P2P SIP using JXTA

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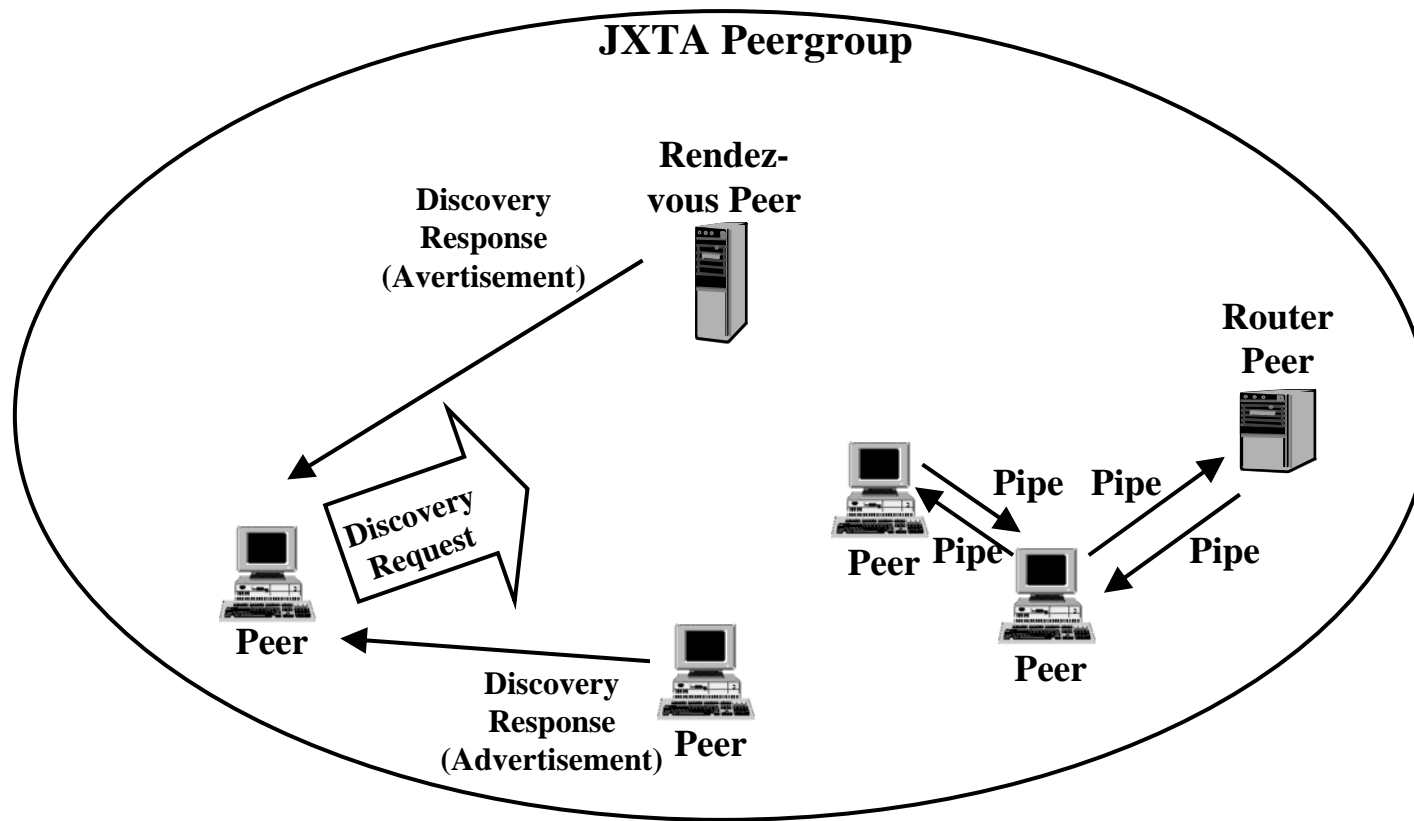University of Applied Sciences Frankfurt/M., Germany

1   Introduction to the JXTA P2P architecture

- **JXTA** (= juxtapose)**: open source P2P architecture, offering a set of standardized protocols to realize true P2P infrastructure**

- **Project founded** (2001) **and overseen by Sun microsystems**

- **Allows the development of standard-based P2P applications without relying on a centralized system**

- **XML-based protocols**

- **Independent of type of network, OS, and programming language** (reference implementations originally based on TCP/IP and Java)

- **Major releases: JXTA 1.0 (2002) and JXTA 2.0 (2003)**

[JXTA; Hale]

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JXTA architecture

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- **Peer**
  - * **Basic unit within JXTA network**
  - * **Simple peer: Can provide a service** (e.g., as part of a P2P file sharing service) **and/or use a service** ($\rightarrow$ application)
  - * **Peer parameters**
    - + **Peer name**
    - + **Peergroup(s) to which the peer belongs**
    - + **Peer ID**
    - + **Peer's network address**
  - * **Must belong to a peergroup before it can communicate with other peers**

  - * **Rendezvous peer: special peer that keeps list of available resources** (e.g., other peers or peergroups)**. Peers get to know rendezvous peers by configuration, by multicast discovery** (within local network)**, or via http-based internet service**
  - * **Router/relay peer: relay for JXTA messages, used for Firewall/NAT traversal, usually HTTP-based** (symmetric response routing)

[Wils; Gong]

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– **Peergroup**

  * **JXTA peergroup = virtual group of JXTA peers which want to use or support a certain service provided by the group** (e.g., a file sharing service)

  * **Default peergroup for all peers: NetPeerGroup** (can not be left by the peers)

  * **Any peer can create, join, or leave further peergroups**

  * **Build virtual secure networks** (content can only be accessed by group members; authentication available) **and scaling areas** (only members of a peergroup see messages exchanged within this peergroup)

  * **Peers get to know other peergroup members by multicast discovery** (local network) **or by querying rendezvous peers**

– **Pipes**

  * **Unidirectional virtual data connections between peers**

  * **Can be point-to-point** (1 sender, 1 receiver) **or multicast** (1 sender, x receivers)

  * **Connect virtual communication sockets of peers** (so called endpoints) **within the same peergroup**

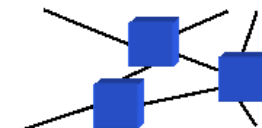 * **Transport any kind of data (binary, XML, …) as "messages"**
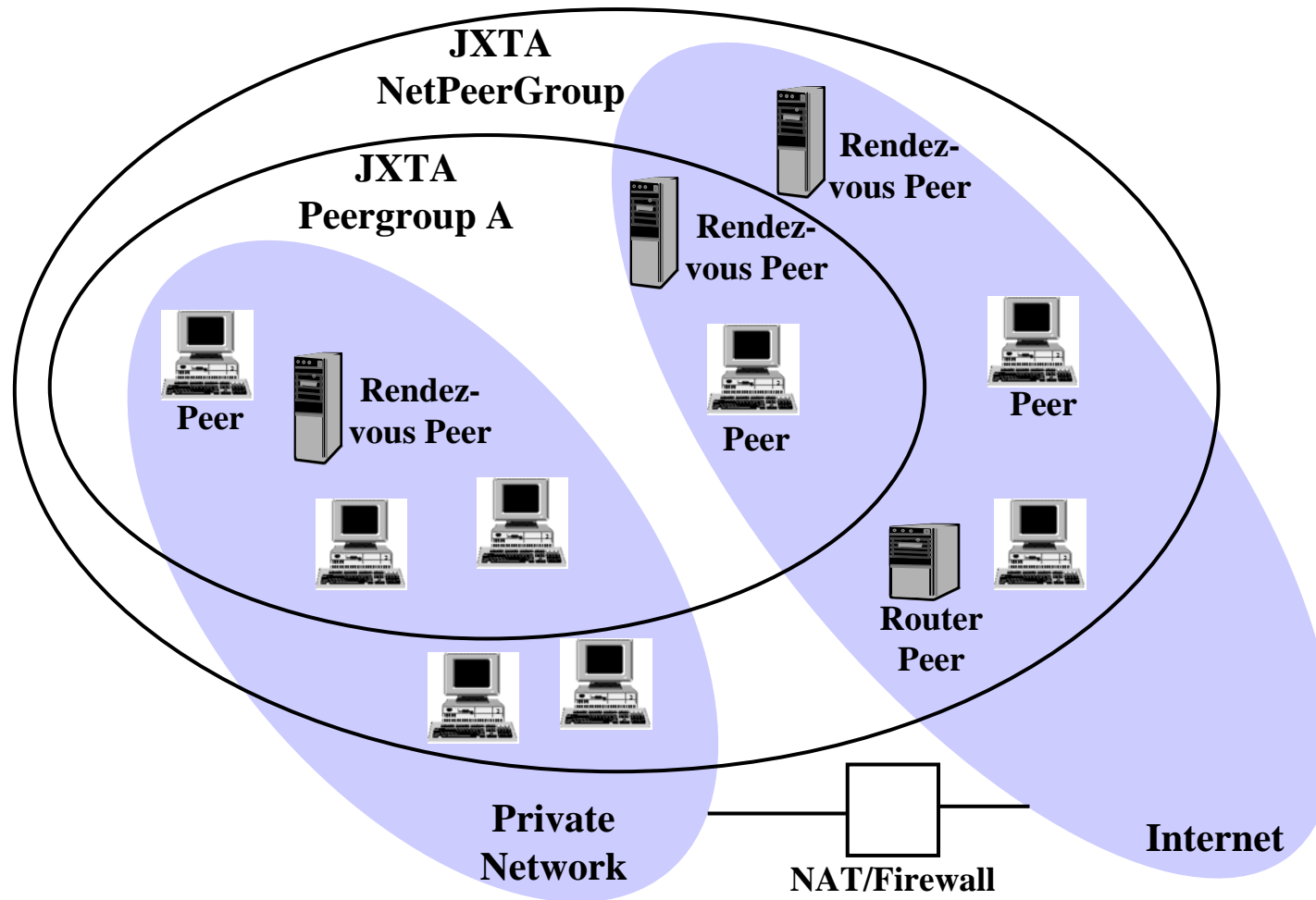
[Wils; Gong]

- **Advertisement**
  - * **XML documents that are used to spread the presence of JXTA resources** (peers, peergroups, pipes, services, …) **and their contact attributes**
    - → **used for P2P SIP approach name resolution**

- **Discovery**
  - * **Basic process by which peers locate advertisements**
  - * **Two principle methods** (combinations depending on available JXTA infrastructure)
    - + **Dynamic discovery** (based on multicast discovery requests within local networks, every receiving peer responds with its advertisement)
    - + **Static discovery** (based on unicast rendezvous peer query only, rendezvous peer sends advertisement of known resources)

[Wils; Gong]

JXTA infrastructure

JXTA
NetPeerGroup

JXTA
Peergroup A

Rendez-
vous Peer

Rendez-
vous Peer

Rendez-
vous Peer

Peer

Peer

Peer

Peer

Router
Peer

Private
Network

NAT/Firewall

Internet

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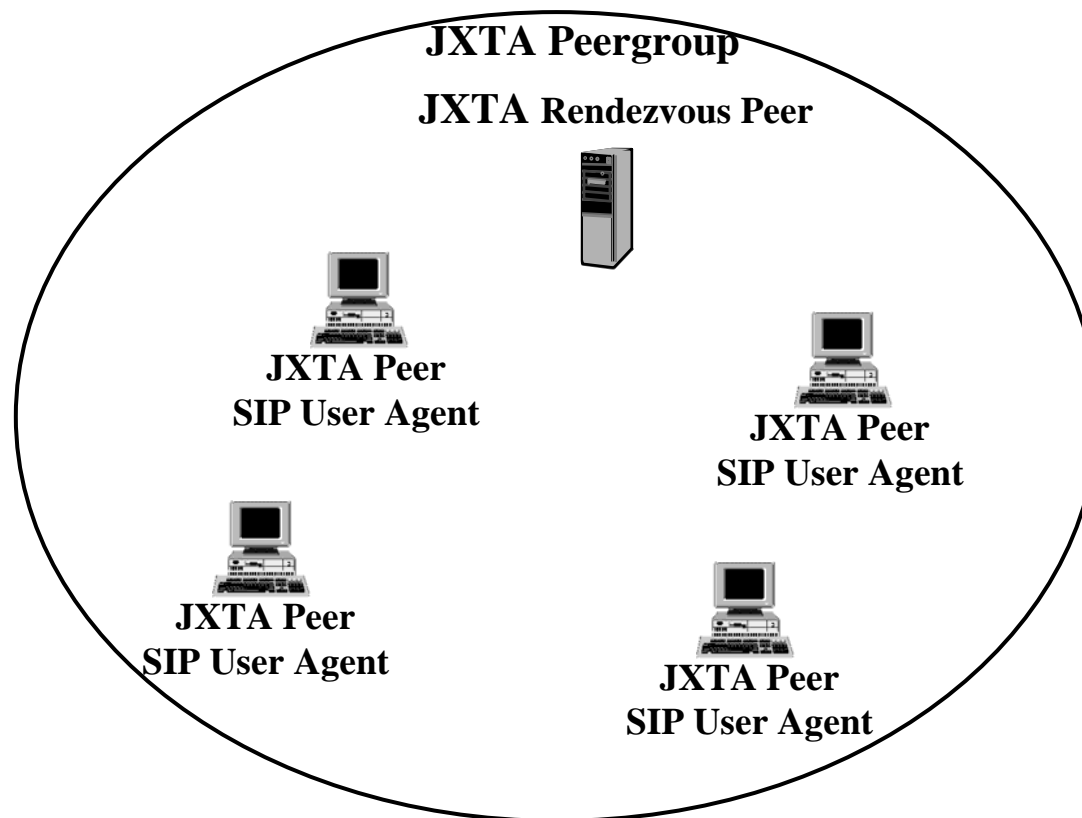Exhibition 2007
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2   JXTA protocols

- **JXTA core protocols** (mandatory)
  - ∗ **Endpoint Routing Protocol** (ERP)**: Discover a route** (sequence of hops) **to be able to send a message to another peer**
  - ∗ **Peer Resolver Protocol** (PRP)**: Send queries to and receive responses from other peers**

- **JXTA standard protocols** (optional)
  - ∗ **Peer Discovery Protocol** (PDP)**: Advertise own resources and discover resources from other peers.**
  - ∗ **Rendezvous Protocol** (RVP)**: Propagate messages to all listening subscribers of a service** (e.g., used by peergroup's rendezvous peers)
  - ∗ **Pipe Binding Protocol** (PBP)**: Establish a pipe** (virtual communication channel) **between two or more peers**
  - ∗ **Peer Information Protocol** (PIP)**: Obtain status information** (e.g., uptime, traffic load) **about other peers**

[JXPS]

JXTA Peergroup

JXTA Rendezvous Peer

JXTA Peer
SIP User Agent

JXTA Peer
SIP User Agent

JXTA Peer
SIP User Agent

JXTA Peer
SIP User Agent

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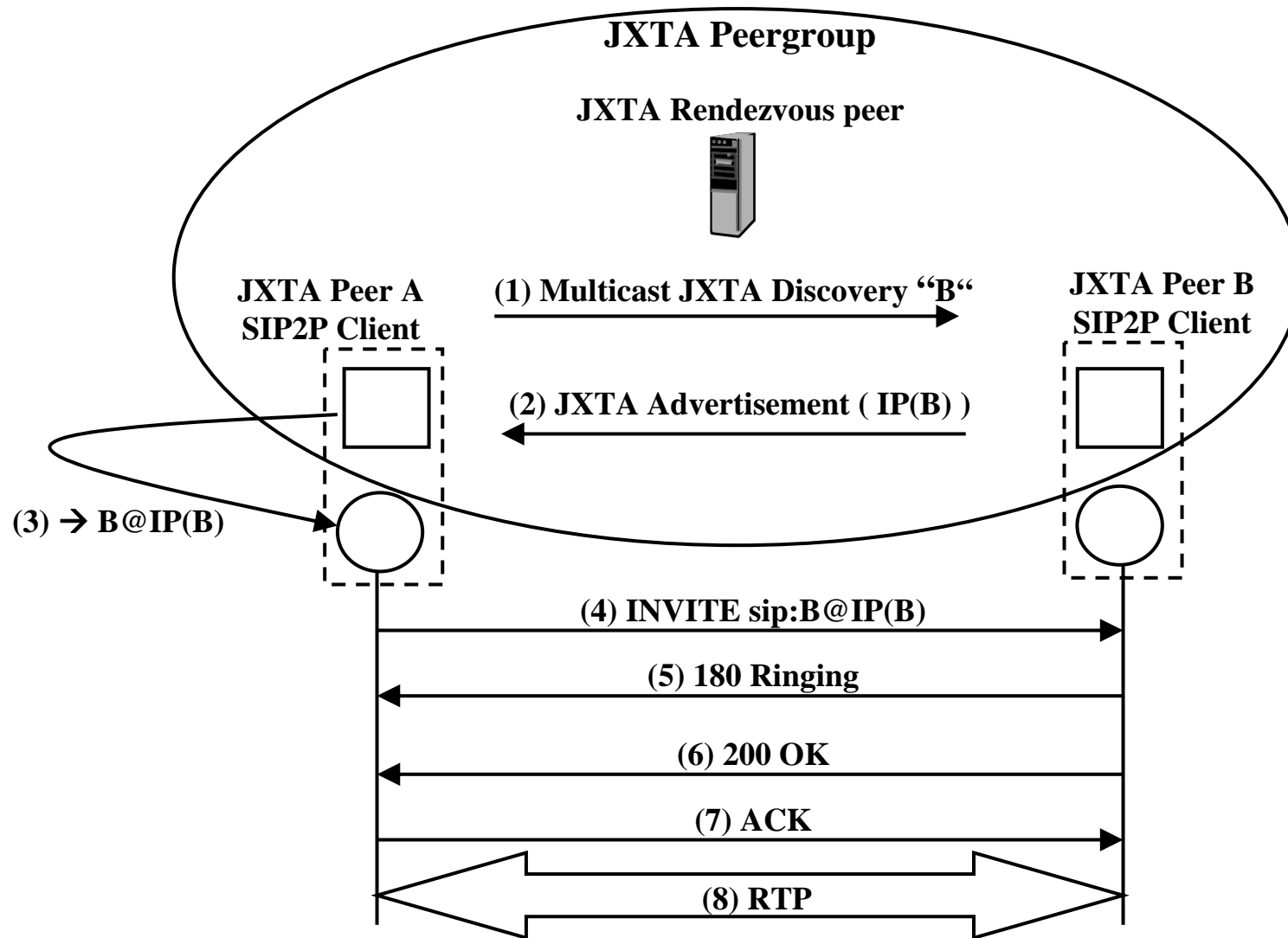University of Applied Sciences Frankfurt/M., Germany

– **"SIP using P2P" demo approach**

– **True P2P overlay, JXTA-based**

– **RFC 3261 compatible SIP user agents: requirements:**
  * **Control interface available** (e.g., web interface → works even with HW IP Phones)
  * **Must support sending SIP requests peer-to-peer** (no proxy/registrar server)

– **JXTA P2P infrastructure: Developed JXTA peer client "SIP2P client", and JXTA rendezvous peers**

– **Software SIP2P Client**
  * **Java-based JXTA simple peer implementation**
  * **Joins JXTA peergroup**
  * **Allows user to search peergroup for a certain username → sends JXTA discovery messages** (multicast within local network, or via rendezvous peer)
  * **→ Receives and analyses JXTA advertisement of peer to contact**
  * **Allows user to initiate call**

[Tric]

P2P SIP using JXTA architecture and functionality

JXTA Peergroup

JXTA Rendezvous peer

JXTA Peer A
SIP2P Client

(1) Multicast JXTA Discovery "B"

(2) JXTA Advertisement (IP(B))

JXTA Peer B
SIP2P Client

(3) → B@IP(B)

(4) INVITE sip:B@IP(B)

(5) 180 Ringing

(6) 200 OK

(7) ACK

(8) RTP

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4   Summary and Outlook

– **Summary**

* **Basic "SIP using P2P" approach**
* **RFC 3261-compatible SIP peer-to-peer communication without proxy/registrar**
* **JXTA-based P2P overlay for username resolution**
* **Interface between open source JXTA P2P network and ordinary SIP user agent**

– **Outlook: imaginable extensions**

* **NAT traversal: e.g., use STUN/TURN/ICE and spread alternative contact addresses within JXTA advertisement** (→ calling peer receives callee's public contact address by JXTA-based P2P name resolution system)

* **Create JXTA peergroups that offer special services** (such as interconnection services (e.g., PSTN, non-P2P SIP networks), emergency calling, location- or interest-based services)

* **Combine P2P SIP communication with other JXTA-based P2P applications** (e.g. P2P online games)

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