedure: relationship



Members of G1@domain A: (Alice@domain A，**Cathy@domain B**)

Potentials: unified relationship and content

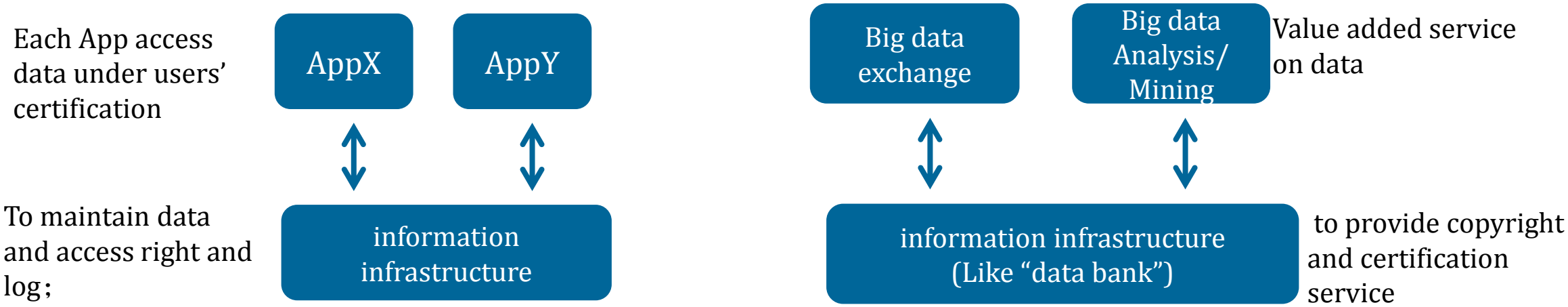


Establish a unified relationship and content, decoupled from OSN Apps

Potentials: to support various data managements

Extremely private for what I don't want to open:
traceable, delete-able

I want to share the profit from my open data:
Data are "currency", able to deal and exchange



2 extreme cases in the spectrum of data sharing

Open questions on “internet-wide federation”

- More detailed case studies for the existing federation
  - Both Successful and failed
- Identify potential new Internet-wide federations
  - IoT, Cloud to Cloud, repository to repository, OSN?
  - What are the requirements at an architectural level
- Design principles on internet-wide federation
- Framework and Architecture: which functions @ where
- Gap analysis on current protocols
- Extent existing protocols or create new ones

Summary

- Distributed service model is required for better access control and better privacy/security
  - Peer-to-Peer is less appealing when mobile devices are popular with limited power and traffic volume caps
  - Federation (client-server-server-client) is the choice?
- Internet-wide federation is challenging
  - Fragmentation issue when new service features are introduced
  - General solution is to build a “layered” architecture, like current TCP/IP ?
- IRTF is the right place to explore such a “internet-wide federation architecture for information sharing”

End