Language and Open Source Update: Where are we now and what's next?

P4 Design Working Group

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Overview

- What's new in P4 v1.1?
- Post v1.1 goals and approach
- Update on open-source contributions
- Update on advanced use cases

New additions to P4 v1.1

- **Feature enhancement**
  - *set_metadata*( ) taking expression
    - Enables TLV-style header parsing
  - *modify_field*( ) taking expression
    - Avoids proliferation of primitive actions, keeping the language clean and simple
  - Proper data types and type-checking system
    - Action parameters are now typed
- **Unified way of embracing functional heterogeneity**
  - *extern* types and instances
- **Improved clarity and understandability of the spec**
  - Sequential-execution semantics

Concepts we reviewed, but didn't add to v1.1

- Architecture-language separation
  - Unified way of embracing architectural heterogeneity
  - Identify P4-programmable modules (*whiteboxes*) and declare their signatures
- Standard library
  - Primitive actions
  - Standard *extern* types
    - Stateful objects (counter, meter, and register)
    - Other objects that are subject to compile-time resource allocation
- Support for de-parser specification
  - Inverse of packet parsing

Primary goals for post-1.1 activity

- **Architecture-language separation**
  - Reuse the same compiler for new targets
- **Portability**
  - Reuse the same P4 code for new targets
- **Composability**
  - Write P4 code (library) once and reuse it many times

How?

- **Architecture-language separation**
  - Introduce architecture-modeling constructs in P4
- **Portability**
  - Standard architecture
  - Standard library
- **Composability**
  - Introduce new constructs for namespace and parameterization

Sample: Architecture-language separation

Switch Architecture Specification

```
// “arch.p4”
// Architecture declaration
parser P<H>(in packet_in packet,
              out H headers);
control Ingress<H>(
        inout H headers,
        in intrinsic_metadata_in imi,
        out intrinsic_metadata_out imo
);
control Deparser<H>(in H headers,
                        out packet_out packet);
package Switch<H>(Parser<H> p,
                       Ingress<H> ingress,
                       Deparser<H> deparser);
```

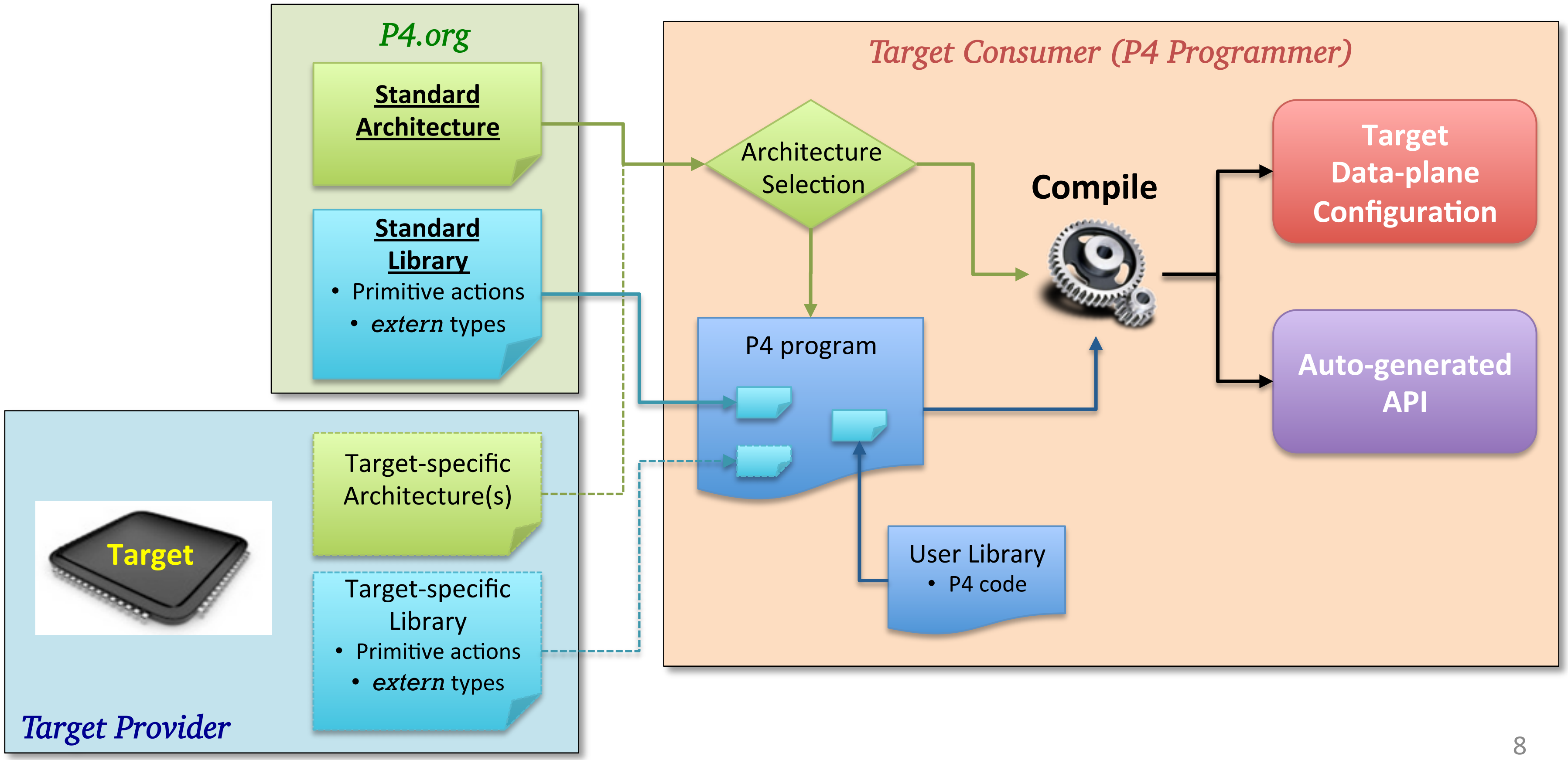
Switch Implementation (by user)

```
// Program written by user
#include “arch.p4”

parser MyParser(...) { ... }
control MyIngress(...) { ... }
control MyDeparser(...) { ... }

// Top-level element instantiation
Switch(MyParser(),
        MyIngress(),
        MyDeparser()) MySwitch;
```

Fitting all these together



Other goals for post v1.1

- Support for …
  - Incremental parsing
  - Deparser specification
  - Compile-time table population
  - Compile-time default-action specification
- Common control-plane API generation convention

Sub-group approach for p4-design

- **Potential sub-groups**
  - Language / Standard library
  - Standard architecture
  - API-generation convention
- Each sub-group could work with its own schedule and logistics
  - Conf calls, in-person meetings, or both
- Monthly in-person plenary meetings
- Seeking representatives who'd like to lead sub-group activities

Update on open-source contributions

- **Behavioral Model v2 (BMv2)**
  - Re-configurable fixed code; no code generation
  - Easier to add features, maintain, and understand
  - Architecture independent
  - Better logging and great test coverage
  - Decent performance
- **Packet Test Framework (PTF)**
  - Replaces OF Test Framework
  - Light weight, more features (network-level testing, etc.)

Update on advanced use cases

- In-band Network Telemetry
  - Full spec & prototype available
    - http://p4.org/p4/inband-network-telemetry/
    - P4 code, mininet-based test framework, and real-time data visualizer
- More in the pipeline
  - L4 load balancing, in-network Paxos, utilization-aware routing, etc.
- P4 code examples (assignments from P4 tutorials)
  - Source routing, flowlet switching, etc.