Multimedia Conferencing

Corso di Applicazioni Telematiche
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Roadmap

- Part I:
  - History, background and state of the art
    - Conferencing as a service
    - Standardization approaches
    - Related topics
      - Media control
  - Coffee break
- Part II:
  - Hands-on conferencing
    - Ongoing activities at the University of Naples
      - CONFIANCE & DCON projects
    - Contribution to standards
    - Implementation efforts
    - Open issues
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Conference

- The term “Conference” can be used to describe any meeting of people that “confer” about a certain topic.
- Web Conferencing is used to conduct live meetings or presentations over the Internet.
Features
- Voice over IP
- Live video
- Text chat
- Slide presentations
- Whiteboard with annotation
- Screen/desktop sharing
- Application sharing
- Recording
- Polls and surveys

History
- Tele-Conferencing
  - Conference calls (Audio Tele-Conferencing)
  - Video conferences (Video Tele-Conferencing)
- Web Conferencing
  - Text Conferencing
  - Audio/Video Conferencing
  - Data Conferencing
Audio Tele-Conferencing (ATC)

- Analog Phone Lines (PSTN)
  - Conference calls
    - Three-way calling
    - Conference bridges
- Digital Telephony (ISDN)
  - ITU-T H.320 umbrella recommendation
- IP-based Tele-Conferencing
  - Real-time Transfer Protocol (RTP)
  - Voice over IP (VoIP)

Video Tele-Conferencing (VTC)

- Closed-circuit television systems
- Radiofrequency (UHF or VHF) links
- Mobile links to satellites
- Analog phone lines (PSTN)
  - Videotelephony (AT&T PicturePhone)
- Digital Telephony (ISDN)
  - ITU-T H.320 Umbrella Recommendation
  - Multipoint Videoconferencing (MCU)
- IP-based Videoconferencing
  - Better video-compressing technologies
Text Conferencing

- **Asynchronous Meetings**
  - Posted text messages (not live)
    - Message/Bulletin Boards
    - Fora/Forums
    - Network news groups/Mailing lists

Text Conferencing

- **Synchronous (Live) Meetings**
  - Live text communication
    - talk/ntalk/ytalk (Unix)
    - Internet Relay Chat (IRC)
    - Web-based Chat (CGI/Java)
    - Instant Messaging
      (Skype/MSN/ICQ/XMPP/SIMPLE/etc.)
Data Conferencing

- Participants sharing computer data in real time
  - Text (Instant Messaging)
  - Audio/Video
  - Screen/Documents/Graphics/Applications

Desktop Systems
- Placeware/ProShare/Databeam
- Netmeeting/Gnomemeeting
- Skype/AIM/ICQ/MSN/Yahoo/etc.

Typical Scenarios

- Point-to-Point Calls to Multipoint Calls
  - Three-way calling
  - Coaching scenario

- Lecture-mode Conferences
  - Presentation
  - Question & Answers session

- Ad-hoc and Reserved Conferences
  - Conference-aware/-unaware participants
    - Manage conference/users/media/policies
    - Sidebars/Whispers
Issues

- Call Signaling
  - Gateway functionality

- Control and Management
  - Tone detection (DTMF)
  - Dedicated protocols

- Mixing and Transcoding
  - Terminal capabilities
  - User media profiling
  - Coaching scenario
  - Videoswitching

Standardization Efforts

- No standardization for many years
  - Lack of interoperability
  - Platform dependency
  - Security issues
  - Cost
  - Market segmentation

- Standardization Bodies
  - ITU (International Telecommunication Union)
  - IETF (Internet Engineering Task Force)
  - 3GPP (3rd Generation Partnership Project)
Standardization Efforts: ITU

- Established to standardize and regulate international radio and telecommunications
- International Standards referred to as “Recommendations”
- ITU-T: Telecommunication Sector
  - G: Transmission Systems and Media
    - G.71x (Audio compression, mu-law and a-law)
    - G.72x (Audio compression, ADPCM)
  - H: Audiovisual and Multimedia Systems
    - H.320 (PSTN/ISDN, Telephone Systems)
    - H.323 (IP, Packet-based Communication Systems)
  - T: Terminals for Telematic Services
    - T.120 (Data Sharing Protocols)
    - T.140 (RTP Interactive Text)

Standardization Efforts: IETF

- Under the umbrella of the Internet Society
- Develops and promotes Internet Standards
- Deals in particular with standards of the TCP/IP suite
- Organization
  - Working Groups (WG)
  - Internet Drafts
  - Requests for Comments (RFC)
  - “Rough consensus, running code”
SIPPING Working Group

- Session Initiation Proposal Investigation
- Documents the use of SIP for several applications related to telephony and multimedia
- SIP Conferencing

Loosely-Coupled Conference

<table>
<thead>
<tr>
<th>Fully Distributed Multiparty Conference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tightly-Coupled Conference</td>
</tr>
</tbody>
</table>

SIP Conferencing Framework (RFC 4353): fundamental elements

- Focus
- Policy Server
- Mixer
- Notification Service (Event Package, RFC 4575)
- Participants

XCON Working Group

- Centralized Conferencing (XCON)
- Extends RFC 4353
  - Protocol-agnostic (not only SIP)
  - Data Sharing (not only audio/video)
- Suite of Protocols
  - Conference Control (CCMP?)
  - Floor Control (BFCP)
  - Call Signaling (SIP/H.323/IAX/etc.)
  - Notification (Event Package?)
XCON Framework

Conference Control Protocol

- Create/Manage/Schedule/etc. Conferences
- Several candidates in the past, all rejected
- New proposal
  - Centralized Conferencing Manipulation Protocol (CCMP)
    - Based on Web-Services (SOAP)
    - Still in early stages
- University of Naples (COMICS research group):
  - Highly active in this field
    - A proposal for a WS-based approach to conference control
    - Running code ☺...but no rough consensus ☹
    - Need for lobbying with enterprises...
Floor Control Protocol

- Coordinates access to set of shared resources
  - A “Floor” is a token, a temporary permission to access or manipulate a specific shared resource or set of resources
- Binary Floor Control Protocol (BFCP)
  - Standardized in RFC 4582
    - Identifiers (Conferences/Floors/Users)
    - Floor Control Server
    - Floor Control Participant
      - Floor Chair
    - Only existing implementation to date: COMICS/Ericsson
  - Negotiation of BFCP connections within SIP/SDP standardized in RFC 4583

BFSCP

1) Floor Request
2) Notify
3) Chair decision
4) Decision
5) Floor Granted/Denied
6) Notify
MEDIACTRL Working Group

- Media Server Control
  - Media Processing
    - Mixing/Transcoding
    - Playing/Recording
    - Storing/Retrieving
    - Detecting Tones (DTMF)
  - Interactive Voice Response (IVR)/VoiceXML
  - Text-to-Speech/Speech Recognition
- RTP Streams Manipulation
- Of great interest to the XCON working group
- MRFC/MRFP (interface/container) in IMS

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Roadmap

CONFIANCE

CONFerencing IMS-enabled Architecture for Next-generation Communication Experience

Open source prototype implementation of the XCON Framework, compliant with the IMS specification

Extends the Asterisk PBX functionality

- Enhanced “MeetMe” application
  - Support for Conference Management (Scheduler)
  - Support for Floor Control (BFCP)
  - Support for BFCP-guided videoswitching
  - Support for MSRP (Message Session Relay Protocol) text chatrooms
Asterisk PBX

- Open source Private Branch eXchange (PBX)
- Advanced features
  - Highly configurable dialplan
  - Modular architecture
    - Channel API
      - SIP channel driver
    - Application API
      - MeetMe conference bridge
  - Codec and File Format API
    - Audio transcoding
    - Video passthrough
  - Remote Manager Interface

Asterisk dialplan: extensions.conf

Definition of a single extension with name "123".

```markdown
exten => 123,1,Answer
exten => 123,2,Playback(tt-weasels)
exten => 123,3,Voicemail(44)
```

When a call is made to extension 123, Asterisk will answer the call itself, play a sound file called "tt-weasels", give the user an opportunity to leave a voicemail message for mailbox 44, and then hangup.

Extension Patterns

A single extension can also match patterns. In the `extensions.conf` file, an extension name is a pattern if it starts with the underscore symbol (_).

```markdown
exten => _123.,1,Answer
exten => _123.,2,Playback(tt-weasels)
exten => _123.,3,Voicemail(${EXTEN})
```

When a call is made to extension 123, Asterisk will answer the call itself, play a sound file called "tt-weasels", give the user an opportunity to leave a voicemail message for mailbox 44, and then hangup.
XCON through MeetMe

extensions.conf

[...]
; XCON through MeetMe: example of wildcards to add flexibility
;   - First 7 numbers = conference
;   - Next (1-4) numbers = PIN (Phone PIN, not Admin's password)
;   - the 'B' flag tells MeetMe this is an XCON conference (B => BFCP)
; exten => _857.,1,Meetme(${EXTEN:0:7}|B|${EXTEN:7})
exten => _857.,2,Hangup
[...]
CONFiance Use Case

Participant (Client)  Focus (Server)
- SIP/IAX/H323/PSTN etc.
- Scheduling Protocol
- Binary Floor Control Protocol

- Query Conferences (Active)
- Info Conferences (Active Conferences list)
- SIP call to number 867100 (to join conference 867100)
- IVR-based messages (Welcome, Muted Status, etc.)
- SIP-re-INVITE (BFCP info encapsulated in SDP body)

- Floor Request
- Floor Request Status (Pending)
- Notify Chair Decision
- Forward the request to the Chair
- Chair Decision

Distributed Conferencing

- Centralized Conferencing being standardized
  - Poorly scalable
  - Limited capabilities
  - Single point of failure

- Distributed Conferencing
  - Cascaded Conferencing
    - Each focus is seen as a participant by the others
    - Only affects mixers' distribution
    - Centralized protocols like BFCP don't work
  - P2PSIP Working Group
    - Has not dealt with conferencing yet
DCON Proposal

- Distributed Conferencing (DCON)
  - Explicitly recalls XCON
    - Orchestrates the operation of a set of XCON focus elements, called “clouds”
    - Overlay network interconnecting the clouds
    - Intra-focus communication
      -Still based on XCON protocols
    - Inter-focus communication
      - Exploits Server-to-Server (XMPP)
  - Requirements
    - Focus discovery
    - Initialization information & spreading of conference events
    - Setup and managing of distributed conferences
    - Transparent dispatching of natively centralized protocols among the involved conferencing clouds

DCON architecture
DCON Implementation

We suppose CONFIANCE is working when the DCON component starts. Three main events happen:

1) Connection to the Asterisk Manager interface
2) Connection to the Gateway interface
3) Request for initialization information

Now the focus cloud involves also the Wildfire server and SPACE component which has in charge:

1) Discovery of other foci
2) Managing of DCON information and BFCP packets.
Testing DCON: Scalability

- The maximum number of participants linearly grows with the number of DCON islands

Testing DCON: Performance

- 2 islands

<table>
<thead>
<tr>
<th>Focus</th>
<th>Number of calls</th>
<th>CPU load (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main</td>
<td>150</td>
<td>30.04</td>
</tr>
<tr>
<td>Remote</td>
<td>150</td>
<td>20.19</td>
</tr>
</tbody>
</table>

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<tr>
<th>Focus</th>
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<tr>
<td>Main</td>
<td>300</td>
<td>99.4</td>
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Focus | calls | CPU load (%) |
------|-------|--------------|
Main   | 300   | 99.4         |
Testing DCON: Performances

- 3 islands

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<tr>
<td>Main</td>
<td>150</td>
<td>31.05</td>
</tr>
<tr>
<td>Remote_1</td>
<td>75</td>
<td>12</td>
</tr>
<tr>
<td>Remote_2</td>
<td>75</td>
<td>12</td>
</tr>
</tbody>
</table>

Testing DCON: Performance

- 3 islands

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<tr>
<td>Main</td>
<td>100</td>
<td>20</td>
</tr>
<tr>
<td>Remote_1</td>
<td>100</td>
<td>18</td>
</tr>
<tr>
<td>Remote_2</td>
<td>100</td>
<td>18</td>
</tr>
</tbody>
</table>
Testing DCON: Performance

- 4 islands

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<thead>
<tr>
<th>Focus</th>
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</thead>
<tbody>
<tr>
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<td>75</td>
<td>12.66</td>
</tr>
<tr>
<td>Remote_1</td>
<td>75</td>
<td>12</td>
</tr>
<tr>
<td>Remote_2</td>
<td>75</td>
<td>12</td>
</tr>
<tr>
<td>Remote_3</td>
<td>75</td>
<td>12</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of islands</th>
<th>Number of local users</th>
<th>Number of remote users</th>
<th>Main focus CPU load</th>
<th>Remote focus 1 CPU load</th>
<th>Remote focus 2 CPU load</th>
<th>Remote focus 3 CPU load</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>300</td>
<td>158</td>
<td>99.4%</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2</td>
<td>150</td>
<td>158</td>
<td>33.04%</td>
<td>29.19%</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>200</td>
<td>150</td>
<td>20%</td>
<td>16%</td>
<td>18%</td>
<td>-</td>
</tr>
<tr>
<td>3</td>
<td>150</td>
<td>200 (150/100)</td>
<td>31.05%</td>
<td>12%</td>
<td>12%</td>
<td>12%</td>
</tr>
<tr>
<td>4</td>
<td>75</td>
<td>225 (75/75/75)</td>
<td>12.66%</td>
<td>12%</td>
<td>12%</td>
<td>12%</td>
</tr>
<tr>
<td>4</td>
<td>150</td>
<td>150 (100/50/50)</td>
<td>32.4%</td>
<td>7.8%</td>
<td>7.8%</td>
<td>7.8%</td>
</tr>
</tbody>
</table>
References

- CONFIANCE web site
  - http://confiance.sourceforge.net/

- DCON web site
  - http://dcon.sourceforge.net/