

LV2 Atoms: A Data Model for Real-Time Audio Plugins

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What Not to Do

(or: Why Extensibility Matters)

LV2 Events

- ▶ LADSPA had only float I/O

- ▶ LV2 added generic events:

time	size	type	body...
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- ▶ Type is a URID: a URI mapped to an integer
- ▶ Truly extensible (anyone can define event types)

Event Types in Practice

- ▶ MIDI for notes, etc.
- ▶ ... and that's about it
- ▶ Yet many developers need more power

What to do?

- ▶ What message format(s) to use?
- ▶ MIDI? OSC? text (JSON, Turtle, sexps)?, blobs? ...

Idea

- ▶ Some good message options
- ▶ ... but what about structured data?
- ▶ Can we simplify/genericize what we already have?
- ▶ Hmm... event – time = ?

time	size	type	body...
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Atom: A container for anything

```
typedef struct {  
    uint32_t size;  
    uint32_t type;  
} LV2_Atom;
```

- ▶ A simple-as-possible “universal” idea (size aside)
- ▶ **Win:** this is all you need to know to copy atoms
- ▶ Hosts, routers, etc., can simply memcpy

Building the Foundation

- ▶ Opacity is nice, but “meaningless” blobs are problematic
- ▶ What can we build on this ground?
- ▶ Primitives are easy, e.g. the body of an `Int` is just that:

```
typedef struct {  
    LV2_Atom atom;  
    int32_t body;  
} LV2_Atom_Int;
```

- ▶ Wonderful: ints, floats, strings, etc.

Structured Data in the Ivory Tower

- ▶ To build larger structures, we need collections
- ▶ A pure and simple model: lists + dictionaries (ala JSON)
 - ▶ Tuple: atom, atom, atom, ...
 - ▶ Object: key, atom, key, atom, ...

Structured Data in the Noisy Trenches

- ▶ For block-processed audio: time stamps
 - ▶ Sequence: time, atom, time, atom, ...
- ▶ For high performance / SIMD: vectors
 - ▶ Vector: atom body, atom body, ...
 - ▶ (Like Tuple but homogeneous with headerless elements)
- ▶ For LV2: Turtle compatibility
 - ▶ Object keys are URIDs (we'll see why shortly)

Object as Message

- ▶ We can “think in Turtle”, though messages are binary
- ▶ ... and/or convert between the two with code (serialization)
- ▶ ... and/or write atoms in plugin data files

eg:control

```
lv2:minimum 0.0 ;  
lv2:maximum 1.0 ;  
lv2:default 0.5 .
```

Time: Position and Speed

```
[]
```

```
a          time:Position ;  
time:frame 88200 ;  
time:speed 0.0 ;  
time:bar    1 ;  
time:barBeat 0.0 ;  
time:beatUnit 4 ;  
time:beatsPerBar 4.0 ;  
time:beatsPerMinute 120.0 .
```

Loading Samples

```
[]
```

```
  a          patch:Set ;  
  patch:property eg:sample ;  
  patch:value  </media/bonk.wav> .
```

Where to go from here?

- ▶ Lots of potential without adding new APIs
- ▶ Event-based parameter control?
- ▶ Max-like programming-with-plugins?
- ▶ What else can we make plugins do?