Following the Packets: A Walk Through Bro's Internal Processing Pipeline

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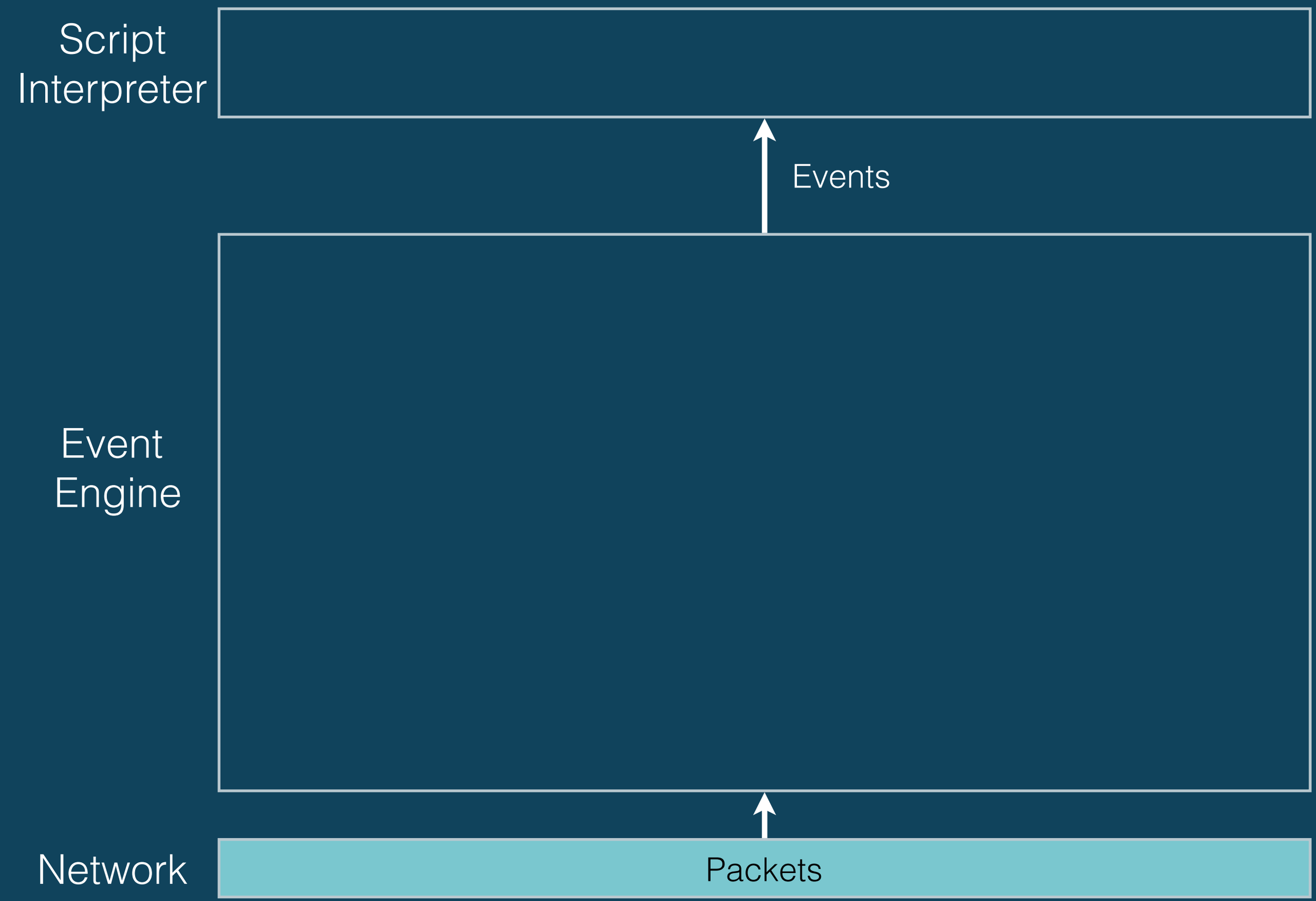
Outline

Bro's Architecture & Data Flow

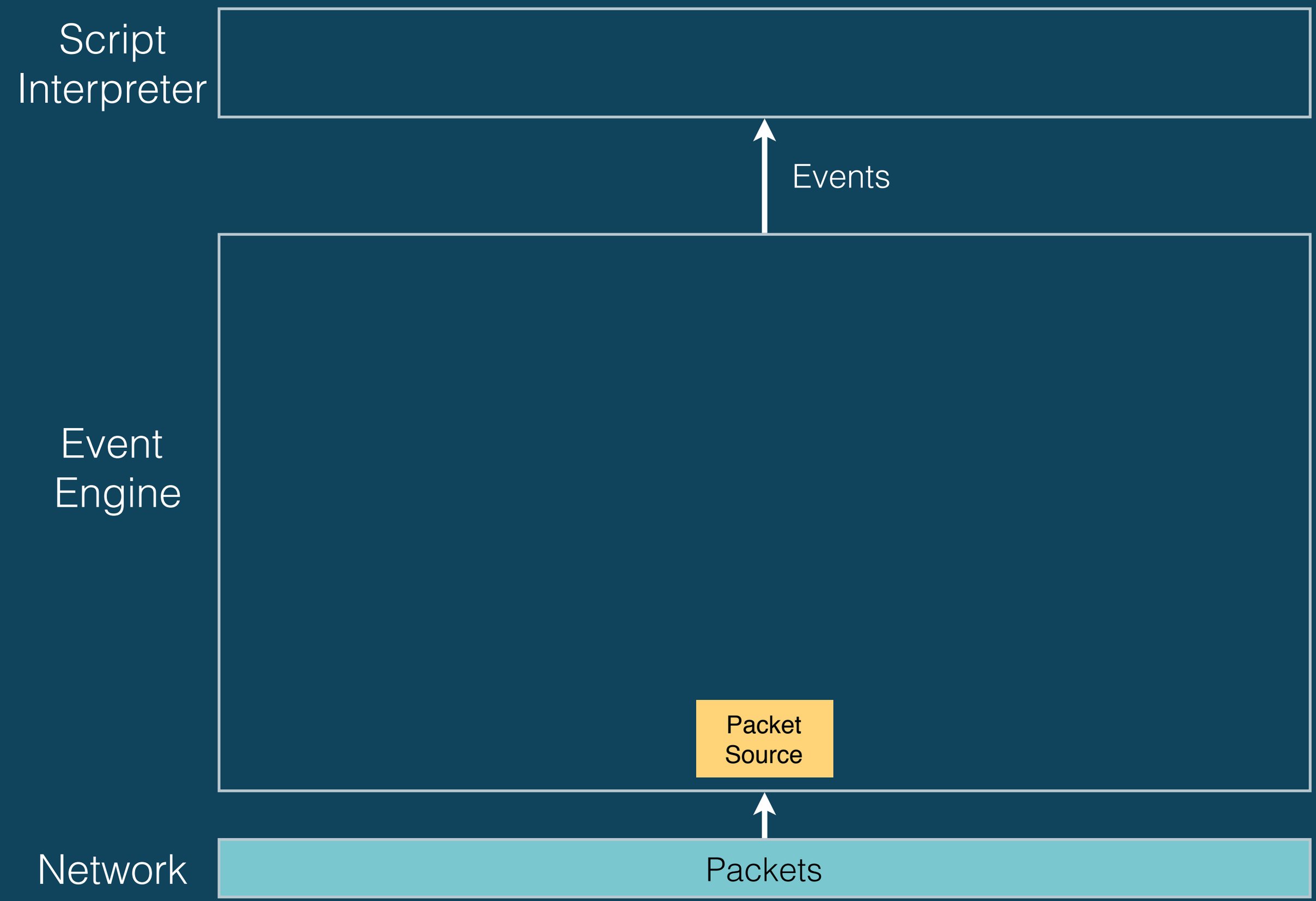
Components

- Protocol & file analysis
- Log writer & input readers
- Bro Plugins

Bro Architecture



Bro Architecture



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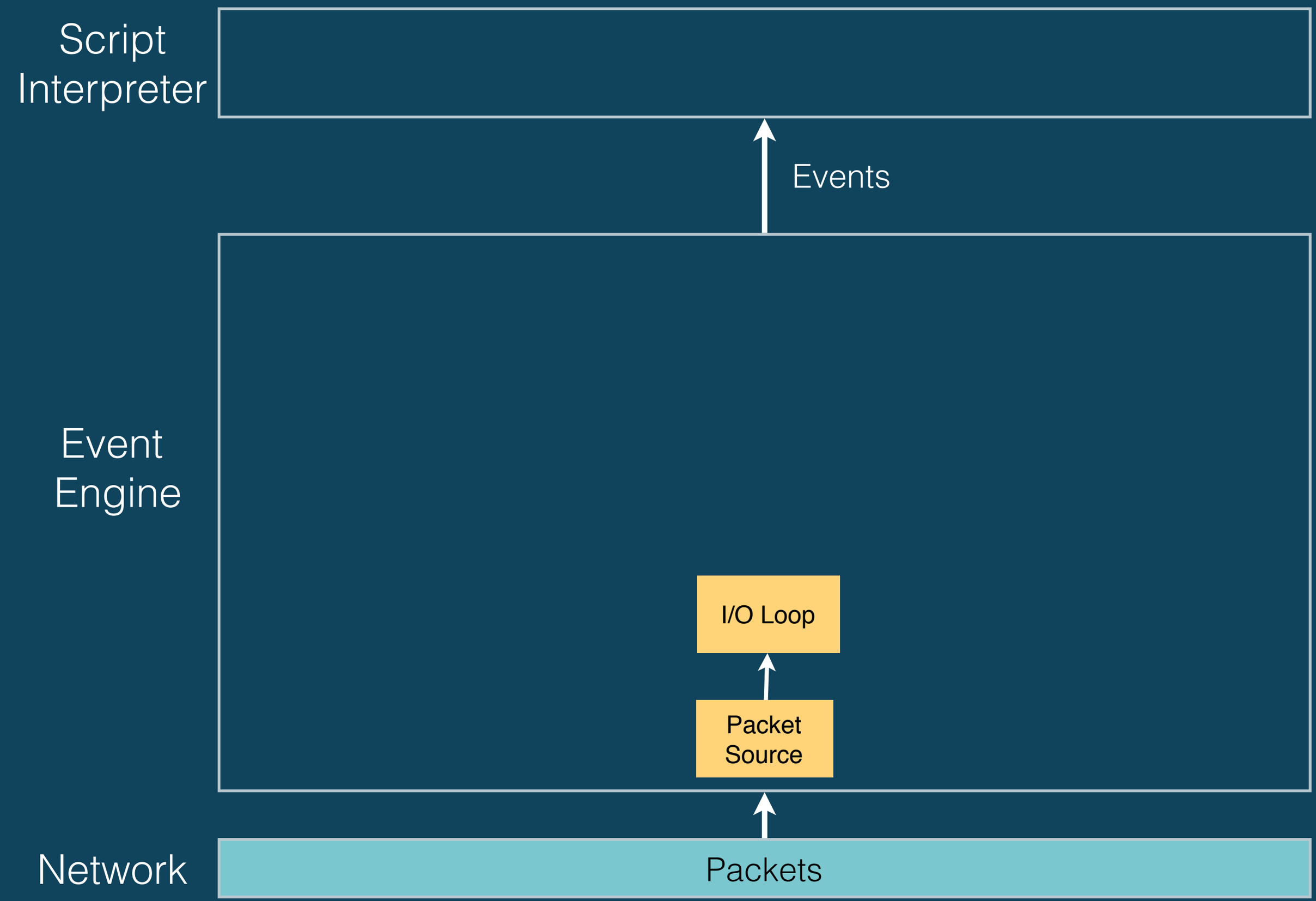

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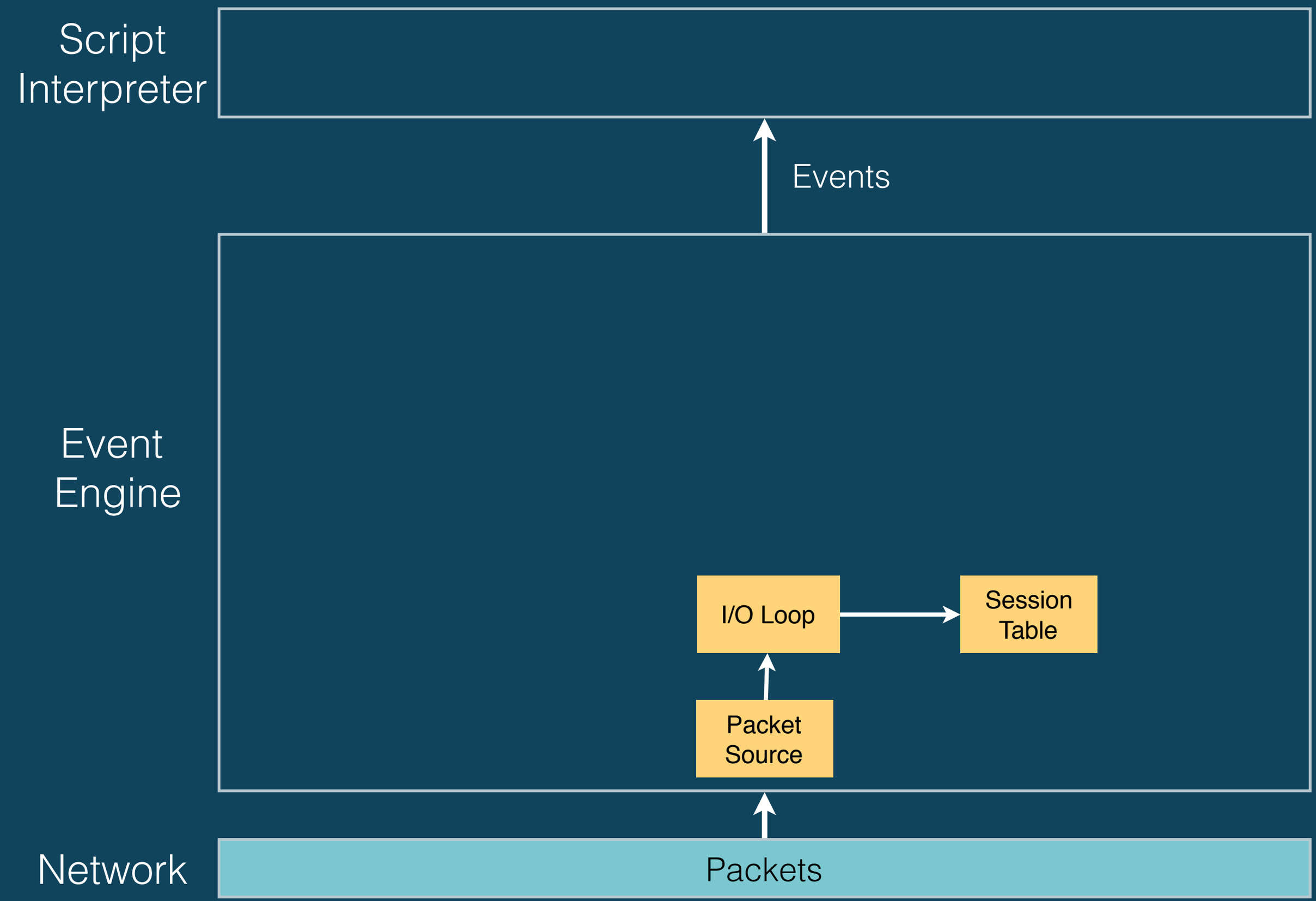

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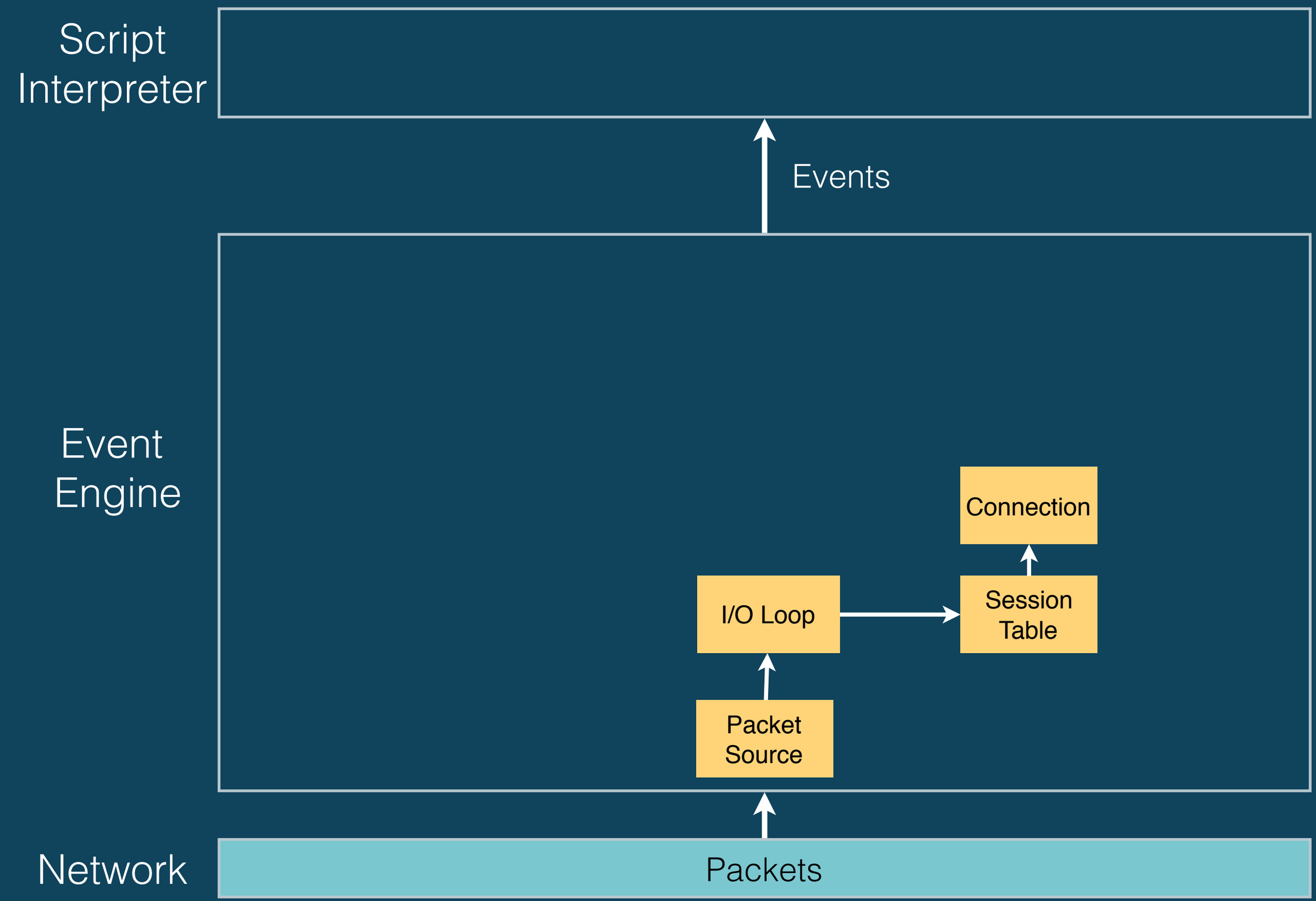

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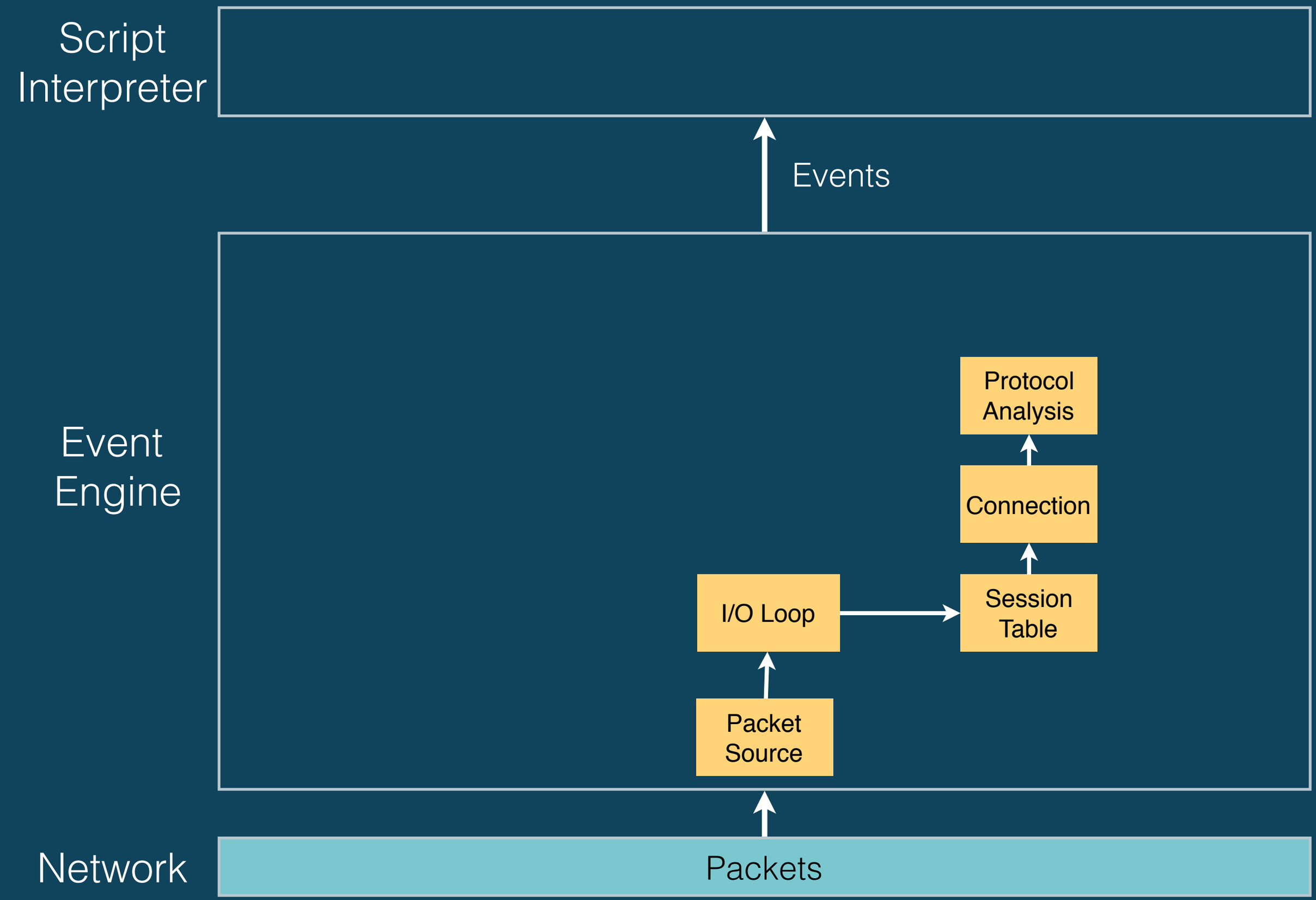

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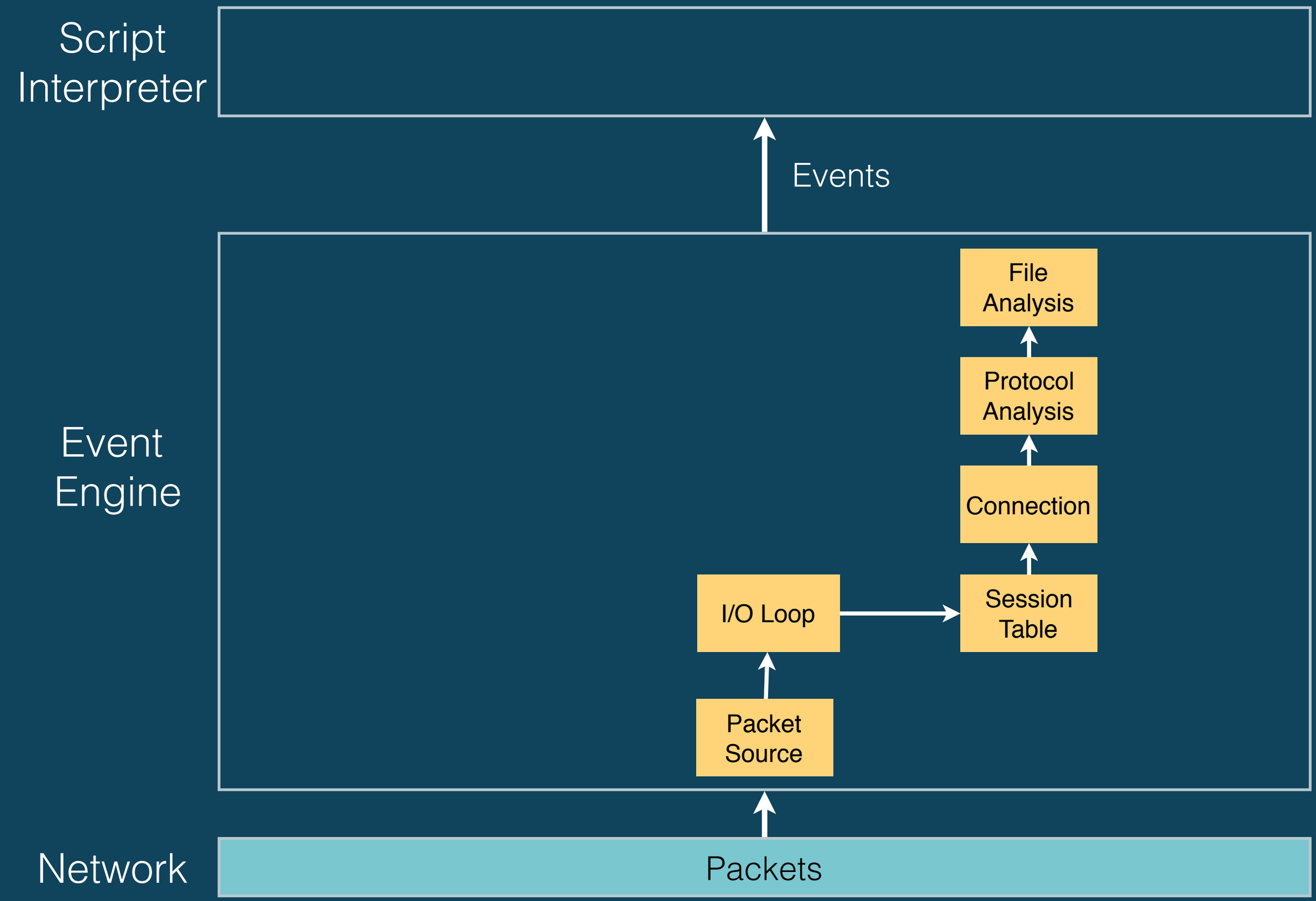

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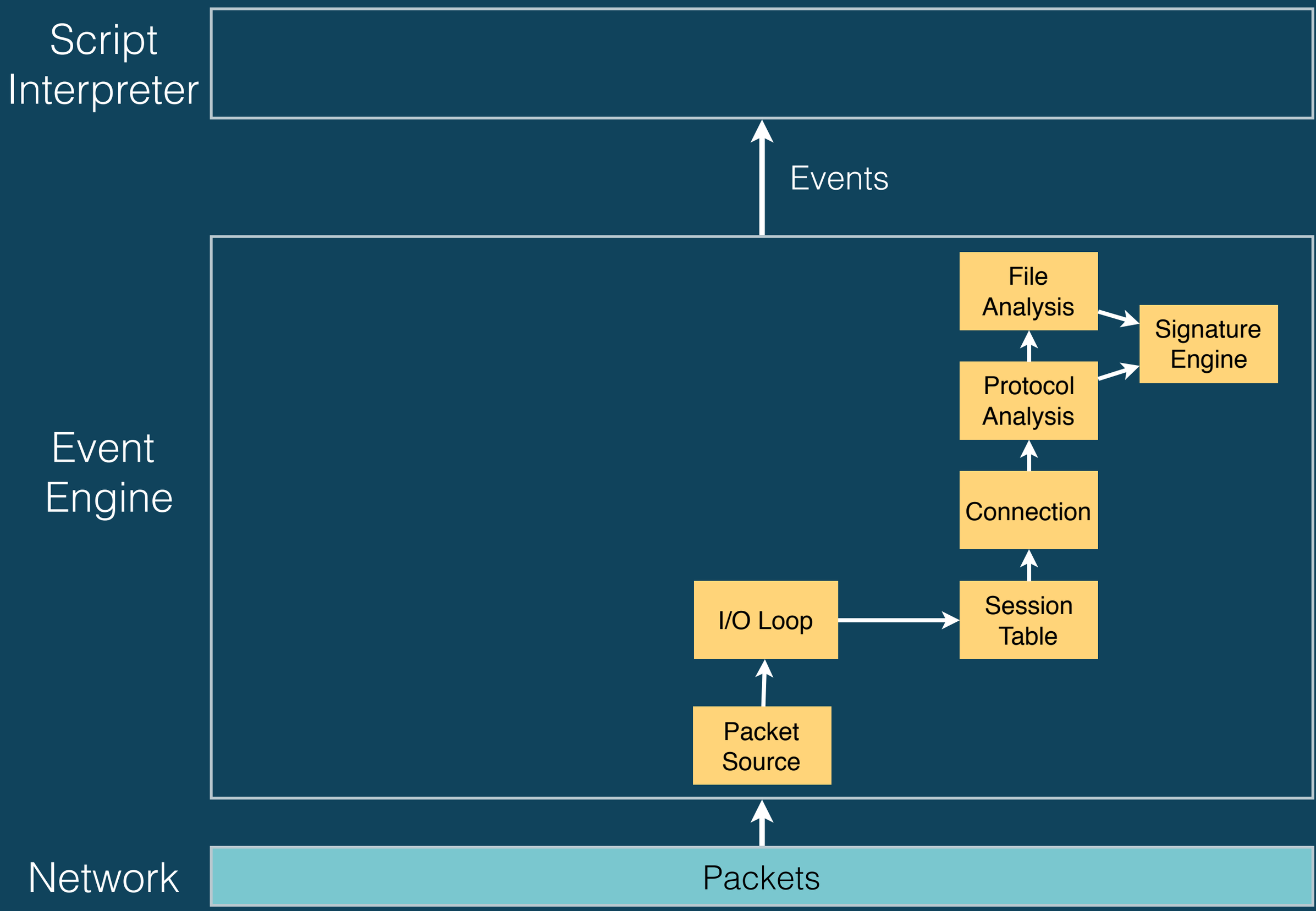

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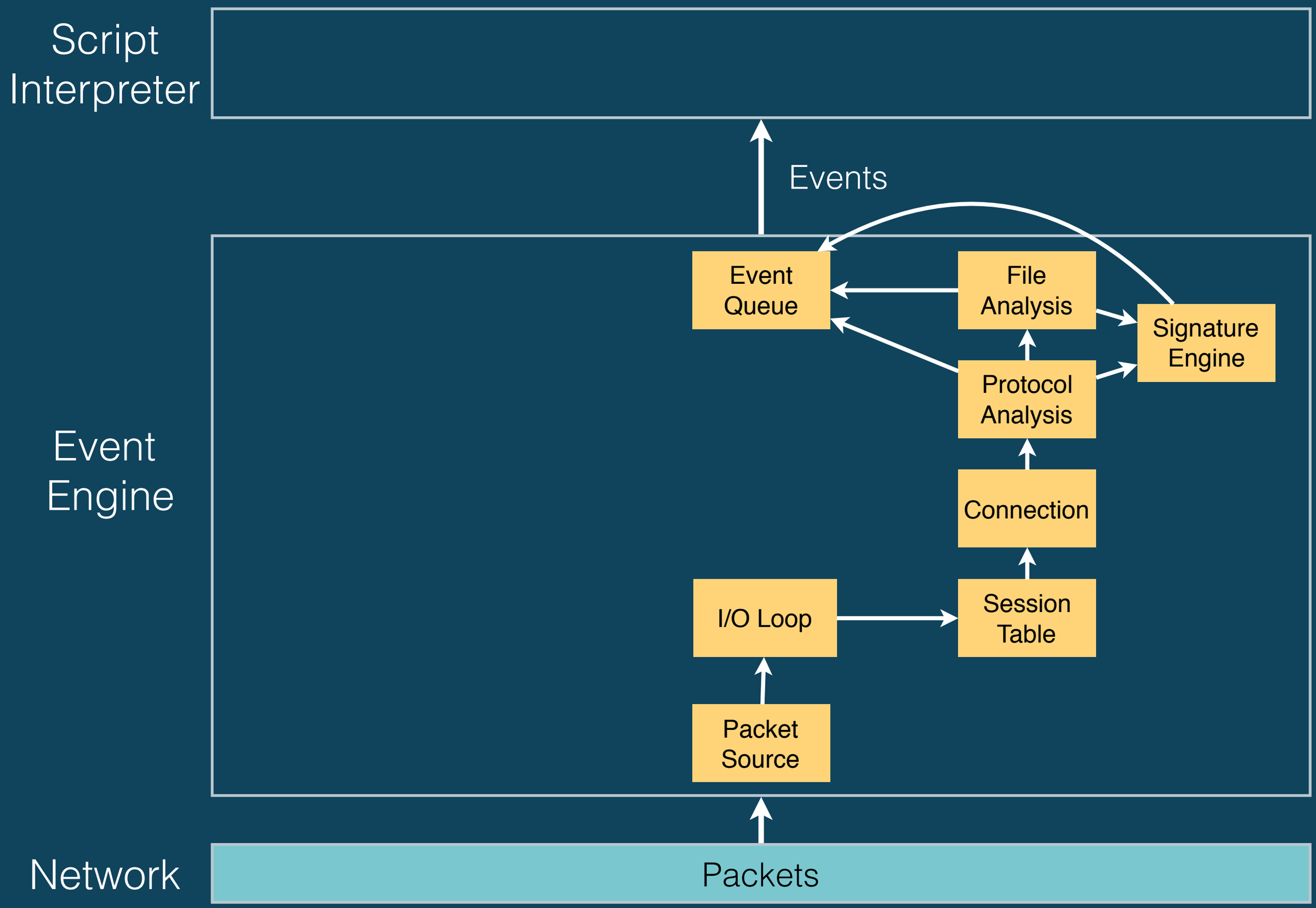

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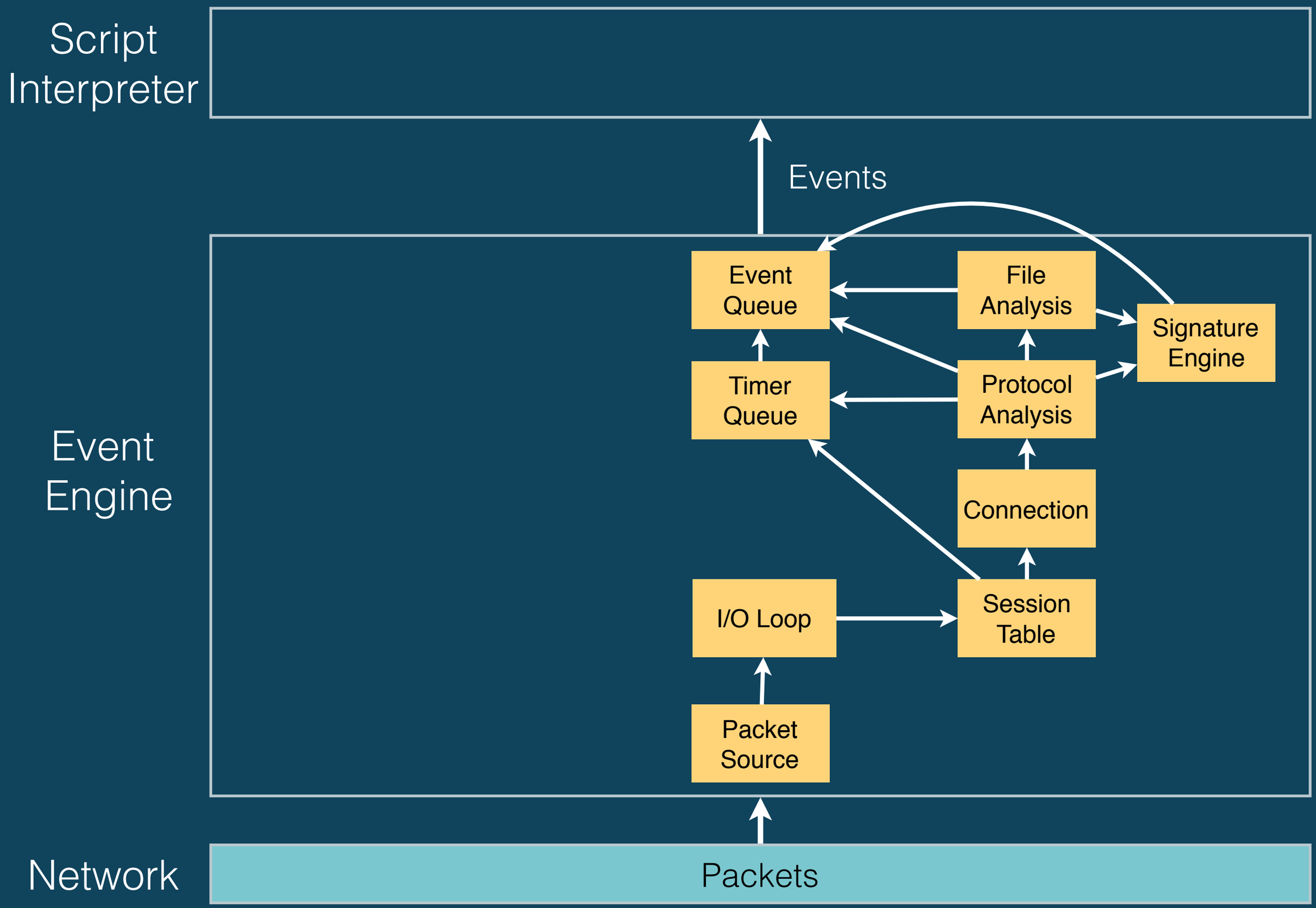

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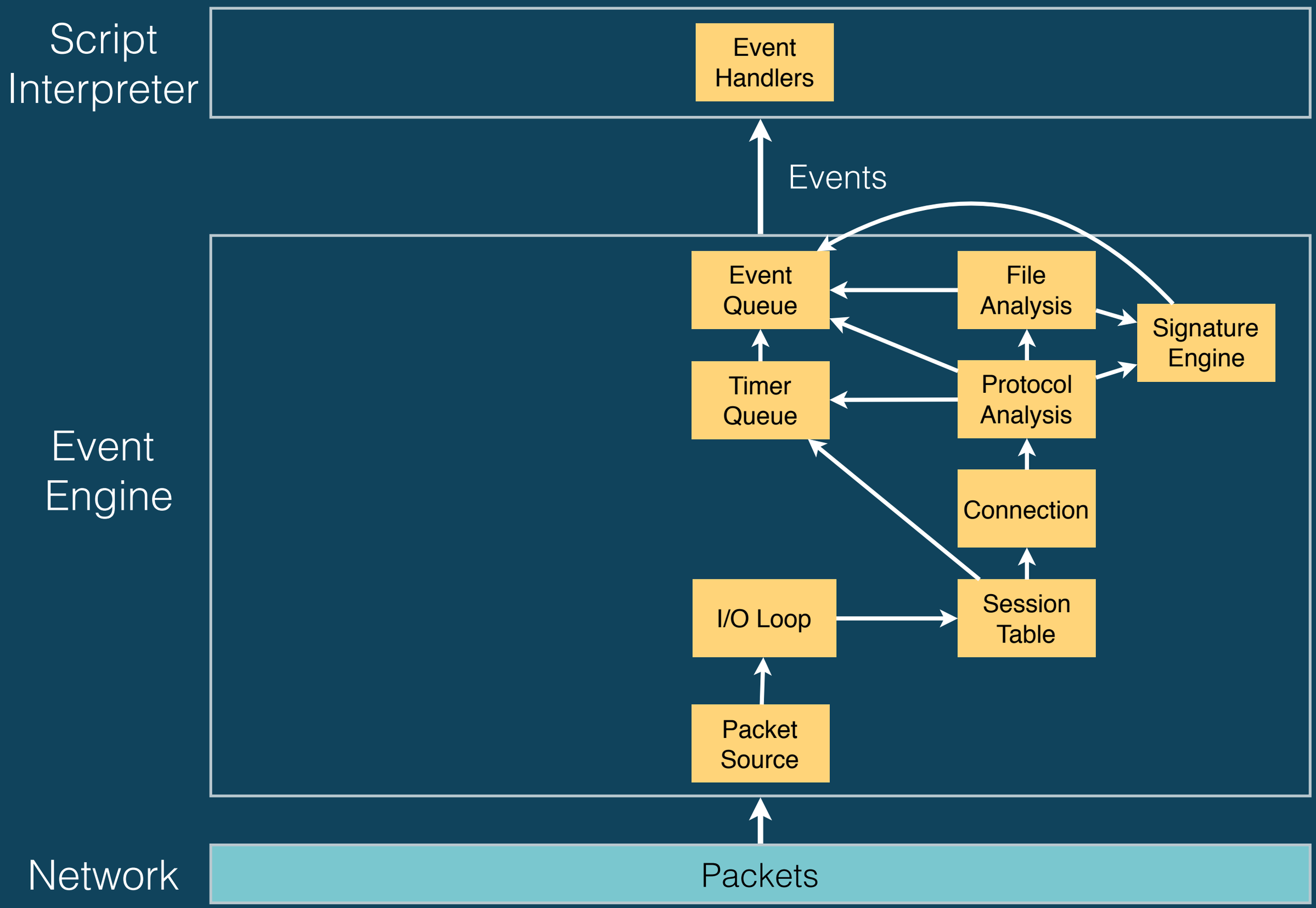

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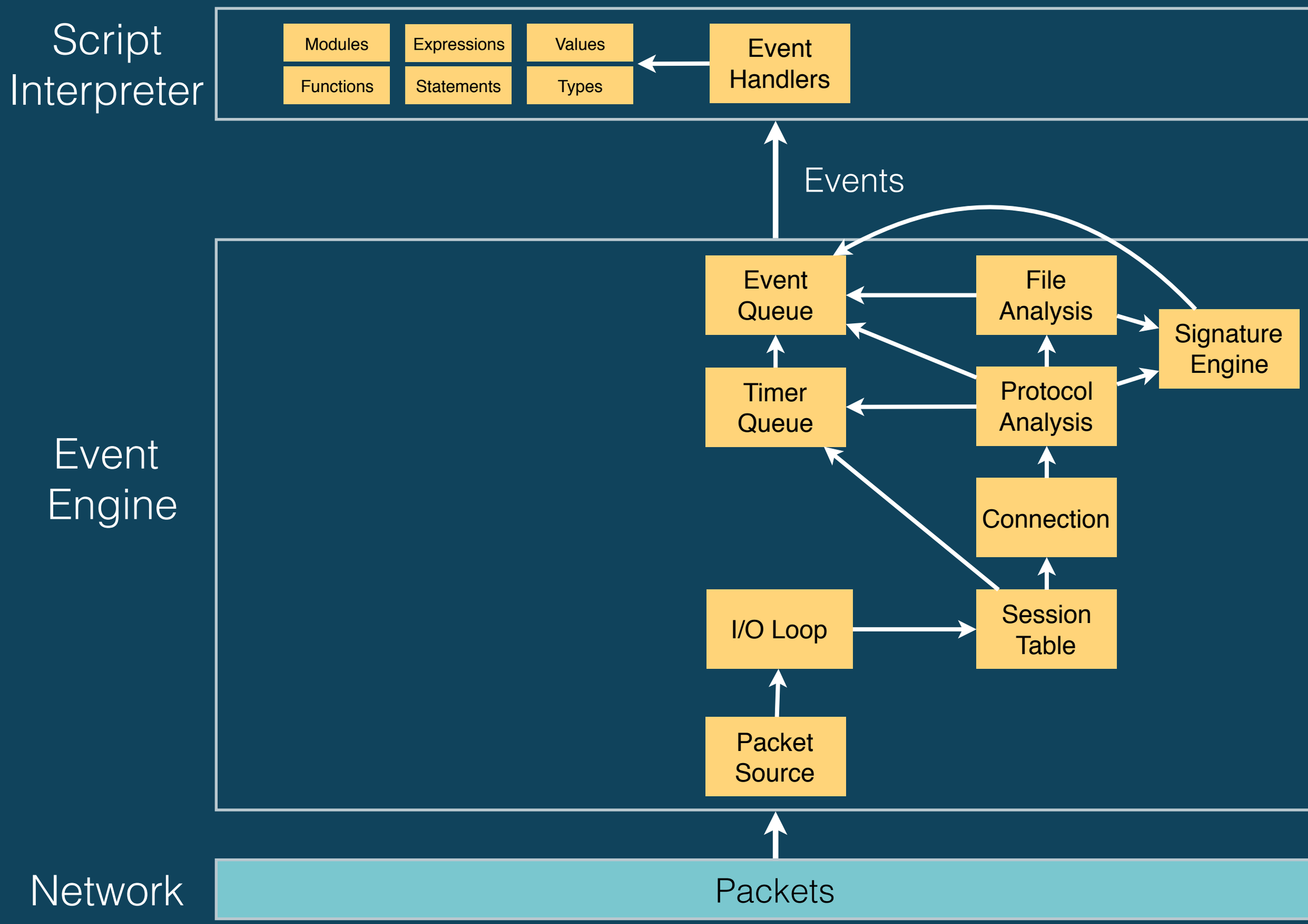

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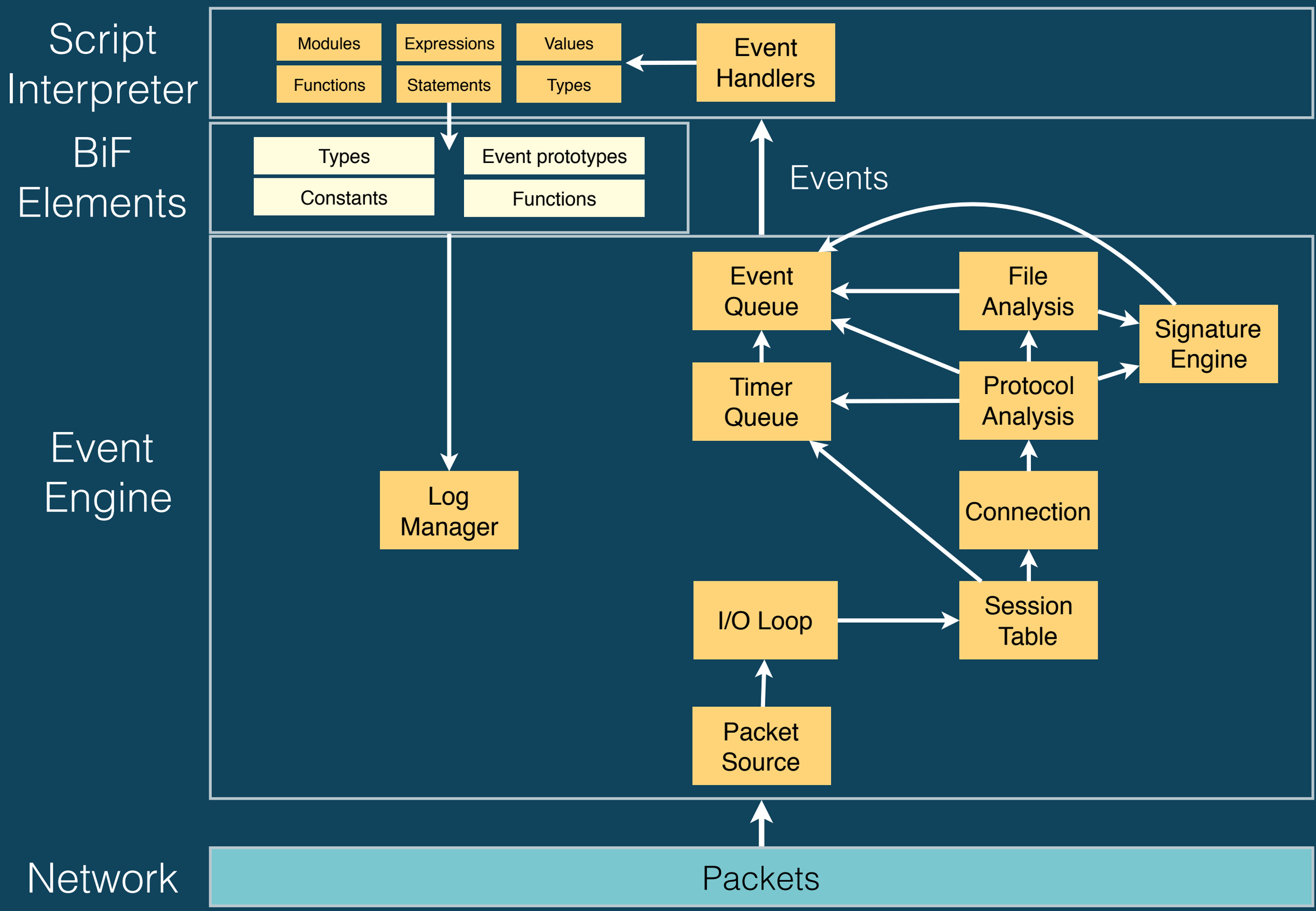

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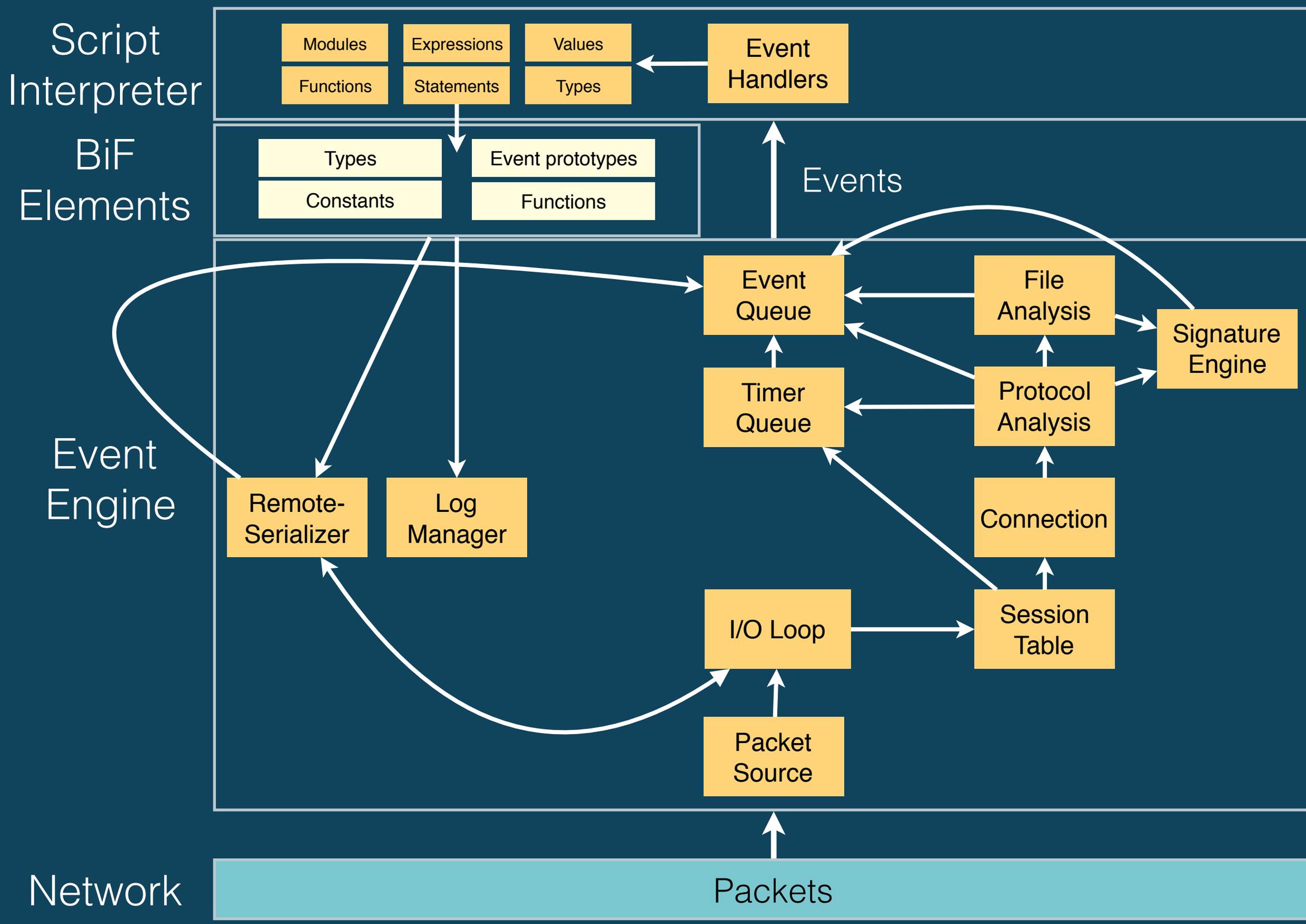

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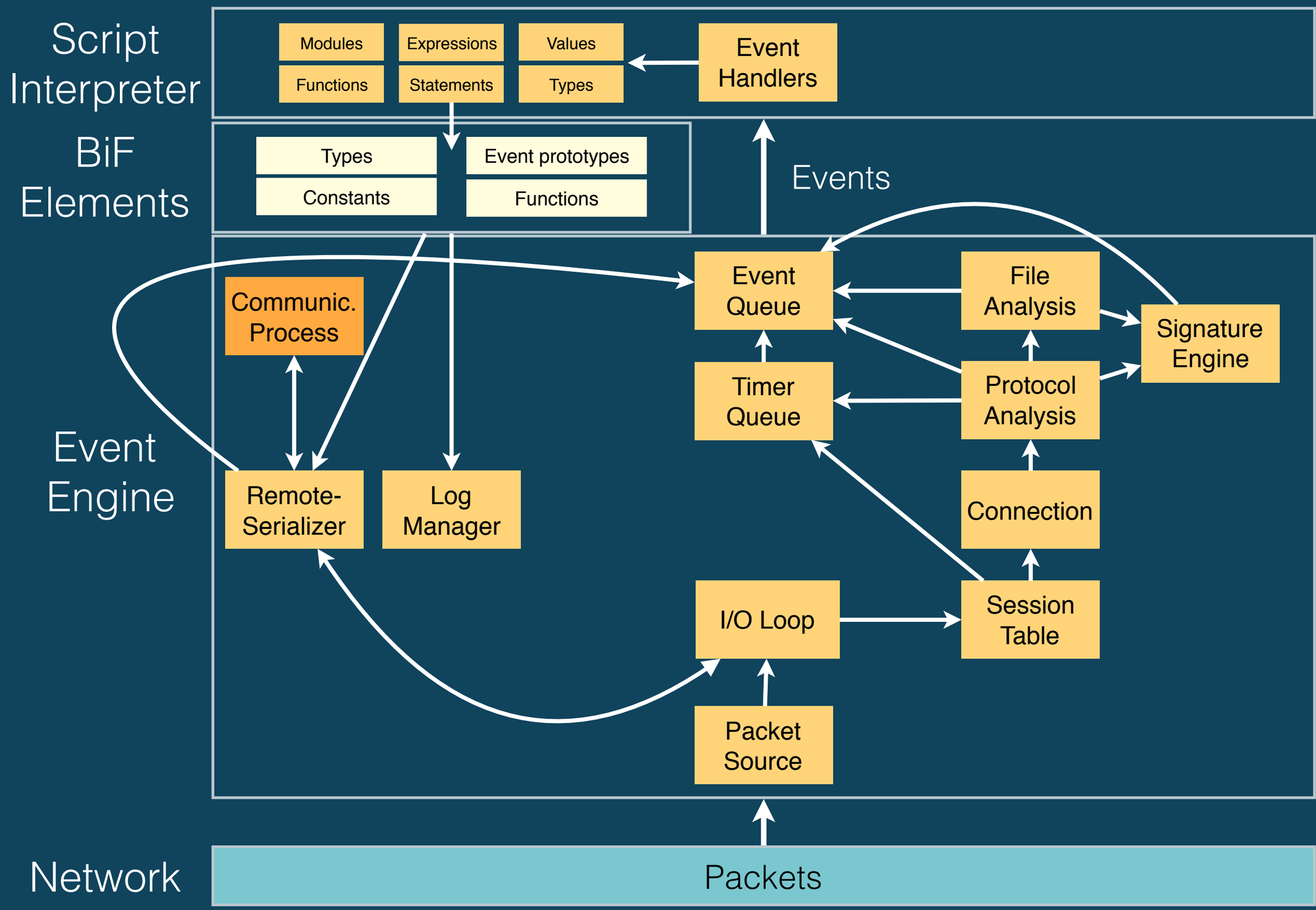

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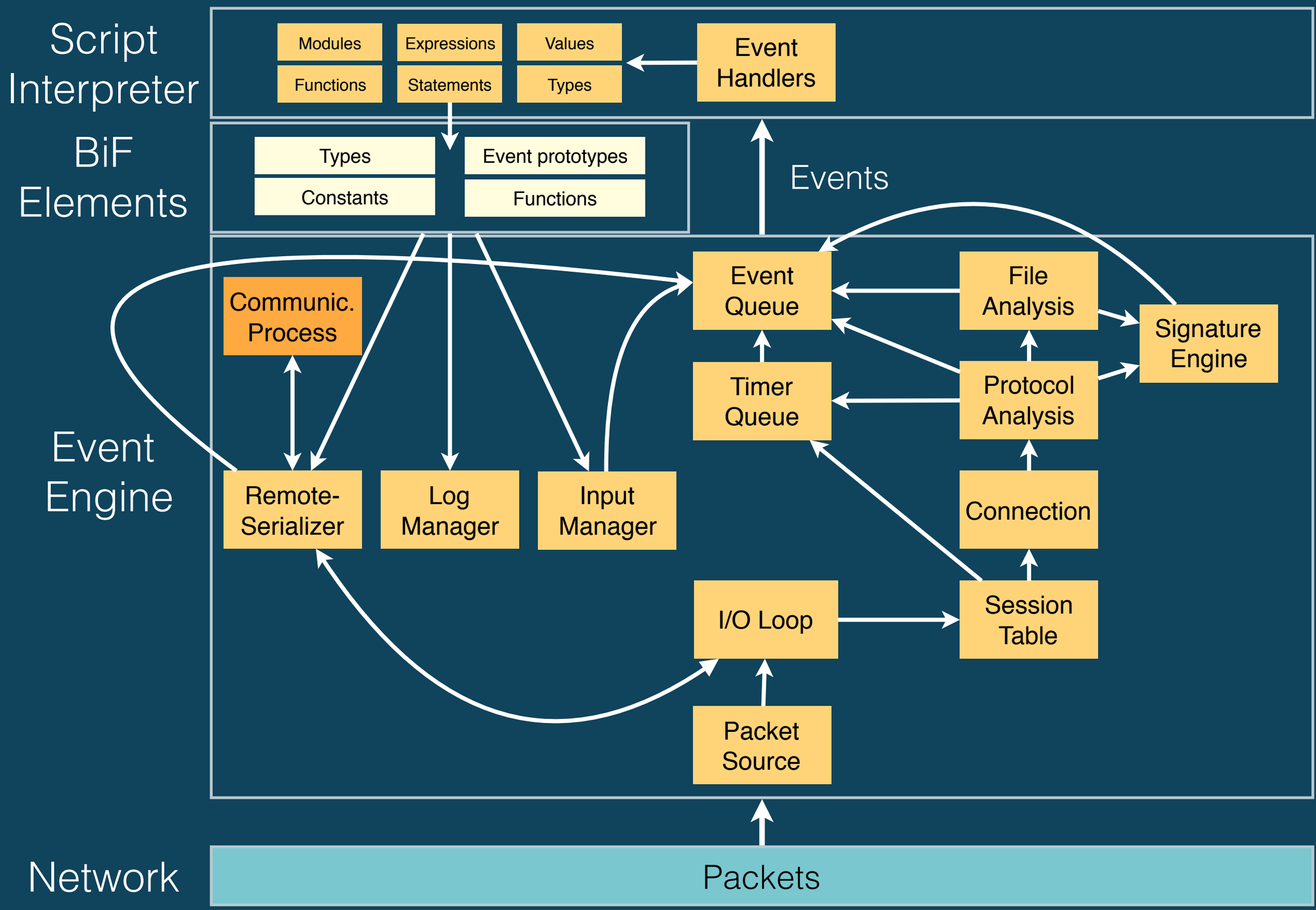

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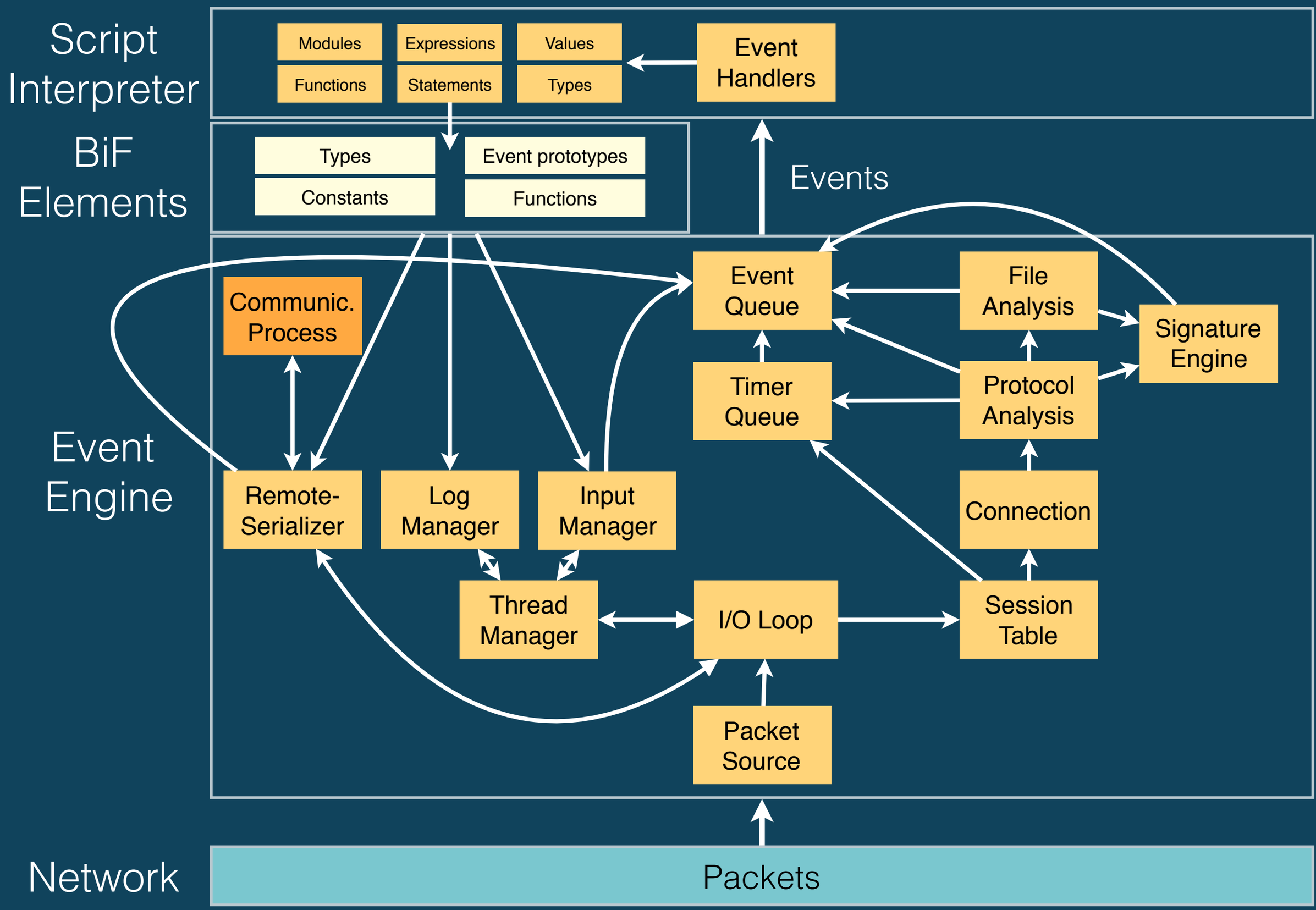

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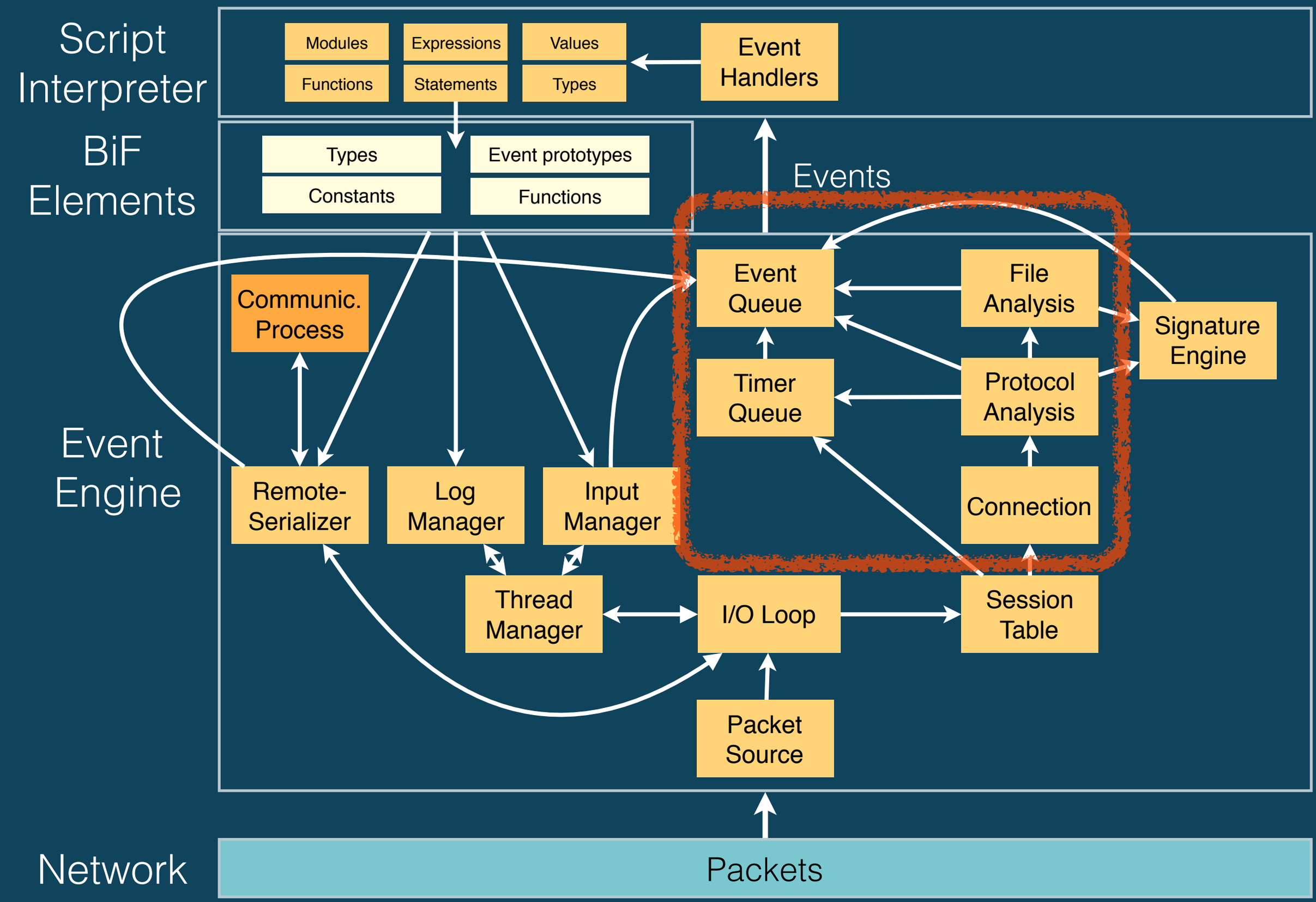
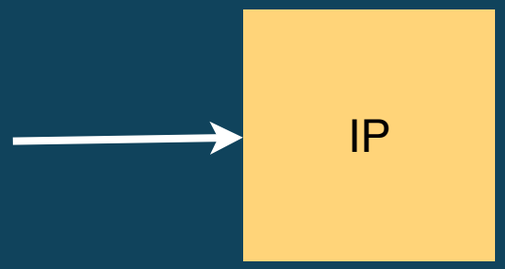


Protocol & File Analysis

Example: SSL Session



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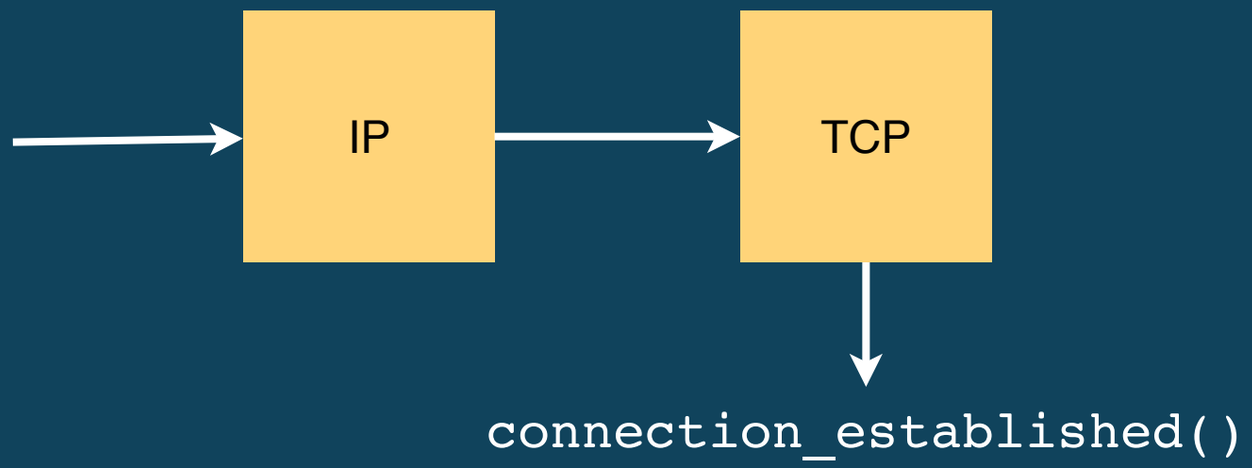

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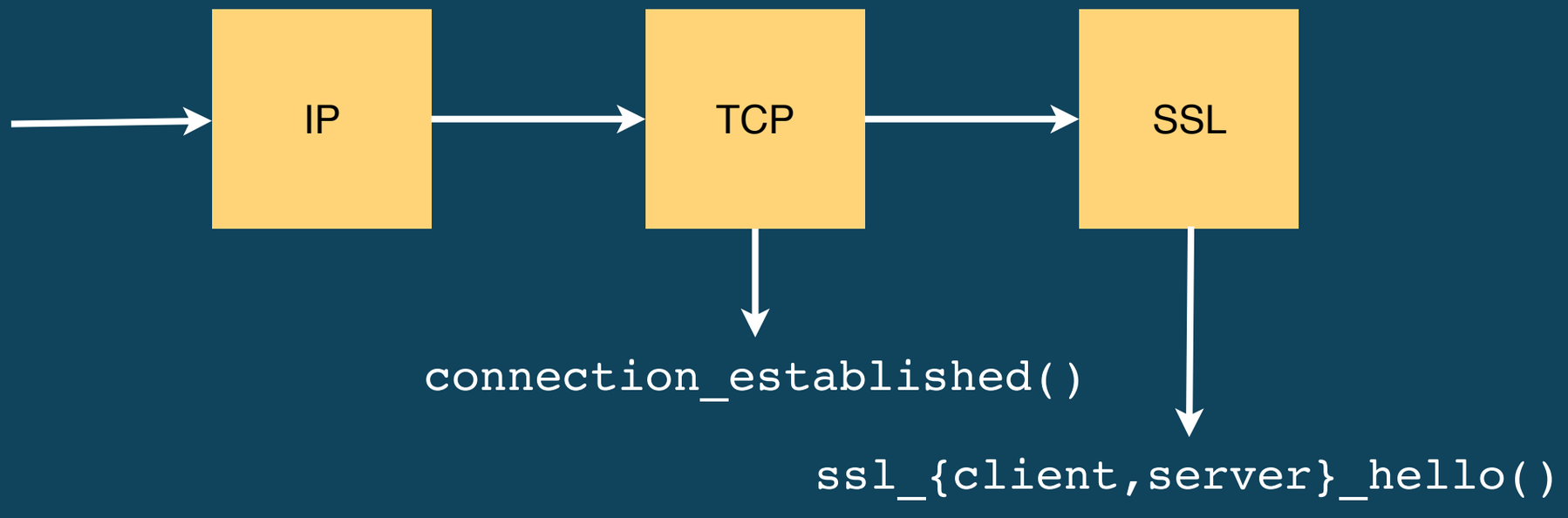

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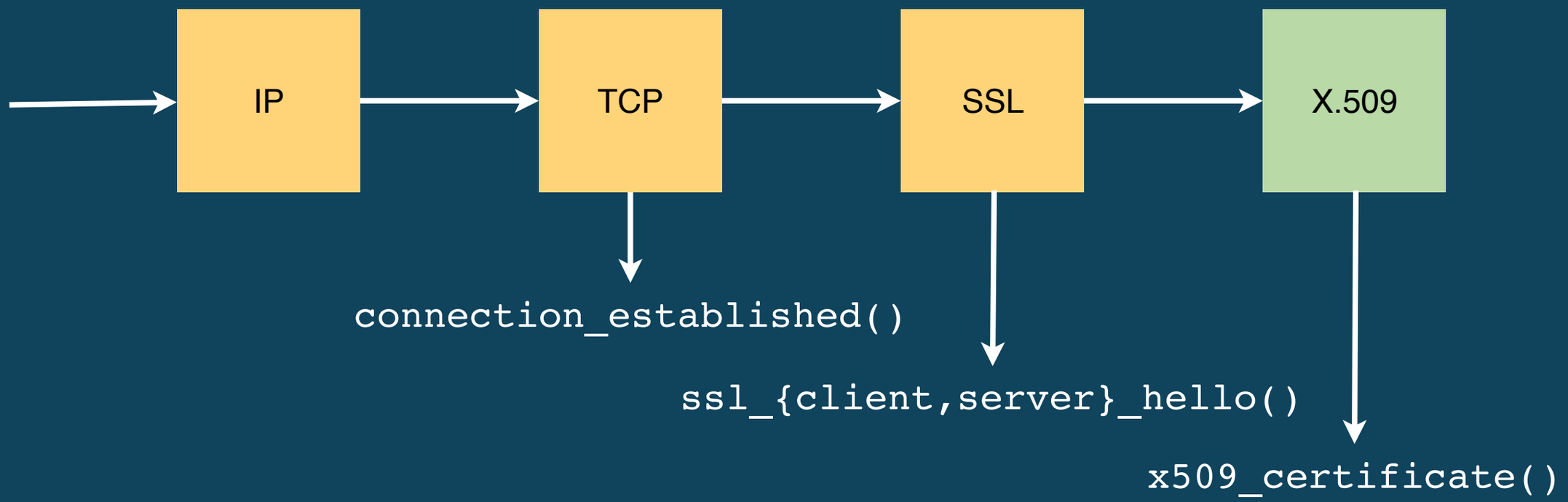

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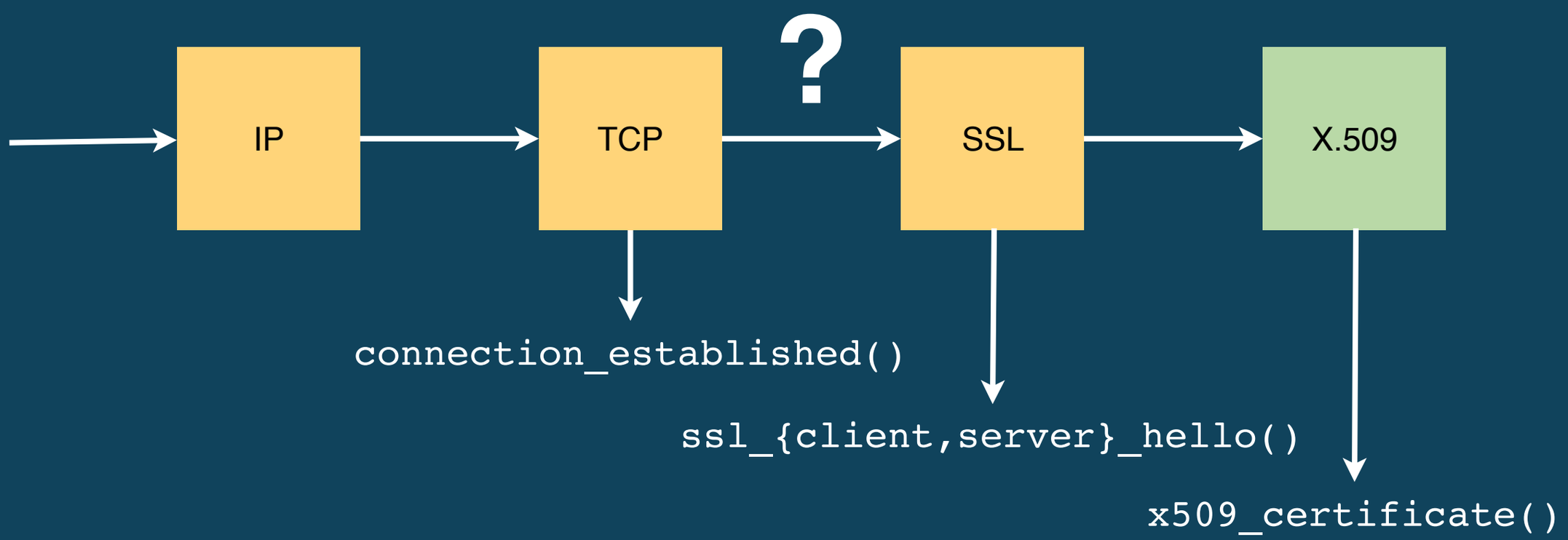
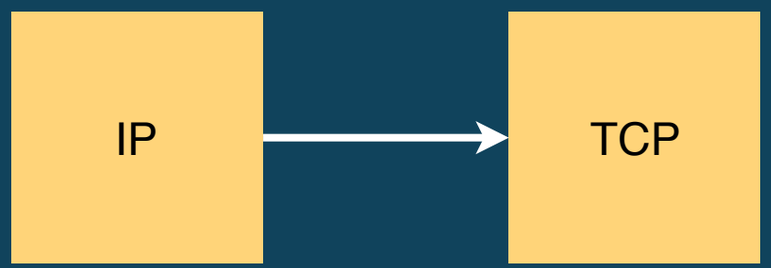


Dynamic Protocol Detection



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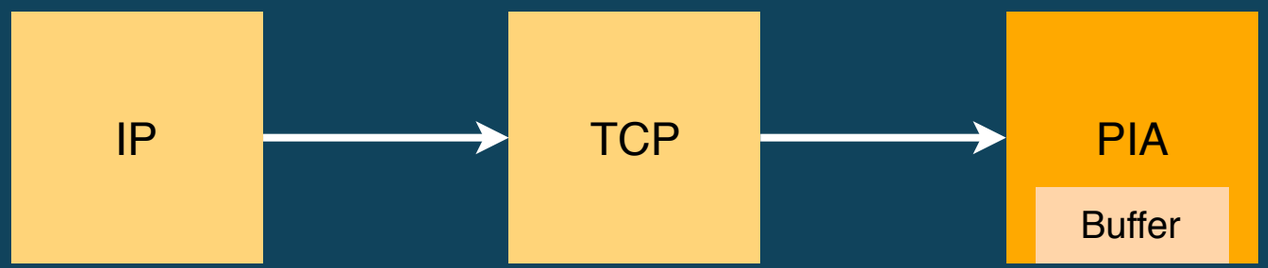
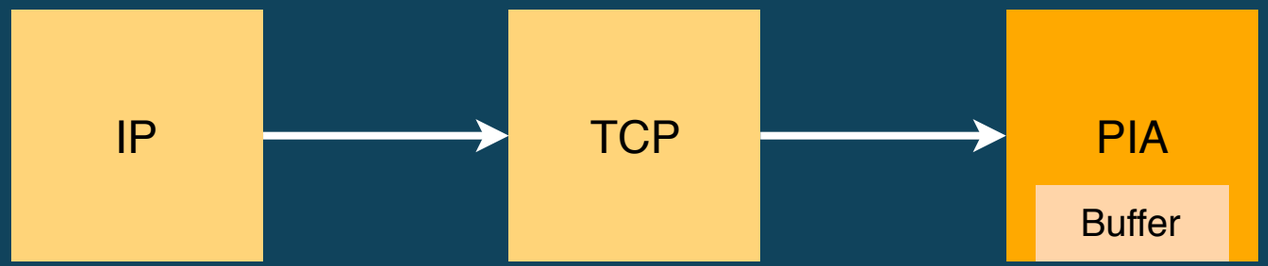


Dynamic Protocol Detection

```
Analyzer::register_for_port(Analyzer::SSL, 443/tcp);
```



Dynamic Protocol Detection

```
signature dpd_ssl_server {
  ip-proto == tcp
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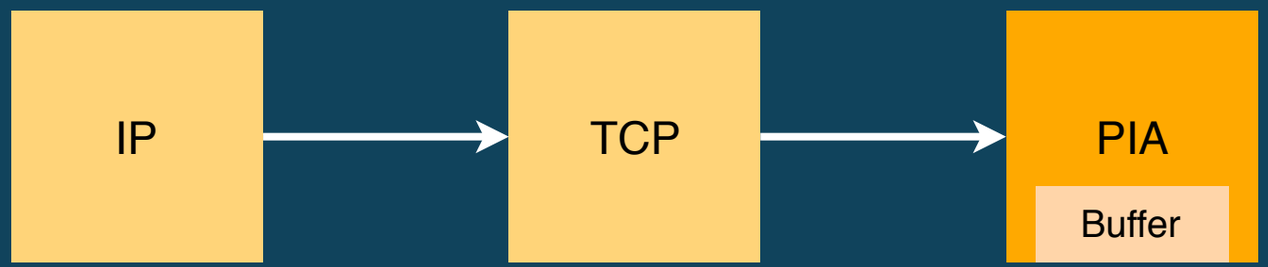

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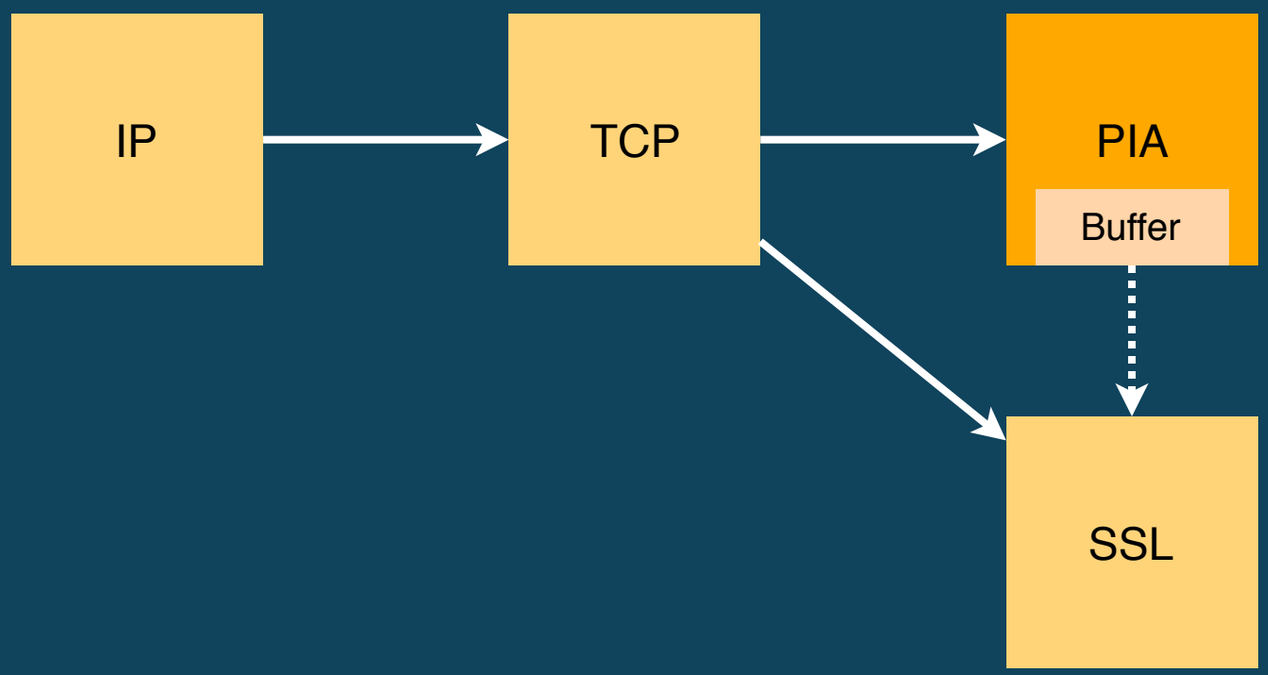

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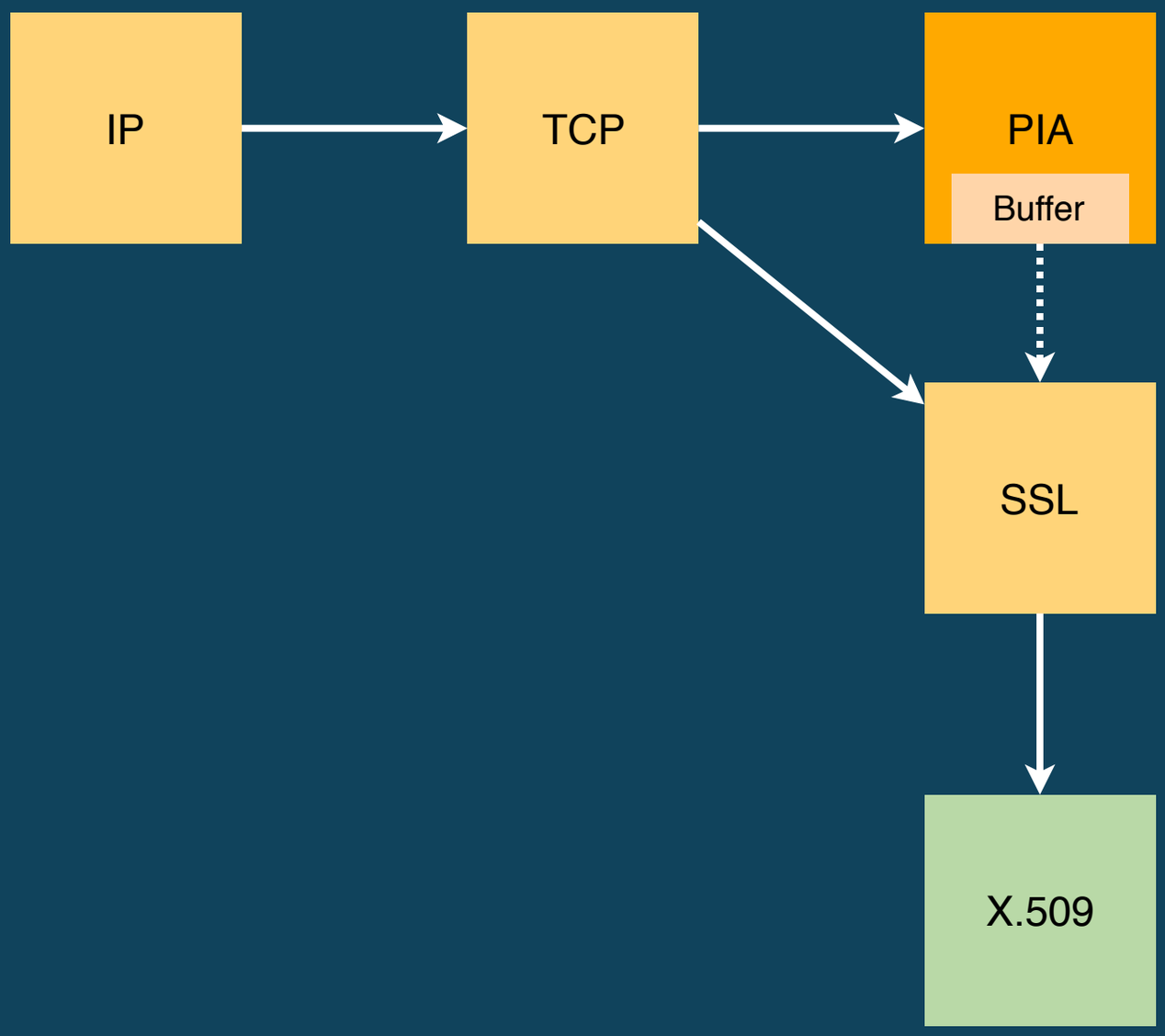

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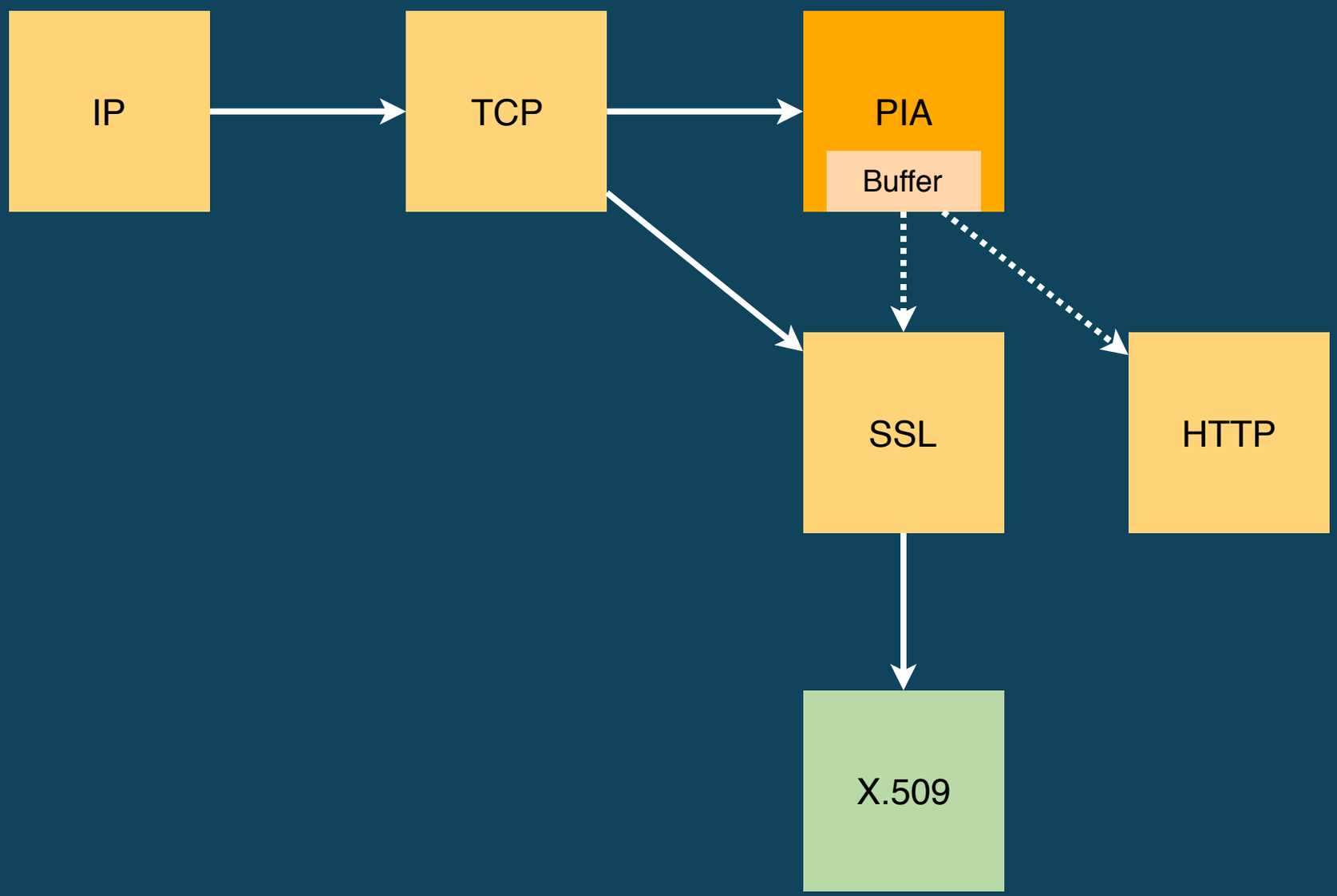

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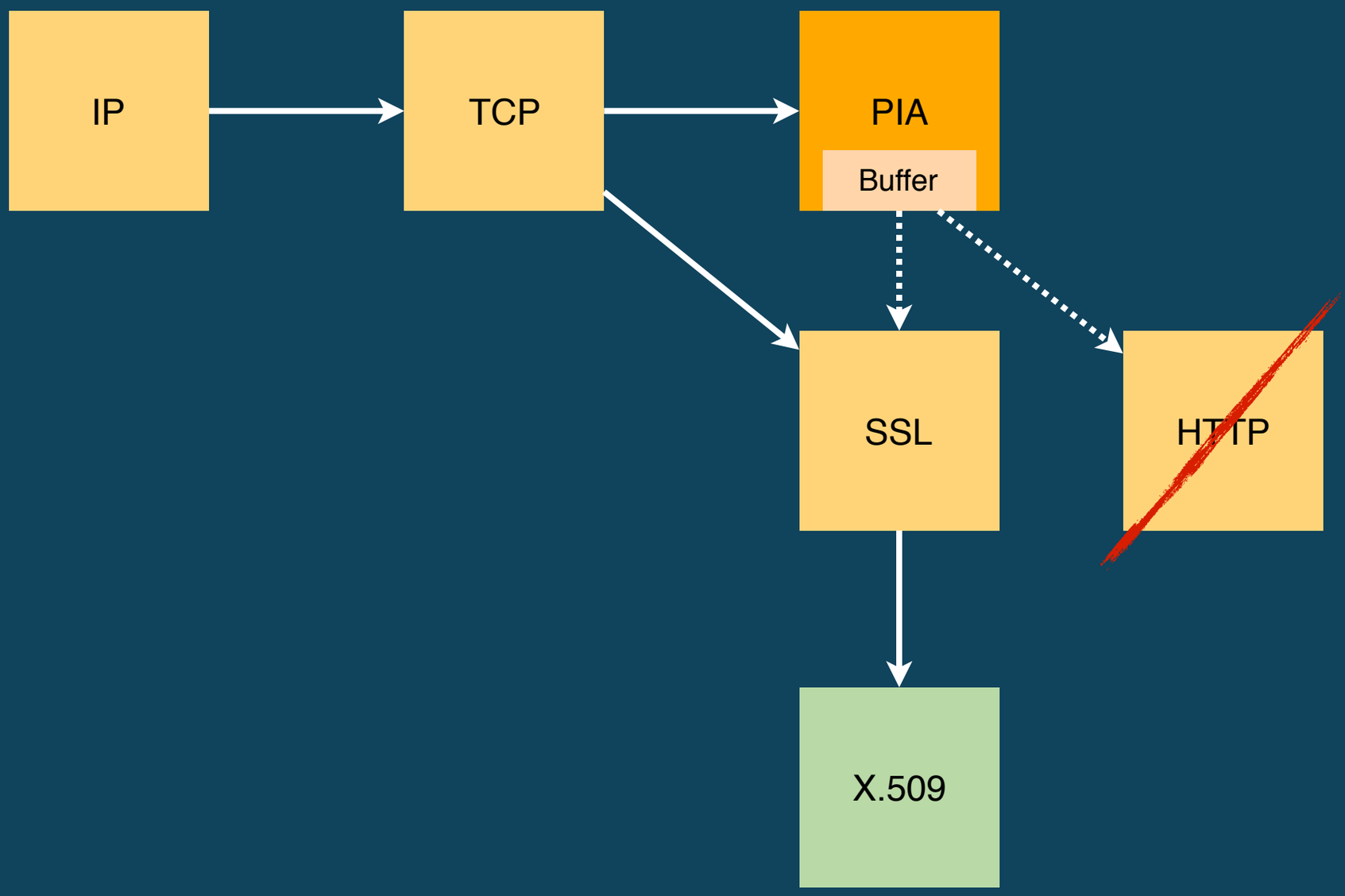


Protocol Analyzer API

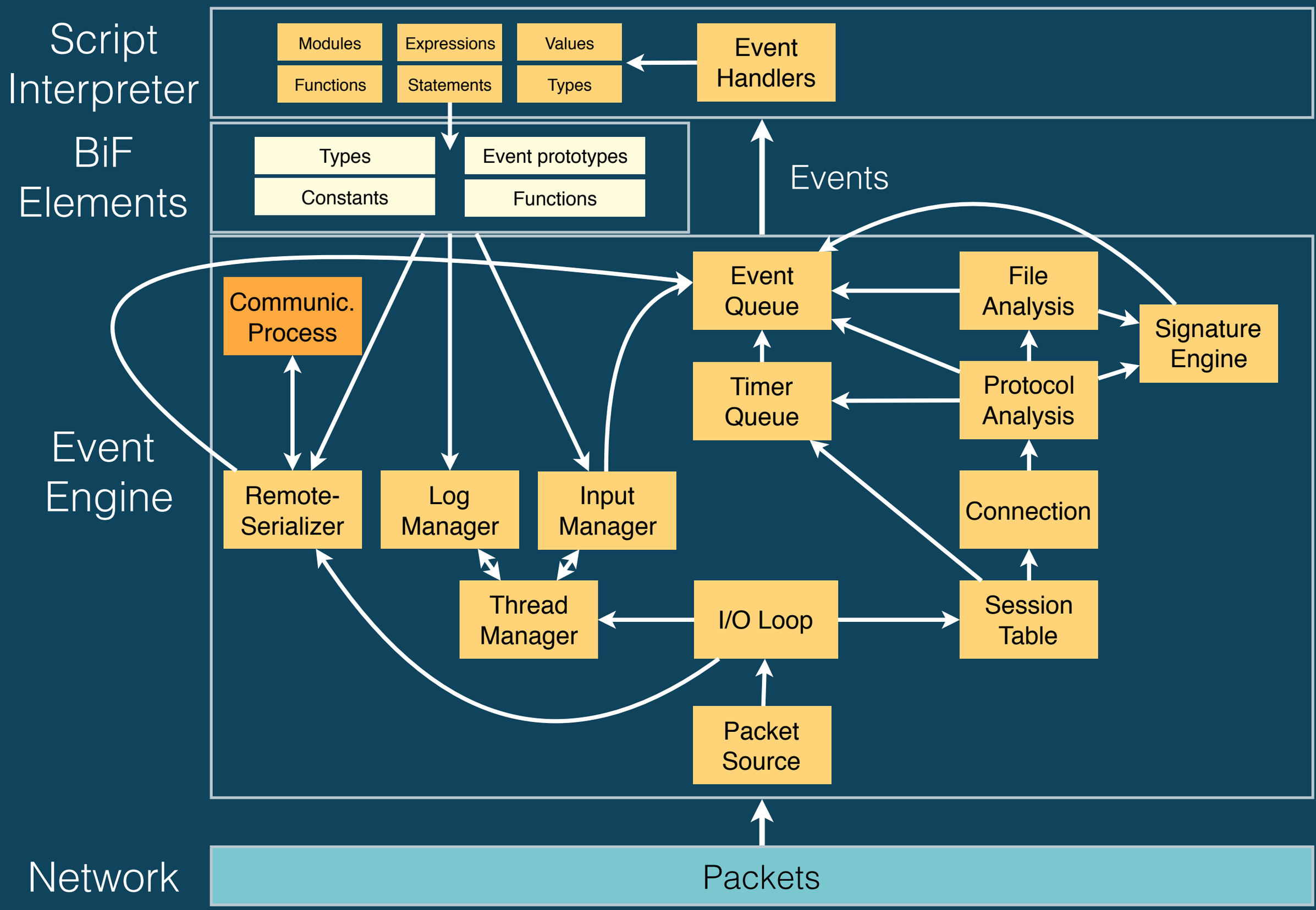
```
class Analyzer {
 virtual void Init();
 virtual void Done();
 virtual void DeliverPacket(int len, const u_char* data, bool orig,
                            bool orig, uint64 seq, const IP_Hdr* ip,
                            int caplen);
 virtual void DeliverStream(int len, const u_char* data, bool orig);
 virtual void Undelivered(uint64 seq, int len, bool orig);
 virtual void EndOfData(bool is_orig);
 virtual void FlipRoles();
 }
```

```
class TCP_ApplicationAnalyzer : public Analyzer {
 virtual void EndpointEOF(bool is_orig);
 virtual void ConnectionFinished(int half_finished);
 virtual void ConnectionReset();
 };
```

File Analyzer API

```
class Analyzer {
  virtual void Init();
  virtual void Done();
  virtual bool DeliverChunk(const u_char* data,
                            uint64 len, uint64 offset);
virtual bool DeliverStream(const u_char* data, uint64 len);
virtual bool EndOfFile();
virtual bool Undelivered(uint64 offset, uint64 len);
};
```

Bro Architecture



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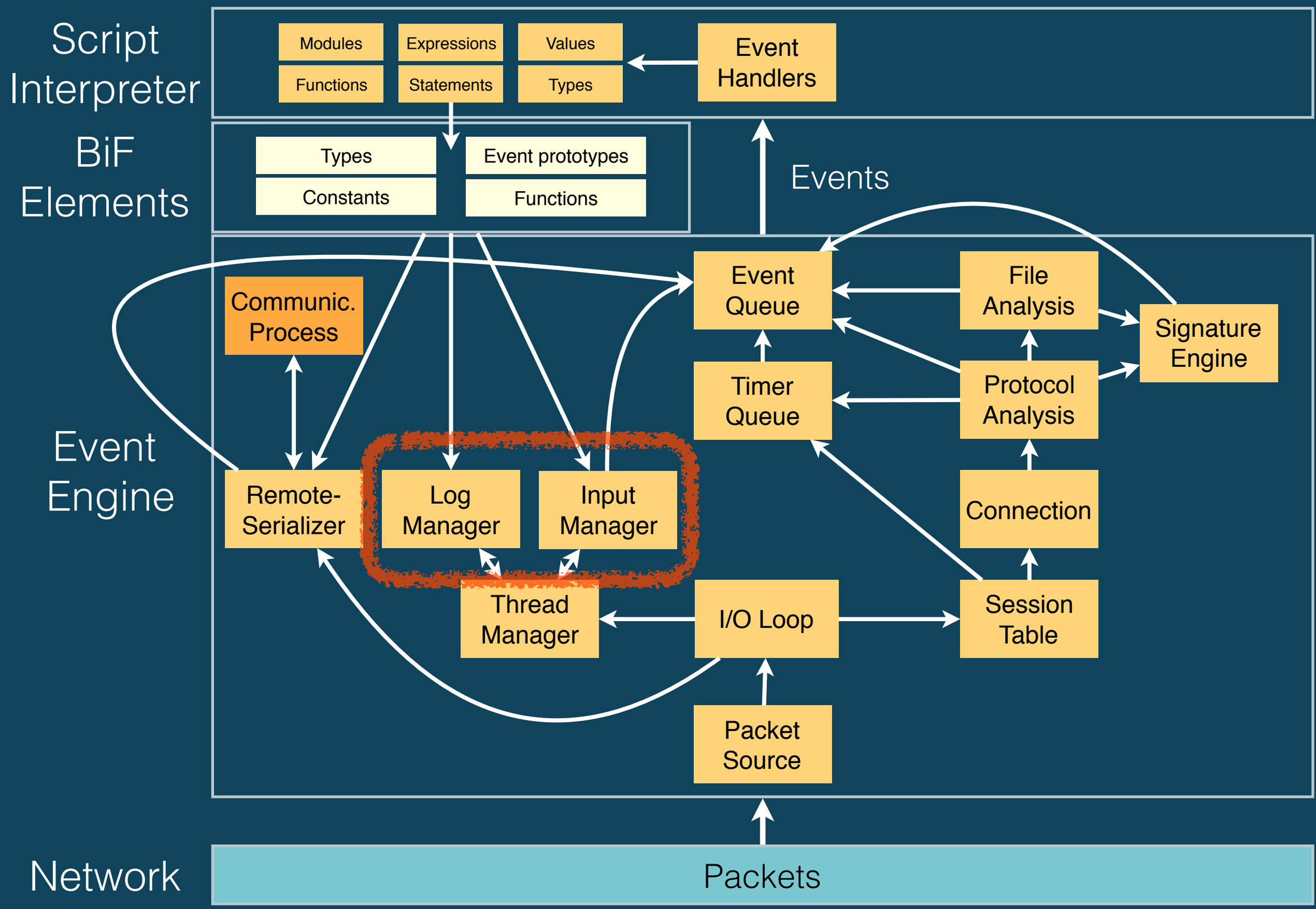

Writers & Readers

Log Writers

ASCII

SQLite

Input Readers

ASCII

Binary

Raw file

SQLite

Log Writer API

```
class WriterBackend {
 virtual bool DoInit(const WriterInfo& info, int num_fields,
 virtual bool DoWrite(int num_fields, const Field* const* fields,
                      threading::Value** vals);
 virtual bool DoSetBuf(bool enabled);
 virtual bool DoFlush(double network_time);
 virtual bool DoRotate(const char* rotated_path, double open,
                       double close, bool terminating);
 virtual bool DoFinish(double network_time);
 virtual bool DoHeartbeat(double network_time, double current_time);
 };
```

Each writer runs in its own thread.

Input Reader API

```
class ReaderBackend {
 virtual bool DoInit(const ReaderInfo& info, int arg_num_fields,
                     const threading::Field* const* fields);
 virtual void DoClose();
 virtual bool DoUpdate();
 virtual bool DoHeartbeat(double network_time, double current_time);

 // Simple mode.
void SendEvent(const char* name, const int num_vals,
               threading::Value* *vals);
void Put(threading::Value** val);
void Delete(threading::Value** val);
void Clear();
void EndOfData();

// Tracking mode.
void SendEntry(threading::Value** vals);
void EndCurrentSend();
};
```

Each reader runs in its own thread.

Bro Plugins

Build & install Bro components independently

Distribute as a Bro package

Log writers
Input readers
Protocol analyzers

File analyzers
Packet Sources
BiF elements

Bro Scripts

BYOP

```
# ~/bro/aux/bro-aux/plugin-support/init-plugin icsi-plugin ICSI BroMagic
Installing icsi-plugin/CHANGES ...
Installing icsi-plugin/CMakeLists.txt ...
Installing icsi-plugin/configure ...
Installing icsi-plugin/configure.plugin ...
Installing icsi-plugin/scripts/__load__.bro ...
Installing icsi-plugin/scripts/ICSI/BroMagic/__load__.bro ...
Installing icsi-plugin/scripts/init.bro ...
Installing icsi-plugin/src/bromagic.bif ...
Installing icsi-plugin/src/Plugin.h ...
Installing icsi-plugin/src/Plugin.cc …
[…]
# cd icsi-plugin/
# ./configure --brodist=$HOME/bro/master
Build Directory         : build
Bro Source Directory    : /home/robin/bro/master
[…]
# make && make install
[…]
# bro -N
ICSI::BroMagic - <Insert description> (dynamic, version 0.1)
Bro::ARP - ARP Parsing (built-in)
Bro::AsciiReader - ASCII input reader (built-in)
Bro::AsciiWriter - ASCII log writer (built-in)
Bro::AYIYA - AYIYA Analyzer (built-in)
[…]
```

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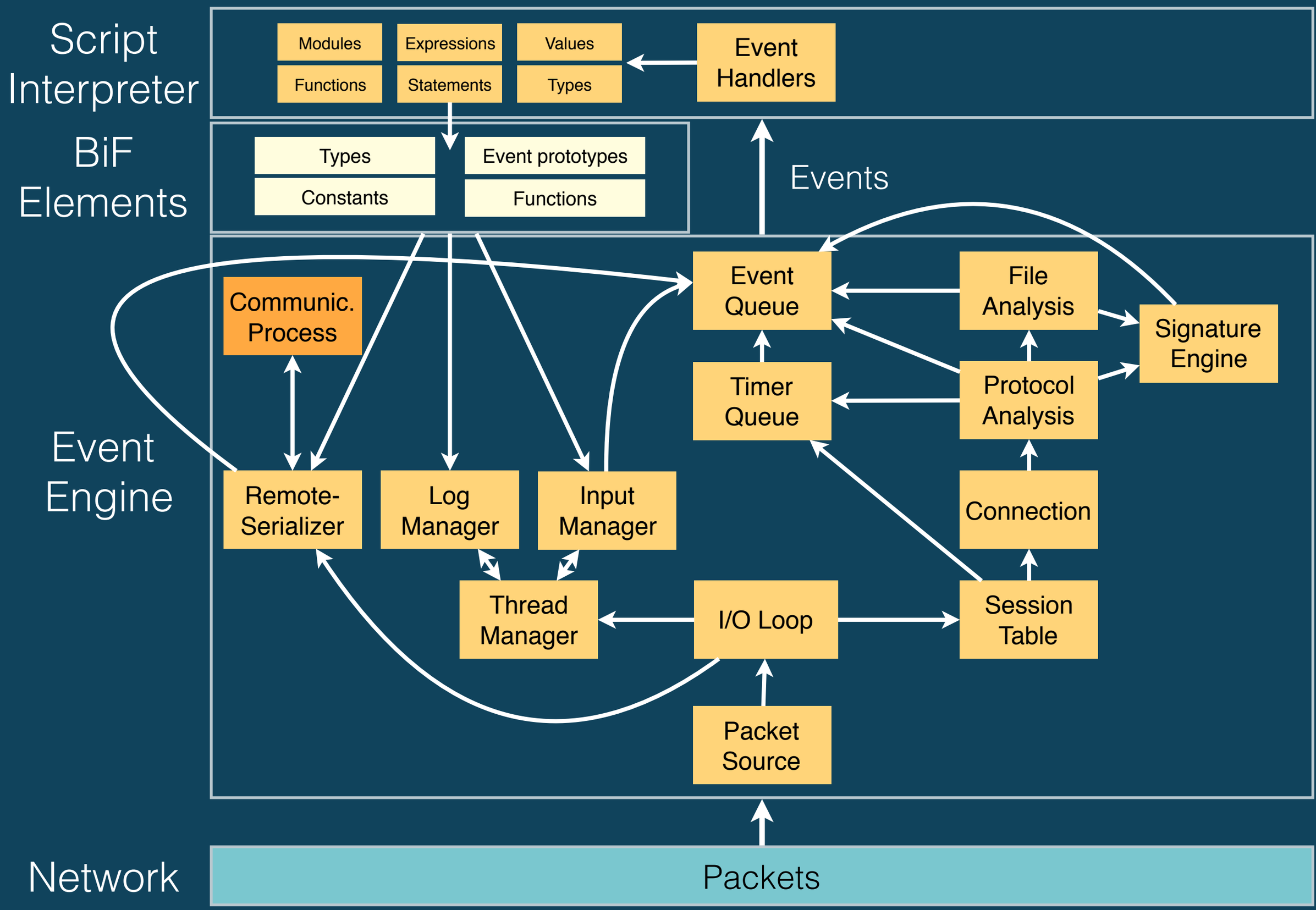

Script Interpreter

Events

Event Engine

Questions?

Network

Packets