An Architecture Concept for Mobile P2P File Sharing Services

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Motivation (Trends and Assumptions)

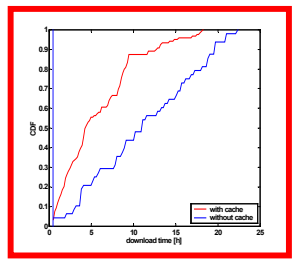
- **Trends**
  - Billing models for GPRS/UMTS: Towards time based and flat rate
  - Rising or evolving amount of „user created mobile content“
    - Photos / small Videos of any (rights-free) kind
    - (self-composed) Ring tones, free text files / Information
  - ISP network traffic is dominated by peer-to-peer file sharing applications
    - Telefonica reports up to 80% fixed network p2p traffic

- **Assumptions**
  - DRM: very complex, inter-disciplinary issue (but ouf of scope)
    - Alternatives: DRM light / Creative Commons Licence model
  - P2P experience is highly attractive to many users
    - Curiosity factor (what do other users have to offer?)

Objectives of MoPi („Mobile P2P“)

- **Problems for P2P in 2.5/3G mobile networks**
  - P2P traffic should be kept local for fixed/wireless operators
  - Asymmetric speed / P2P-unattractive charging
  - Variable terminal connectivity
  - High signalling traffic in unmodified P2P systems
  - Operators wish to participate in service creation

→ **Qualitative + quantitative analysis of P2P in 2.5G / 3G**



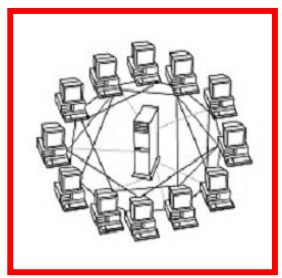
- **Approach / options:**
  - Operator-managed P2P services:

    Operator controls service and traffic dynamics

    Improved P2P performance for mobile environments

    Realize in 3G by hybrid P2P structure

→ **Introduce infrastructure elements to address the above problems**



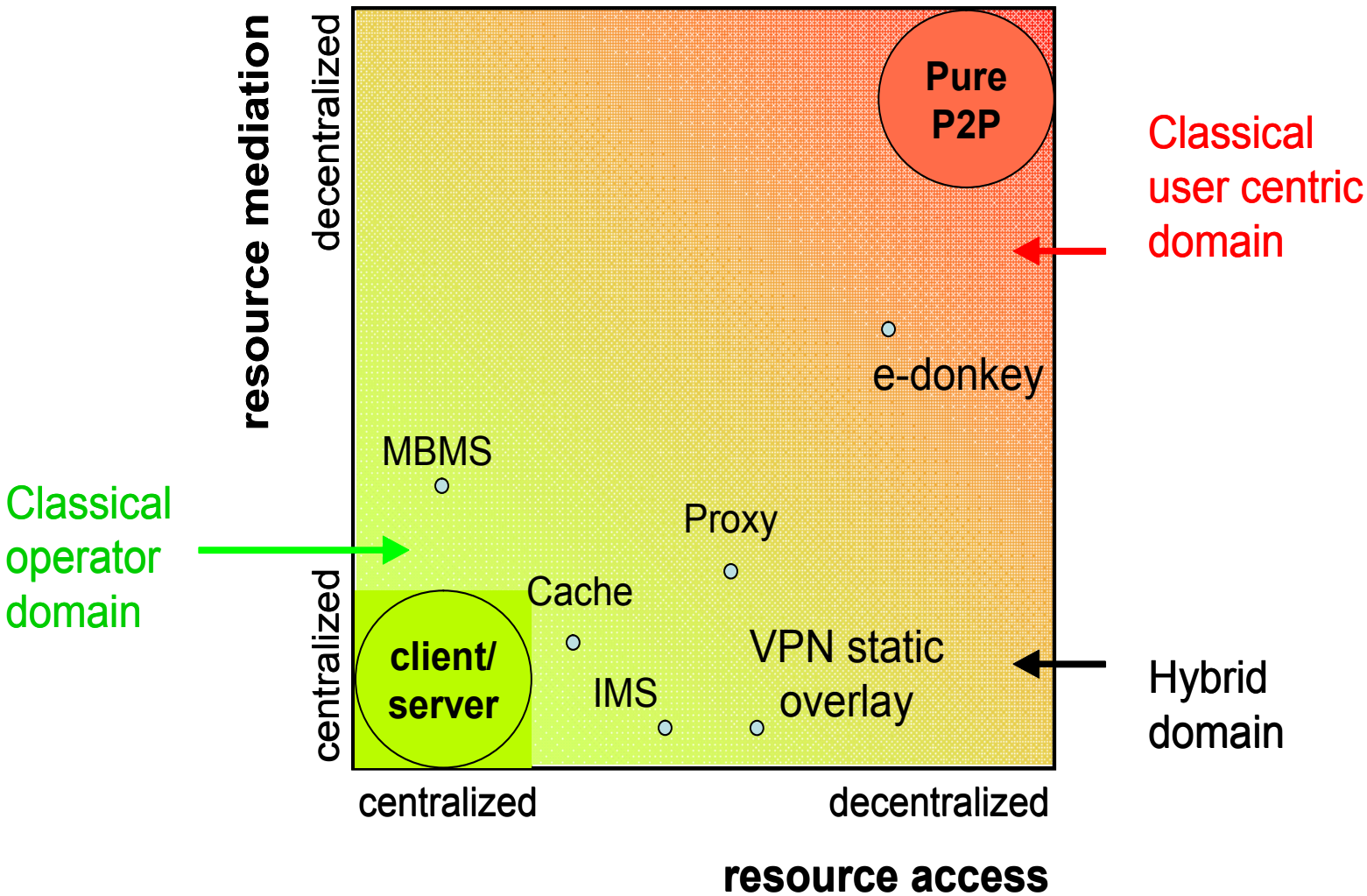
State of the art / related work

- Smart cache for KaZaA (Joltid Inc.) and other P2P systems
  - **man-in-the-middle approach. Protocol messages are intercepted and then tried to satisfy from a cache database**

- Project JXTA for mobile devices (J2ME, JXME)
  - **mobile P2P messaging / lightweight JXTA APIs for mobiles**
  - **relays enable connection to JXTA networks**
  - **rendezvous peers with full capabilities (message routing / proxy services)**
  - **no consideration of cellular mobile requirements**

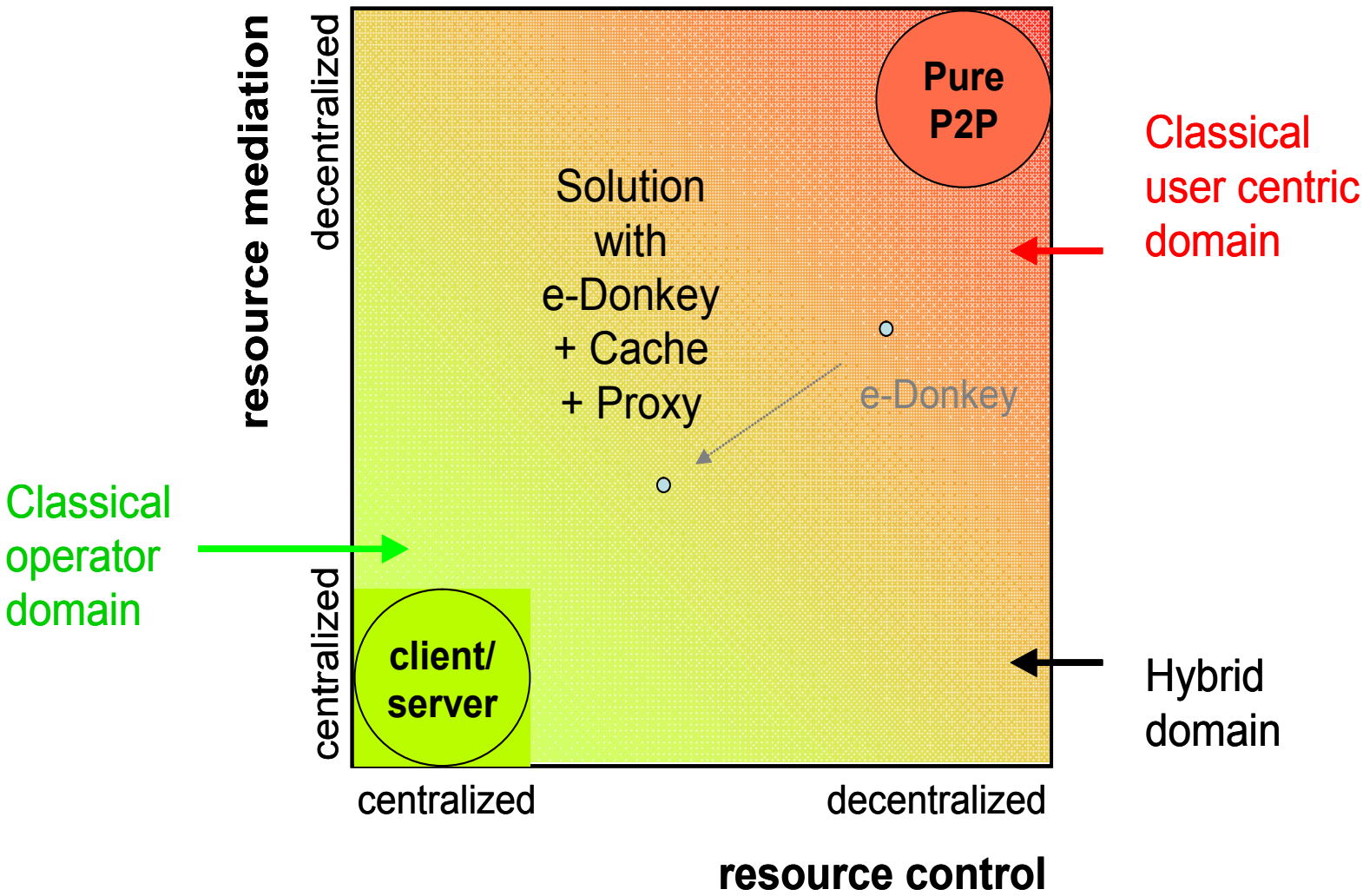
- "A platform and applications for mobile peer-to-peer communications" (Kato et al., WWW2003, DoCoMo / Ericsson)
  - **mobiles cannot run "full" P2P client software → proxy**
  - **mixed architecture: hybrid, superpeer + pure P2P part.**
  - **multicast overlay carries out multicast forwarding by multi-hop or multidestination unicast (ALM).**

Option Space Cartography (I)

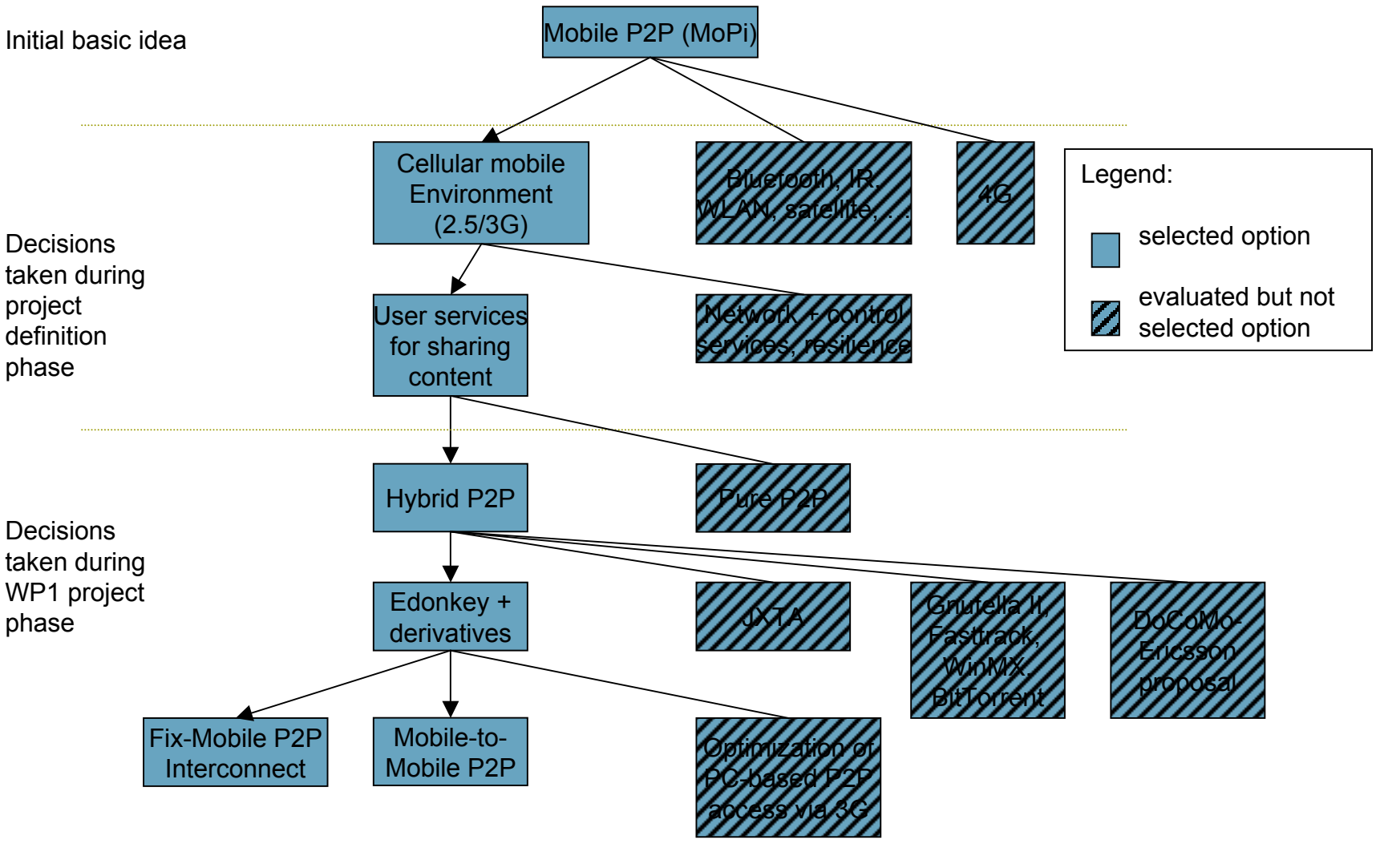


Option Space Cartography (II)

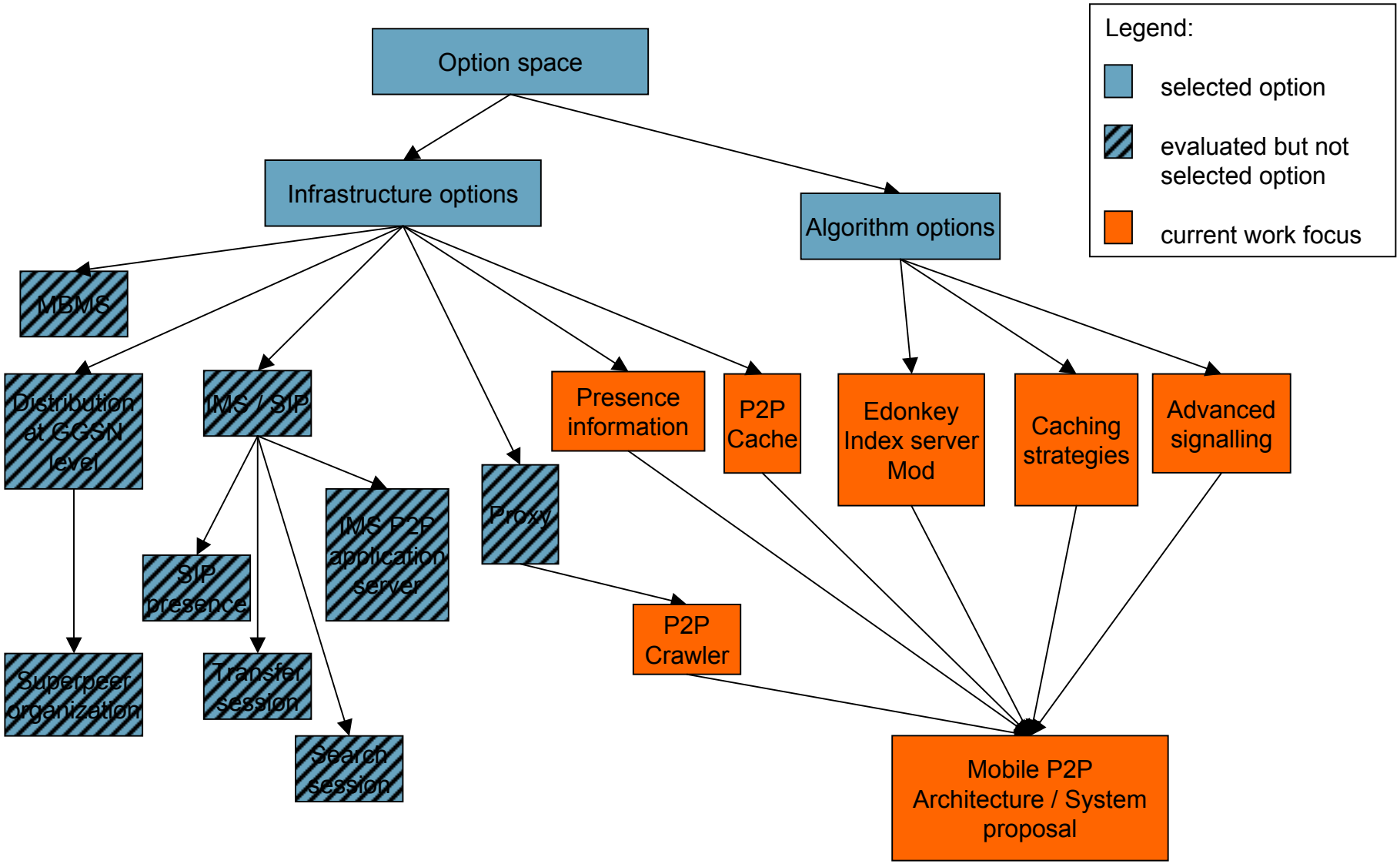
Shifting a pure P2P system towards the client-server model



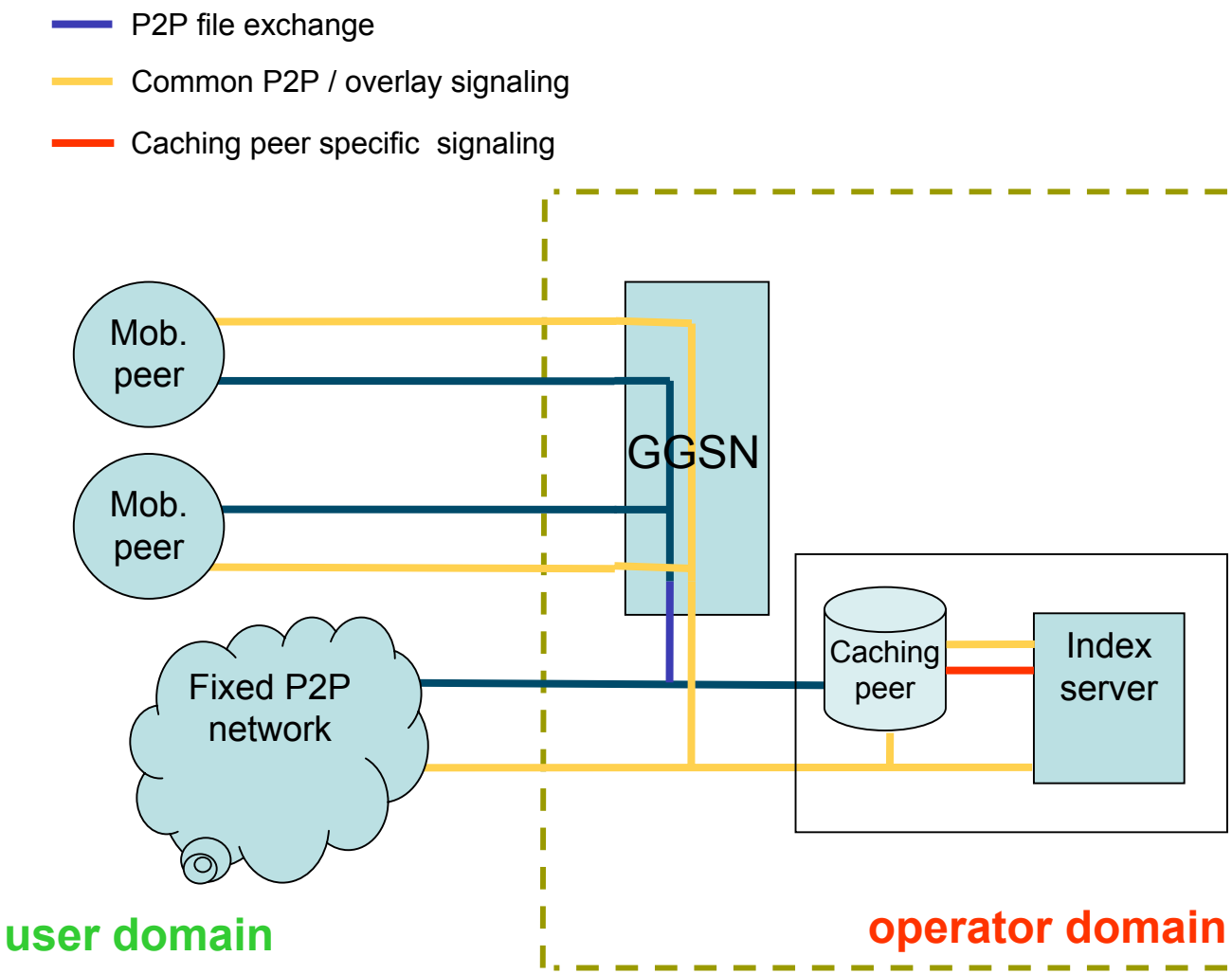
Scope of work



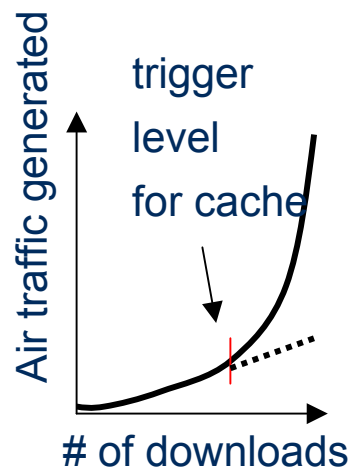
Design decisions



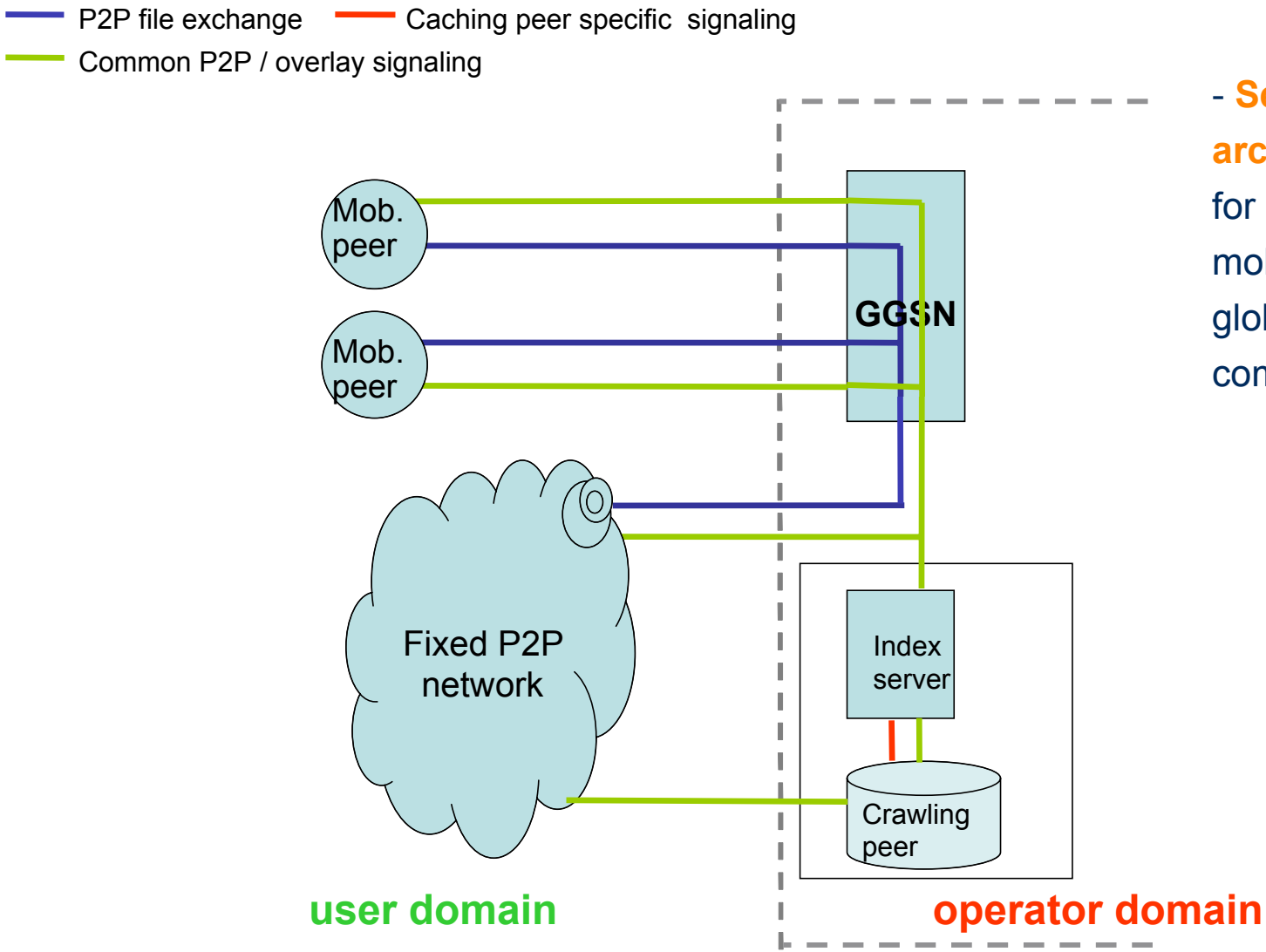
Caching Peer (pat. pend.) sub-system



- **Selected for final architecture**; strong improvement of performance; implementation without changes in client peer software

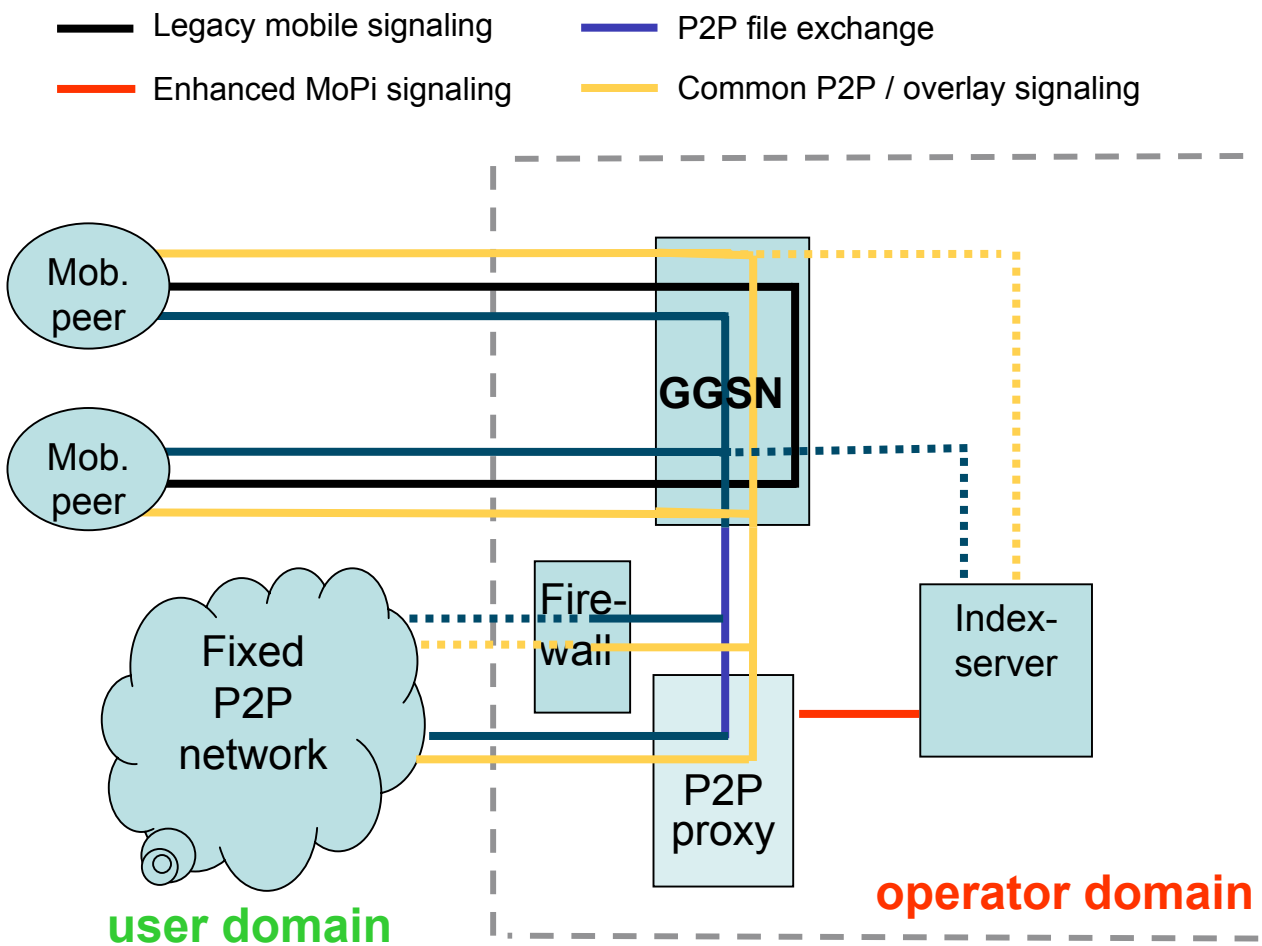


Crawling Peer (pat. pend.) sub-system



- **Selected for final architecture**; allows for integration of mobile peers into the global P2P community

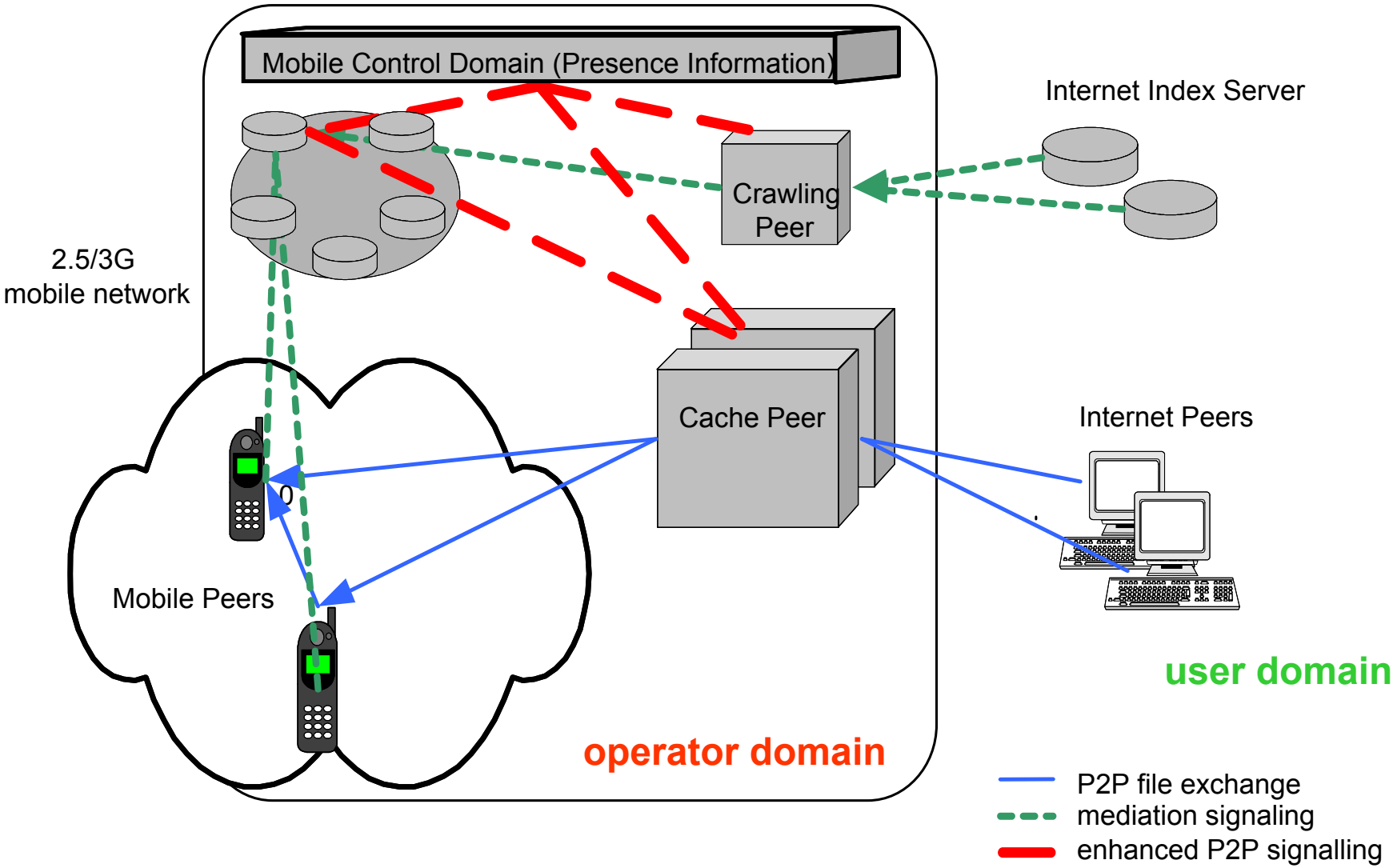
Smart Proxy (pat. pend.) sub-system



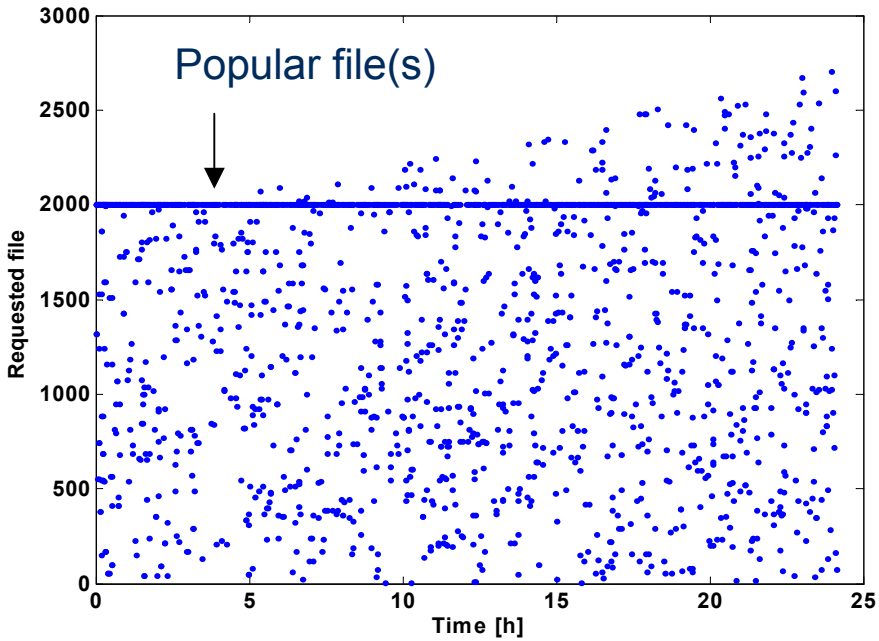
-Some of its core functionality can be taken over by the caching and crawling peers

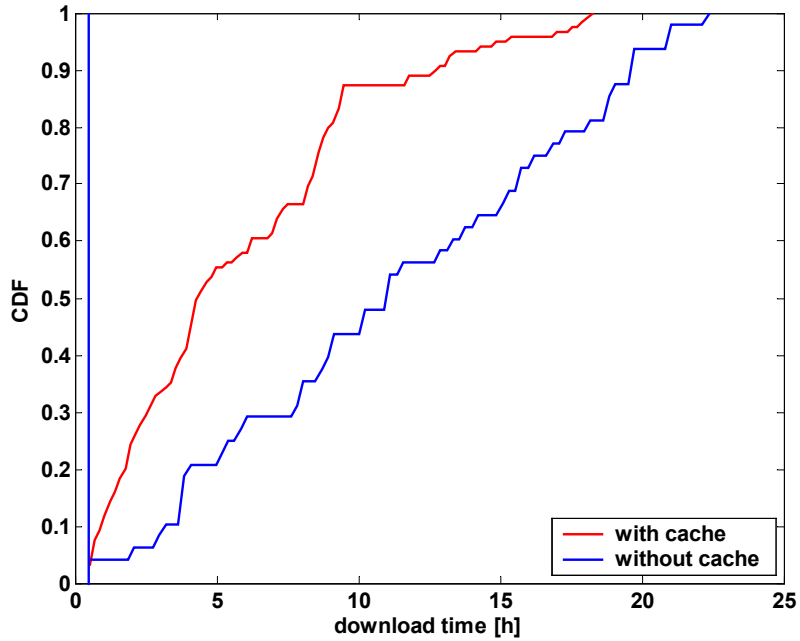
- **Deselected for final architecture**; has lots of interesting options for further research (e.g. queue sharing)

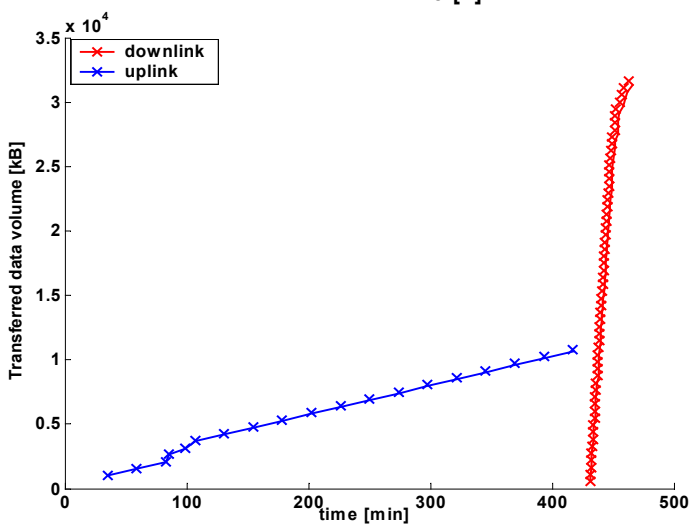
Proposed Architecture



Simulation model and first results







Mean value without cache: 11.2915 h
Mean value with cache: 5.8751 h

Simulation model type: Queue-based,event-oriented (virtual time base) and implemented in Java. Event inter-arrival time is randomized.

First results and conclusions
(project is still running)

- **The project shows that**
  - It is possible to use P2P with GPRS with limitations
  - The limitations can be addressed by using the described infrastructure elements / architecture
- **If the proposed architecture is used, it has the following advantages:**
  - More performant P2P data exchange via the 2.5/3G cellular air IF
  - Increasing reliability of mobile-to-mobile file transfers
  - Caching (→ only 1 air interface needed)
  - Based upon a fixed network P2P standard (eDonkey)
  - Connecting to fixed network P2P world in a controlled way
  - Operator-provided index-server manages content mediation
  - Redirection of clients to the operator‘s index server → reducing inter-domain traffic
  - For the most parts, also applicable to fixed networks
  - Motivation for end users to subscribe to a mobile P2P service because of a noticeable performance improvement