



Open Sound Control -- A flexible protocol for sensor networking

n Freed, Andy Schmeder, Michael Zbyszynski



University of California at Berkeley ▪ Department of Music
Center for New Music & Audio Technologies

Open Sound Control (OSC) is a protocol for communication among computers, sound synthesizers, and other multimedia devices that is optimized for modern networking technology. Compared to protocols such as MIDI, OSC's advantages include interoperability, accuracy, flexibility, and enhanced organization and documentation.

Anatomy of an Open Sound Control *Packet*:

[address type-tags (i,f,s,b) arguments (binary) . . .]

Anatomy of an Open Sound Control *Bundle*:

[“#bundle” timestamp integer-length packet-1 packet-2 . . .]

	OSC	MIDI
Examples of Messages	/wii/ir/x 0.1503 /stylus/pressure 0.014 /camera/look-at 5. 12. 17. /play-note 15 0.9	144 60 64 (MIDI Note-on) 128 60 64 (MIDI Note-off)
Message types	User-defined Human-readable	Pre-determined Byte-encoded
Atomic Update of Multiple Parameters	✓ via Bundles	☹
Time-tagging	✓ via Bundles	☹
Hardware Transport Independent	✓	☹
Number of channels	Unlimited	16
Data formats	Integer, Double Precision Floating Point, Strings, and more	1-byte integers 0-255
Message Structure	User-defined	Pre-determined
Microcontroller-friendly	✓	✓
State-machine independent	✓ * (Unless user-imposed)	☹ (e.g. “The Note-off problem”)
Application Areas	Music,, Video, Robotics and more	Music
Clock-sync accuracy, theoretical limit	picosecond (via NTP / IEEE 1588 Sync)	20833 microseconds
Data Rate	Gigabit Speed (> 800M bits / sec)	31,250 bits / second

Common Transport Mechanisms for OSC

Transport	Encoding	Examples
IP Network	Packetized UDP, SLIP-Encoded TCP	All OSC Libraries, Jazz Mutant Lemur
Max/MSP	Standard List Format: [/path/x 1 2 3.14159]	Builtin
Serial Stream (USB-Serial, RS232, etc)	SLIP-Encoded	Make Controller Kit
HTTP (AJAX, XML Sockets)	XML-Encoded	flosc (Flash-OSC)
Synchronous Digital Audio	SLIP-Encoded	PIC Microcontroller (e.g., CUI)

OSC Support

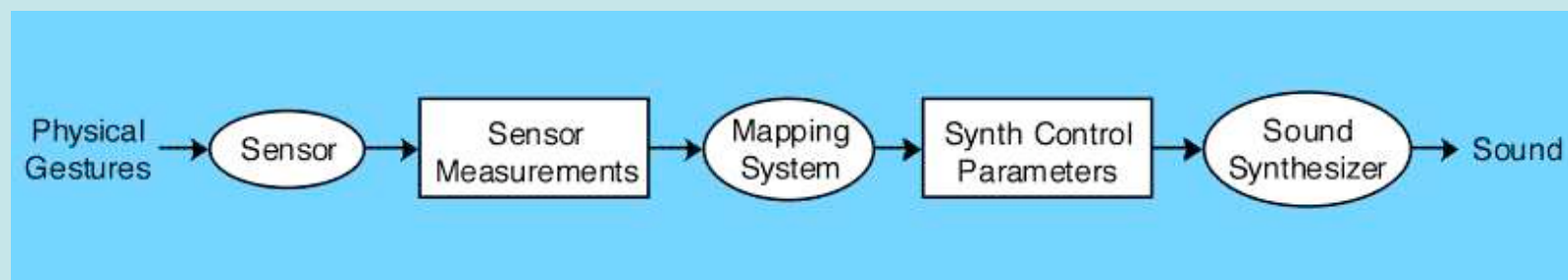
Liblo: Lightweight OSC API	plugin.org.uk/liblo/	Programming Library
Matlab OSC	www.a2hd.com/software/	...
PHP	www.a2hd.com/software/OSC.phps	...
cl-osc	www.cliki.net/OSC	...
NetUtil OSC Library for Java	www.sciss.de/netutil	...
Squeak OSC	minnow.cc.gatech.edu/squeak/5836	...
oscpack	http://www.audiomulch.com/~rossb/code/oscpack/	...
WOscLib	http://wosclib.sourceforge.net/	...
OSC-Kit	http://www.cnmat.berkeley.edu/OpenSoundControl/Kit	...
ChuckK => OSC	chuck.cs.princeton.edu/	...
Jamoma	http://jamoma.org/	...
OSC.net (V1.2)	http://www.ventuz.com	...
Open Sound World	http://osw.sourceforge.net/	Software Application
devosc	www.cnmat.berkeley.edu/Research	...
Csound	http://www.csounds.com/manual/html/OSC.html	...
SwingOSC Java Server	http://www.sciss.de/swingOSC/	...
Mirage	sourceforge.net/projects/mirage/	...
OSCGroups	http://www.audiomulch.com/~rossb/code/oscgroups/	...
MadJACK - MPEG Audio Deck	http://www.ecs.soton.ac.uk/~njh/madjack/	...
JackMiniMix	http://www.ecs.soton.ac.uk/~njh/jackminimix/	...
Impromptu	http://impromptu.moso.com.au/	...
MouseTrap	www.humatic.de/htools/MouseTrap.htm	...
KWlive Realizer	kwlive.dev.waag.org/	...
KWlive hid2osc	kwlive.dev.waag.org/	...
ROB - Remote over Bluetooth	http://rob.tim-schenk.de/index.php?id=rob_home_en	...
oscjoy	http://www.lcscanada.com/oscjoy/index.html	...
MXWendler Realtime Compositing	http://www.mxwendler.net	...
rob.otnik	http://rob.otnik.com/	...
DiABlu	http://diablu.jorgecardoso.org	...
Ventuz Realtime 3D Rendering (.net)	http://www.ventuz.com	...
OSCulator	http://www.osculator.net	...
Gluion sensor to OSC interface	http://www.glui.de/prod/gluion.html	Hardware
Ethersense Sensor interface	forumnet.ircam.fr/362.html	...
CNMAT Connectivity Processor	www.cnmat.berkeley.edu/Research	...
Smart Controller	www.smartcontroller.com.au/smartController/smartController.html	...
Matrix3 digital mixer (LX-300)	http://www.lcsaudio.com/Products/Matrix3.html	...
The WiSe Box - Wireless Sensors	www.ircam.fr/wisebox.html	...
La Kitchen Hardware	http://www.la-kitchen.fr/kitchenlab/kitchenlab.html	...
Monome	http://monome.org	...
Make Controller Kit	www.makingthings.com	...
More Information: http://www.opensoundcontrol.org/		

OSC At Maker Faire 2007

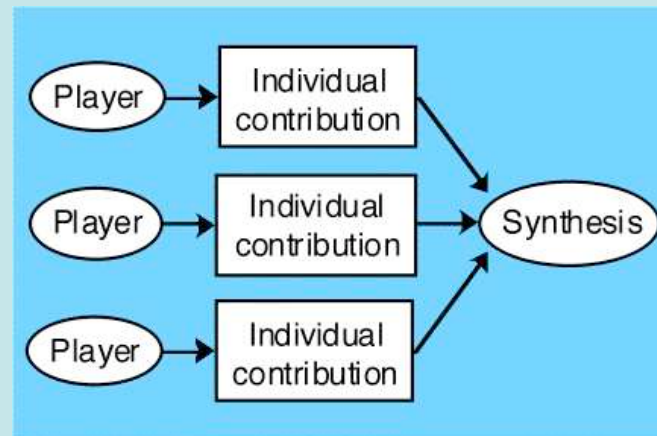
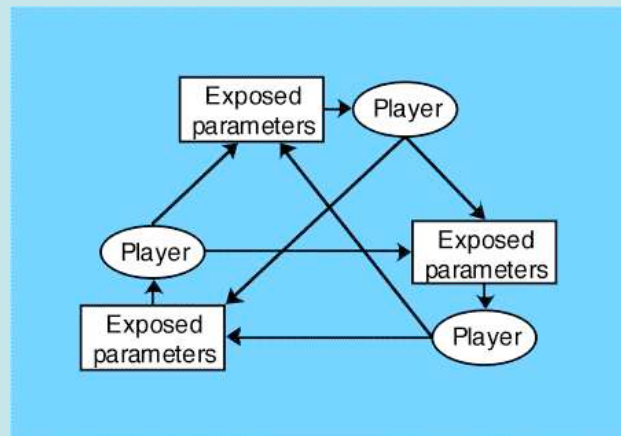
- Monome #282
- CCRMA Stanford University, #272
- CREATE: CUI UC Santa Barbara: #145
- Make Controller Kit, Making Things: #146
- Derek Scott and Steve Cooley, DIY Music Tools and Visuals #143
- Sparkfun, Giant Video Games #405
- Tim Tompson, Multitouch #223
- CNMAT OSC Demo #144 (You are here now!)

Design Patterns for Musical Interaction with Sensors:

Going from Sensors ... to Music:



Interactive scenarios for sensor networks in musical collaboration:



Technical and Artistic Examples of OSC-based Projects:

Bencina, R. (2003), PortAudio and Media Synchronisation. In Proceedings of the Australasian Computer Music Conference, Australasian Computer Music Association, Perth, pp. 13-20.

Garnett, G.E., Jonnalagadda, M., Elezovic, I., Johnson, T. and Small, K., Technological Advances for Conducting a Virtual Ensemble, in International Computer Music Conference, (Habana, Cuba, 2001), 167-169.

Garnett, G.E., Choi, K., Johnson, T. and Subramanian, V., VirtualScore: Exploring Music in an Immersive Virtual Environment, in Symposium on Sensing and Input for Media-Centric Systems (SIMS), (Santa Barbara, CA, 2002), 19-23. (pdf)

Goudeseune, C., Garnett, G. and Johnson, T., Resonant Processing of Instrumental Sound Controlled by Spatial Position, in CHI '01 Workshop on New Interfaces for Musical Expression (NIME'01), (Seattle, WA, 2001), ACM SIGCHI. (pdf)

Hankins, T., Merrill, D. and Robert, J., Circular Optical Object Locator, Proc. Conference on New Interfaces for Musical Expression (NIME-02), (Dublin, Ireland, 2002), 163-164.

Impett, J. and Bongers, B., Hypermusic and the Sighting of Sound - A Nomadic Studio Report, Proc. International Computer Music Conference, (Habana, Cuba, 2001), ICMA, 459-462.

Jehan, T. and Schoner, B., An Audio-Driven Perceptually Meaningful Timbre Synthesizer, in Proc. International Computer Music Conference, (Habana, Cuba, 2001), 381-388. (pdf)

Overholt, D., The MATRIX: A Novel Controller for Musical Expression, Proc. CHI '01 Workshop on New Interfaces for Musical Expression (NIME'01), (Seattle, WA, 2001). (pdf)

Pope, S.T. and Engberg, A., Distributed Control and Computation in the HPDM and DSCP Projects, in Proc. Symposium on Sensing and Input for Media-Centric Systems (SIMS), (Santa Barbara, CA, 2002), 38-43. (pdf)

Wessel, David, Matthew Wright, and Shafqat Ali Khan. Preparation for Improvised Performance in Collaboration with a Khyal Singer, in Proc. International Computer Music Conference (Ann Arbor, Michigan, 1998), ICMA, 497-503. (html)

Wilson, Scott, Michael Gurevich, Bill Verplank, and Pascal Stang. Microcontrollers in Music HCI Instruction: Reflections on Our Switch to the Atmel AVR Platform, In Proc. of the Conference on New Interfaces for Musical Expression, (Montreal, 2003) 24-29.

Young, J.P., Using the Web for Live Interactive Music, Proc. International Computer Music Conference, (Habana, Cuba, 2001), 302-305.

