**RMCP:**
*Remote Music Control Protocol — Design and Applications —*

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**1. Introduction**

- **Our Goal**
  - Integrate MIDI and computer networks
  - Network musical applications
    - live MIDI broadcasts
    - remote sessions via network
  - Computer supported sessions
    - human-computer improvisation
    - interactive-graphics displays

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**2. RMCP (Remote Music Control Protocol)**

- **Network Protocol for Music Applications**
  - Share symbolized musical information via networks
    - integrate MIDI and LAN (Ethernet)
  - Efficient information sharing among processes
    - connection-less protocol on UDP/IP
    - support broadcast-based information sharing
      - without the overhead of multiple transmission
  - RMCP packet
    - include various musical information

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**3. Network Protocol for Musical Information**

- Transmit symbolized musical information via network
- Network musical applications
- Distributed implementation of music-related software
  - achieve good load-balancing
  - exploit various facilities
    - connected with different computers

Efficient information sharing over network is important

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**4. Related Work**

- MIDI-based network protocols
  - connection-oriented
  - not emphasize low-latency information sharing among multiple distributed processes
- MIDI
  - weak in efficient information sharing among devices
    - low bandwidth / just for local communication
- Non-MIDI-based music protocols
  - generally presuppose the use of special devices

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**5. Design Policy**

- **Implement necessary functions**
  - as small different processes
    - so that they can be reusable

- Easy system implementation and expansion
  - each process can be devoted to its own small function
  - new function is achieved just by adding a new server
- Good load-balancing
  - easy to allocate RMCP servers and clients on distributed computers

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**6. Basic RMCP Servers and Clients**

- **RMCP Display Server**
- **RMCP MIDI Receiver**
- **RMCP Animation Server**
- **RMCP Sound Server**
- **RMCP SMF Player**
- **RMCP MIDI Station**
- **RMCP server**
- **RMCP client**
3. Implementation of RMCP

- **RMCP Packet**
  - RMCP magic number
  - server number
  - message length
  - client/user identification (R)
  - client/user identification (G)
  - type of time stamp
  - reserved
  - time stamp (sec)
  - time stamp (msec)
  - client/user identification
  - reserved
  - time stamp (sec)
  - time stamp (msec)

- **Basic message types**
  - MIDI information: transmitting MIDI messages
  - beat information: beat synchronization
  - chord information: chord name and voicing
  - animation information: controlling computer graphics

- **RMCP Time Synchronization Server**

- **RMCP over the Internet**
  - RMCP Gateway
    - bidirectional relay of RMCP packets over the Internet
    - connection-oriented protocol on TCP/IP
    - RMCP servers and clients can communicate
    - as if different LANs were the same network
    - relay with the specified latency
      - live MIDI broadcasts
      - RemoteGIG

- **Experimental Results**
  - RMCP programming libraries in both C and Java
    - tested on various computers and OSs
      - IRIX-5.3, Solaris-2.5, SunOS-4.1.3, HP-UX, Linux-2.0, Windows-95, Windows-NT
    - Communication delay between server and client
      - Ave: 0.30 ms, Min: 0.28 ms
      - SD: 0.06 ms, Max: 1.24 ms
      - Fast enough compared with MIDI (31.25 Kbps)

4. Applications

- **Networked Session**
  - Several players perform music together via Ethernet
  - listen to other players’ performances
  - see visualized performances

- **Improvisation**
  - Musical-instrument interface for untrained novices
  - improvise unconventional music easily
  - by clicking and dragging a computer mouse
VirJa Session
- Virtual jazz session system
  multimodal interaction among all players
  sounds / 3D computer graphics / gestures

VirJa Session

Virtual Dancer “Cindy”
- Interactive performance of a music-controlled CG dancer
  two players choreograph Cindy by their improvisation
  interact through music and 3D computer animation

RemoteGIG
- Remote session with delay
  impossible to avoid network latency over the Internet
  models of traditional sessions are not useful
  RMCP gateways provide a certain constant latency
  with very small deviation
- Innovative remote session over the Internet
  overcome long network latency
  offer a new possibility for future remote sessions

RemoteGIG

Virtual Dancer “Cindy”

5. Conclusion

Summary
- RMCP: Network protocol for music applications
- Multiple distributed processes can share
  symbolized musical information such as MIDI
- Features:
  efficient broadcast-based information sharing over LAN
  time-scheduling using time stamps
  live MIDI transmission over WAN such as Internet
- Utilized for various applications

Future Work
- Provide an API “Jam” to make
  RMCP and MIDI usable in Java applets
- Implement various RMCP-based applications

RMCP Software Package Distribution

http://www.info.waseda.ac.jp/muraoka/members/goto/RMCP/