OSC in SuperCollider Server

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OSC in SC

- SC server architecture
- OSC usage in SC server
- thoughts on OSC issues

SC architecture

- client-server
- client: scripting language
- server: synthesis engine
- client and server speak OSC

SC client

- dynamic programming language
- Smalltalk object model
- real time garbage collection
- also borrows from Scheme, APL, Icon, Ruby, HMSL.

SC server

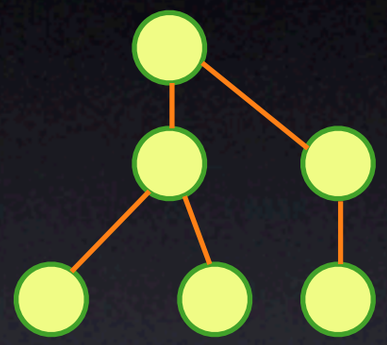
- a virtual machine for audio
- as dynamic as possible
- as simple as possible
- higher level representation left to client

an audio virtual machine

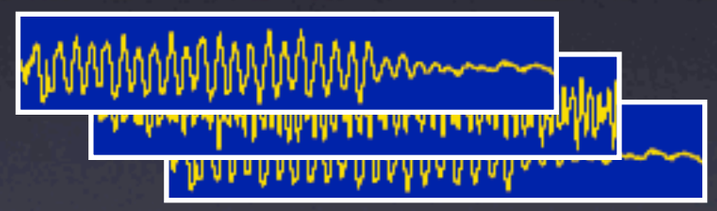
- functional units
- operations on the functional units
- OSC messages are a way of dynamically editing the virtual machine program

functional units

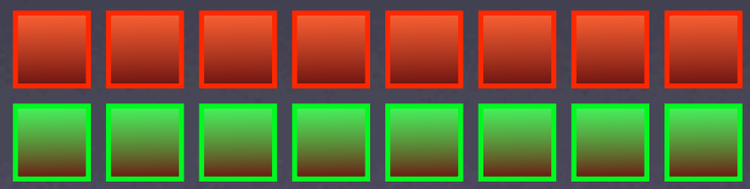
- execution tree



- buffer array

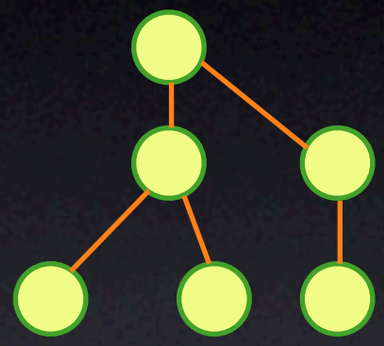


- audio and control buses



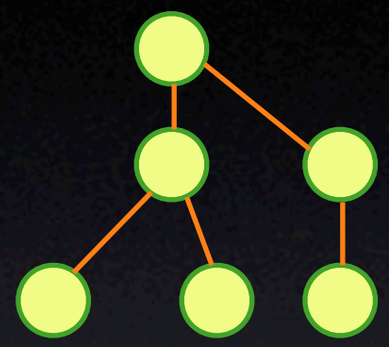
execution tree

- internal nodes: groups
- leaf nodes: synths



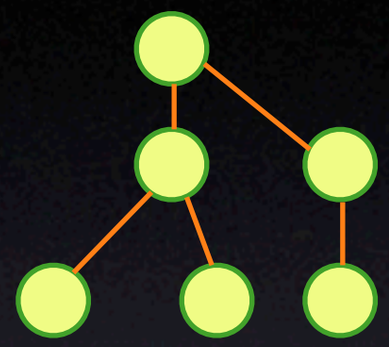
- synth is a collection of unit generators with a shared lifetime
- unit generator is a basic signal processing element

execution tree



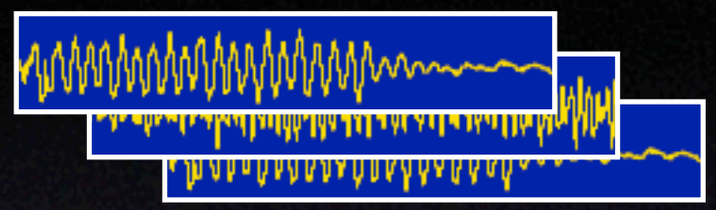
- the tree is the virtual machine's program
- synths are the subroutines
- unit generators are the instructions
- order of execution: depth first, left to right

execution tree



- all nodes are identified by number
- synths have parameters that can be set
- setting a parameter on a group sets the parameter for all synths it contains

buffer array



- buffers can contain audio or control data
- most buffer commands are asynchronous:
  - read/write soundfiles
  - alloc, free
  - fill by a function
- async commands send a reply when done

audio & control buses

- synths do not connect directly
- all synth connections are through buses
- unit generators for:
  - reading, replacing, summing, crossfading

usage of OSC

- obeys time stamps! assumes NTP
- single level name space
- notifications of state changes
- queries
- replies for asynchronous commands
- embedded completion msgs for async cmds

single level name space

- conventional OSC name space not practical
  - nodes in the tree may come and go in the hundreds per second (granular synthesis)
    - wanted constant time access to nodes
- pattern matching unecessary
- commands can be hashed

node IDs vs. paths

instead of sending this:

```
/group0/group1/group101/synth200/freq/set 440
/group0/group1/group101/synth200/amp/set 0.1
/group0/group1/group101/synth200/pan/set 0.7
```

can send this:

```
/n_set 200 freq 440 amp 0.1 pan 0.7
```

notifications

- notifications are sent when there is a change in the execution tree
- clients register their interest
- server maintains a list of interested clients
- notifications bubble up from the RT thread to be sent on the NRT thread

queries

- state of the server
- state of a node
- state of a buffer
- values of synth parameters
- values of control buses
- values in a buffer

replies to async comands

- async commands reply to the sender when done.
- “/done”,“commandName”
- “/fail”,“commandName”,“errorMsg”

completion messages

- a command to execute when an async command completes
- embedded in the async command as a blob
  - type tag ‘b’

issues

- identifying replies
- structured data
- nested bundles
- sequenced bundles
- security

identifying replies

- quoting entire message back - wasteful
- unique numbers in every message - painful
- hash code
  - chance of collision negligible
  - very low messaging overhead

structured data

- most RPC schemes can represent rich data (e.g. XML-RPC, SOAP, XDR) such as arrays and key-value pairs (a.k.a. structs, records, maps, dictionaries).
- richer data types allow richer interactions
- OSC has arrays already via ‘[’ and ‘]’ tags
- similarly key-value pairs could use ‘(’ and ‘)’

structured data

- unfortunately no one implements '[' and ']'
- most current hosts' have data types that are too limited.
- more people are beginning to use tools like SC, Lisp, Scheme, Python, Ruby, Javascript which can handle richer data types.

sequenced bundles

- asynchronous messages suspend the bundle
- bundle continues to execute when async command completes
- eliminates need for completion messages

sequenced bundle example

- Bundle contains these commands:
  - load a sound file into a buffer
  - start a node that uses the buffer
  - wait for the node to end
  - free the buffer

nested bundles. Why?

- no additional guarantees (atomicity)
- consecutive bundles have same behavior
- larger packets not good for UDP
- requires reference counting in the host
- provide no benefits, so let's remove or deprecate them

security

- on a network, an open port with a rich command protocol for initiating tasks on a very high priority thread is an invitation for trouble.
- it would be nice for there to be a log in protocol for OSC

http://www.audiosynth.com
asynth @ io.com