

Internet-wide Federation

-- for Data Sharing, with Layered Architecture

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Distributed, Decentralized

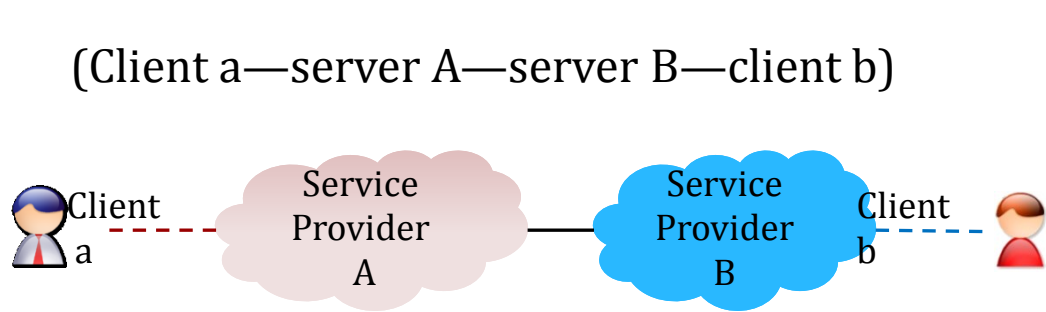
- European Work Programme Horizon 2020 (ICT-12b-2016)
 - “Current centralised platforms for big and social data management consolidate the dominance of existing incumbent actors, stifling innovation and allowing less and less control over the data by citizens. **Distributed architectures and decentralised platforms** have a huge potential to enable the creation of viable alternatives to current dominant models.”
- Cloud Federation
 - Fifth IEEE International Workshop on Cloud Computing Interclouds, Multiclouds, Federations, and Interoperability (**Intercloud 2016**)
 - IEEE Second International Workshop on Cloud Federation Management (**CFM 2015**)
 - **NIST** has recognized “Frameworks to Support Federated Community Clouds” as one of the top ten priorities for cloud adoption in the US Government: “Industry and the USG need to develop frameworks to support seamless implementation of federated community cloud environments”
- Decentralized Online Social Network (OSN)
 - **DeSN 2016** : 2nd Workshop on Decentralized Social Networks

Current Practices in Distributed Architecture: P2P and Federation

P2P : peers are both suppliers and consumers

- 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

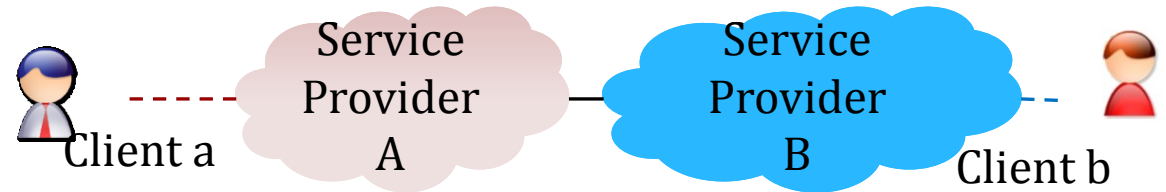


XMPP	-It enables the near-real-time exchange of structured yet <u>extensible</u> data between any two or more network entities. XMPP features such as federation across domains, publish/subscribe, authentication are being used to implement the IoT.
Matrix.org	-Matrix is an open standard for interoperable, 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 <u>IP Multimedia Subsystem</u> (IMS)

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

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**.



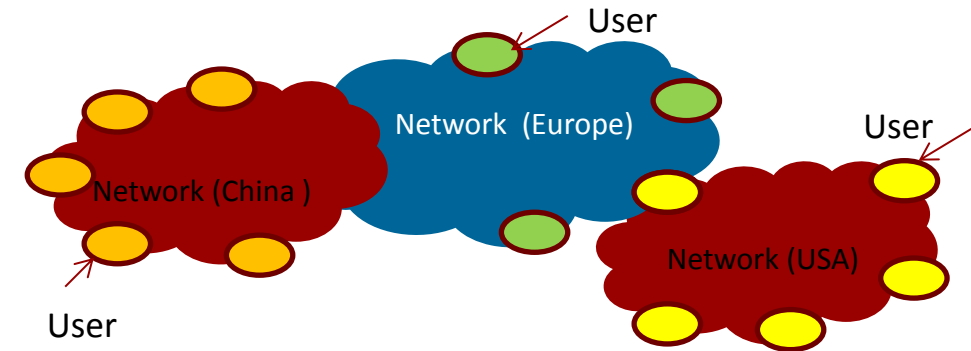
- Service innovations will never end.
- It is difficult to update an Internet-wide federation with thousands of domains, since the federating domains have to inter-operate with other domains with a **“standard” peering interface**.
- While the “centralized service systems” can deploy new services overnight

Proprietary/walled garden vs Interoperate/standardization

- Discussion at ieft@ietf.org on May 11~15 on a blog: [“The ecosystem is moving”](#)
 - the set of expectations users have for social and communication features are evolving rapidly. Anyone building software today knows that it is not possible to stand still.
 - it's undeniable that **once you federate your protocol, it becomes very difficult to make changes**. And right now, at the application level, things that stand still don't fare very well in a world where the ecosystem is moving.
 -By contrast, WhatsApp was able to **introduce end to end encryption to over a billion users with a single software update**. So long as federation means stasis while centralization means movement, federated protocols are going to have trouble existing in a software climate that demands movement as it does today.
 - **Like any federated protocol, extensions don't mean much unless everyone applies them, and that's an almost impossible task in a truly federated landscape**. What we have instead is a complicated morass of XEPs that aren't consistently applied anywhere.

Internet as a Reference

- **Internet is a federation**
 - Different autonomous domains peering with BGP.
- **Design Principles of current Internet:**
 - “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]
 - **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]
- **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”.



Users in different countries communicate with each other via Internet.

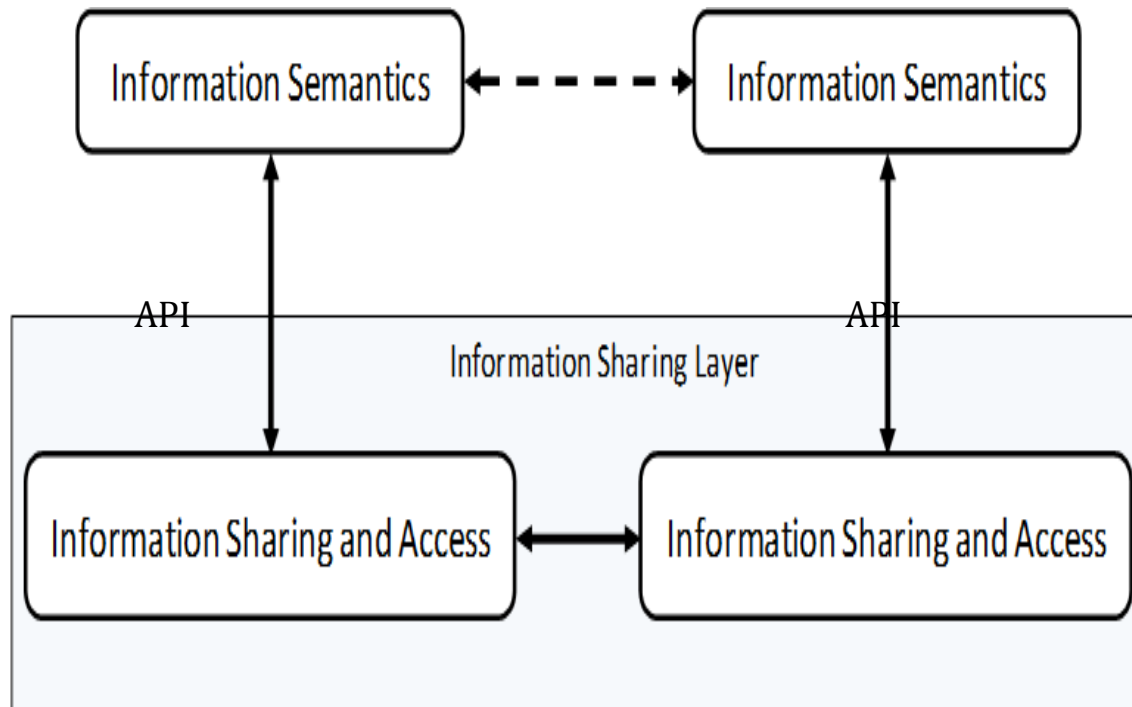
[1] B. Van Schewick, Internet architecture and innovation. MIT Press, 2012.

[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

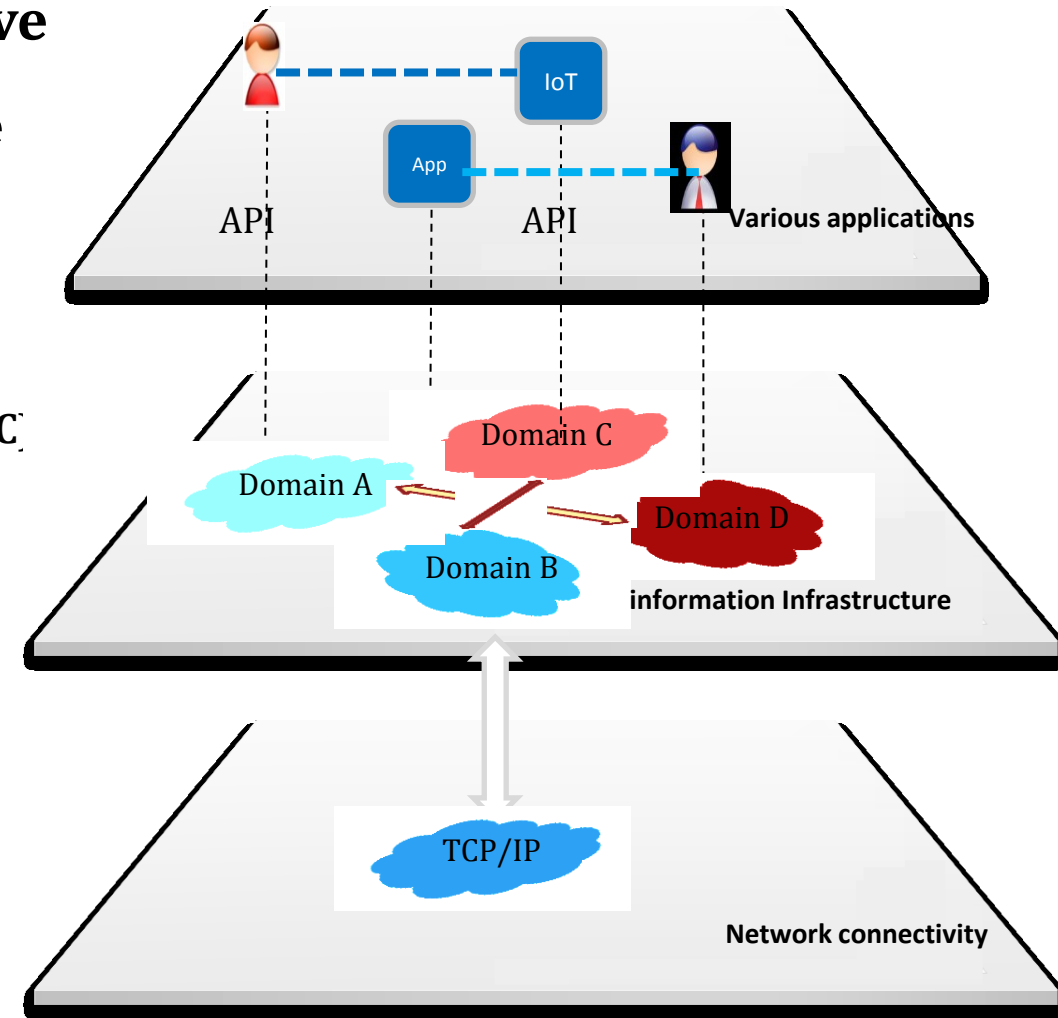
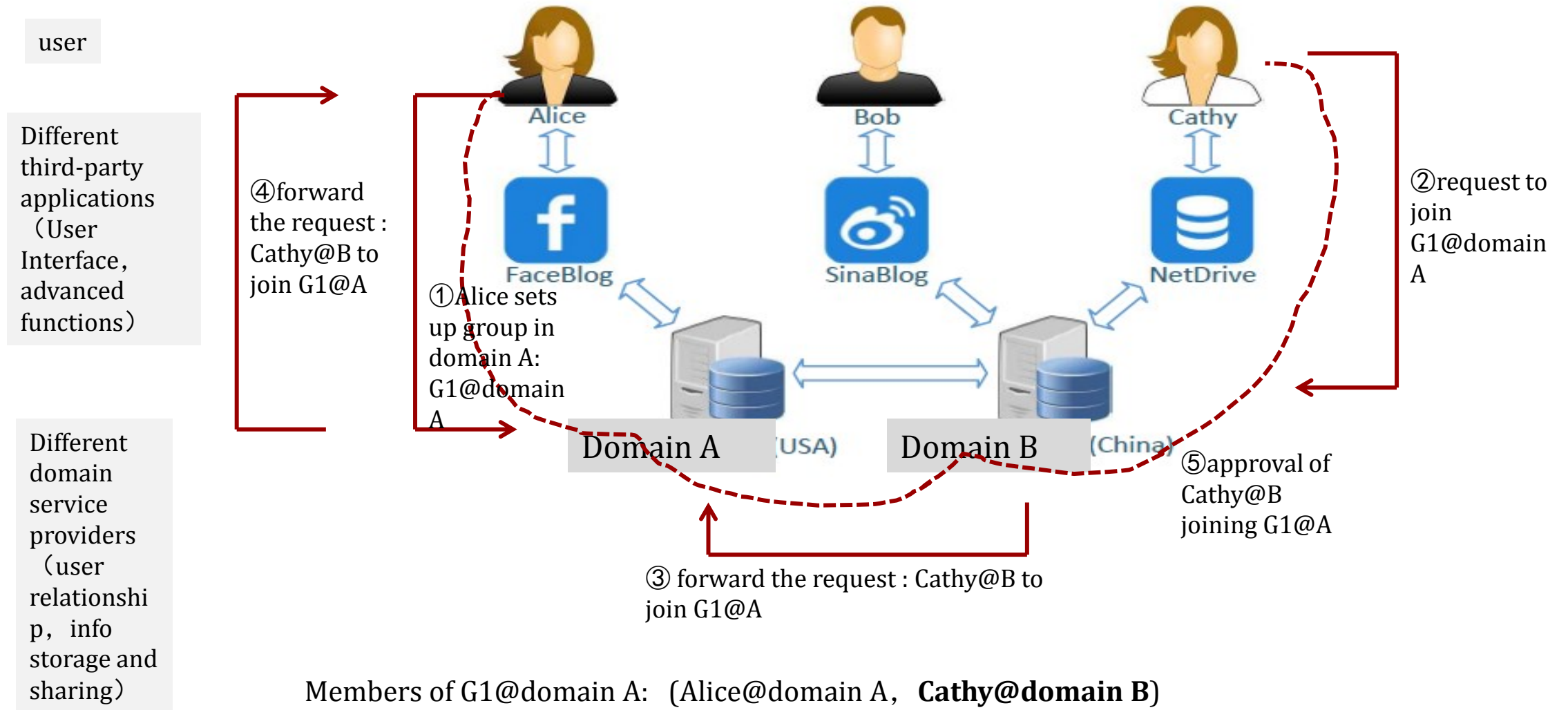


Illustration of Basic procedure: relationship



Open questions on “internet-wide federation”

- More detailed case studies for the existing federation
 - Both Successful and failed; tech issues and non-tech issues
- 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
 - Interoperating at different levels: Info/data model, data format, semantics
 - Security, privacy...
- Framework and Architecture: which functions @ where
- Gap analysis on current protocols
- Extend existing protocols or create new ones

Thanks