Next-gen Market Access:
ULL tick-to-trade made easier with Enyx

STAC New York | October 2018

Enyx | A Global Offering

Full Hardware Feed Handler

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Full Hardware Feed Handler

Bandwidth Management

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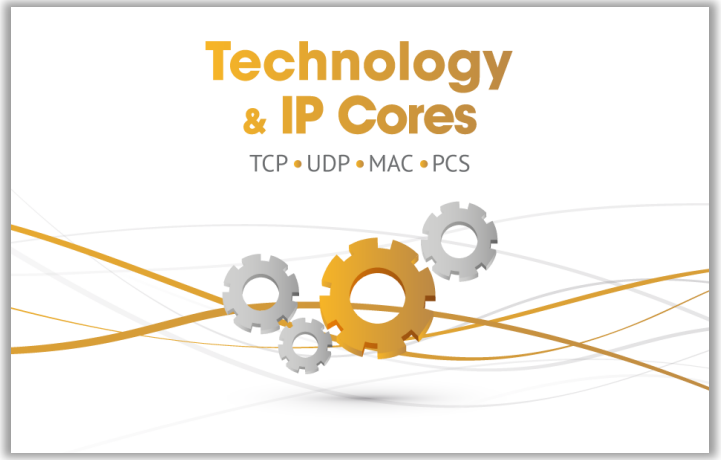
Full Hardware Feed Handler

Bandwidth Management

Development Framework



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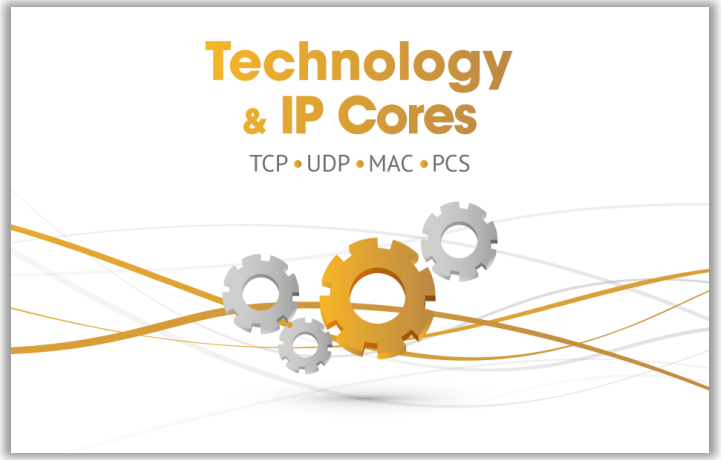
Full Hardware Feed Handler

Bandwidth Management

Development Framework



Low Latency Market Access

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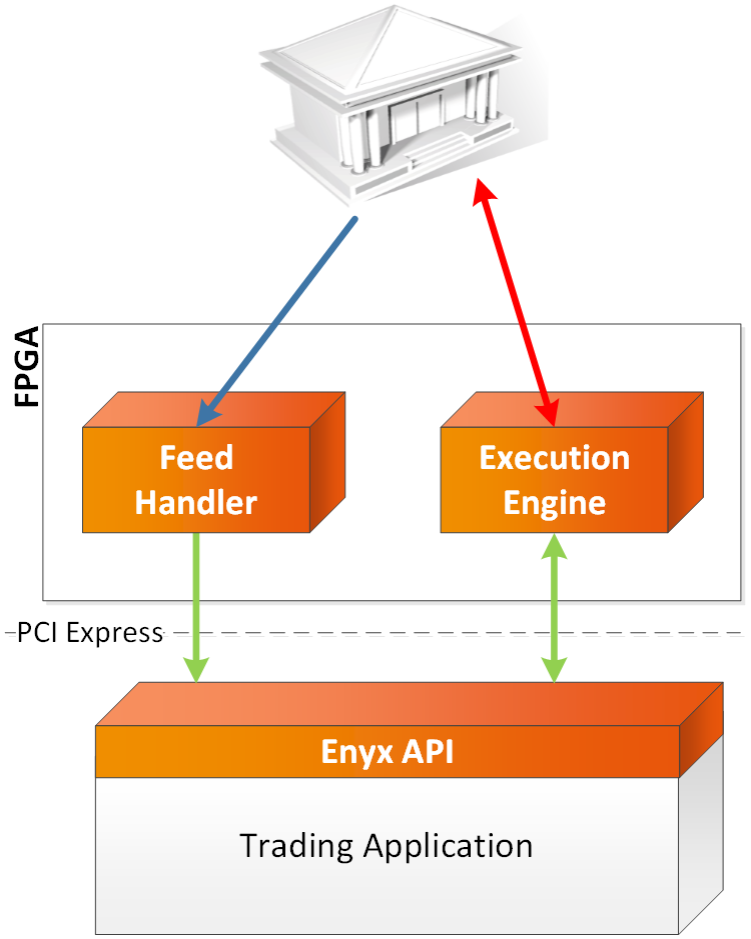
nxAccess | A Full Hardware Tick-to-Trade



Advantages

- **Full hardware Feed Handler** and **Execution Engine**
- **C++ API** to interface with your software application
- Supports **every market data message** and **every type of order**

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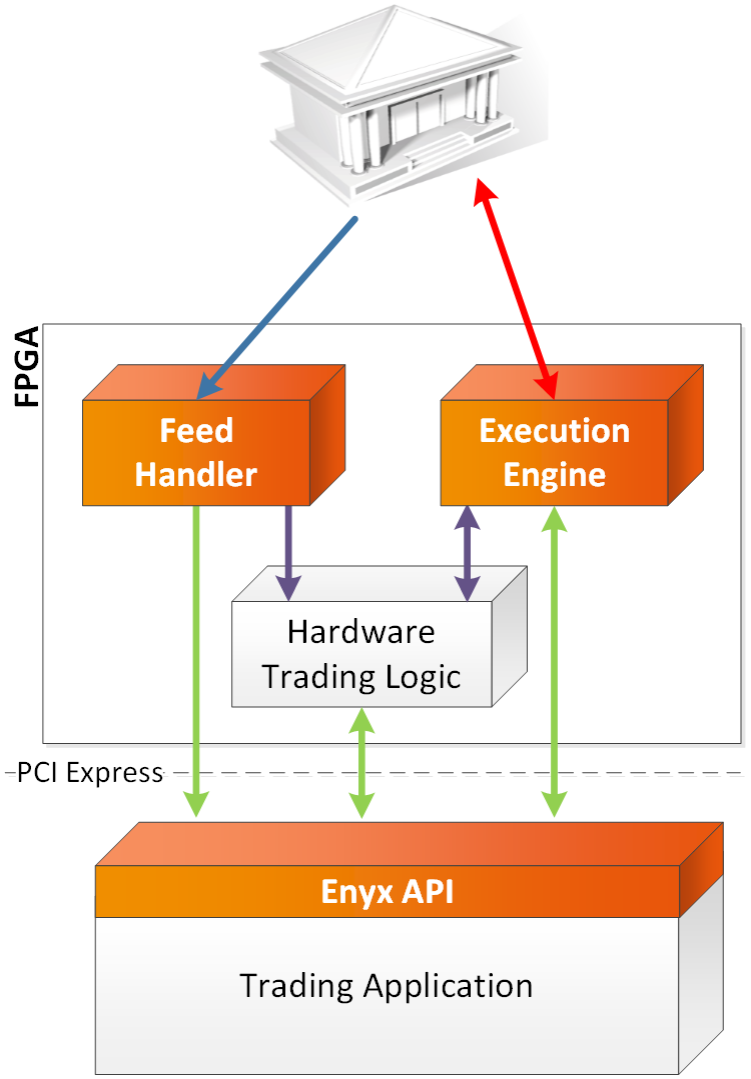
nxAccess | A Full Hardware Tick-to-Trade



Advantages

- **Full hardware Feed Handler** and **Execution engine**
- **C++ API** to interface with your software application
- Supports **every market data message** and **every type of order**
- **Autonomous development of your hardware logic** using our Hardware Development Framework
- Compatible with our **50+ venues** coverage

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nxAccess | How To Deploy It?

- Integration with your trading infrastructure using our C++ software API
- Development of your hardware logic with our Hardware Framework:
  - Using **VHDL** or **Verilog**
  - Using **HLS** and the **Vivado HLS** framework

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nxAccess | HLS Code Example

Trading Decision on Trade Summary:

```
Void handle_trade_summary(nxbus_word_t & nxbus_word){
  if (is_instr_subscribed(nxbus_word)){
      nxbus_instr_id_t const instr_id = get_instr_id(nxbus_word);
      nxbus_price_t const trade_price = get_price(nxbus_word);

      switch (agressor_side(nxbus_word)){
          case BUY_SIDE:
              if (trade_price < order_book_bid_[instr_id][0].price){
                  price_collar_scenario(instr_id, trade_price, TRUE);
              }
          case SELL_SIDE:
              if (trade_price > order_book_ask_[instr_id][0].price){
                  price_collar_scenario(instr_id, trade_price, FALSE);
              }
          case default:
              assert(!"Unexpected aggressor side");
      }
  }
}
```

Advantages

- High level efficient language using **C++** type syntax
- Sequential description but **parallel execution**
- Can be unit-tested in a software manner

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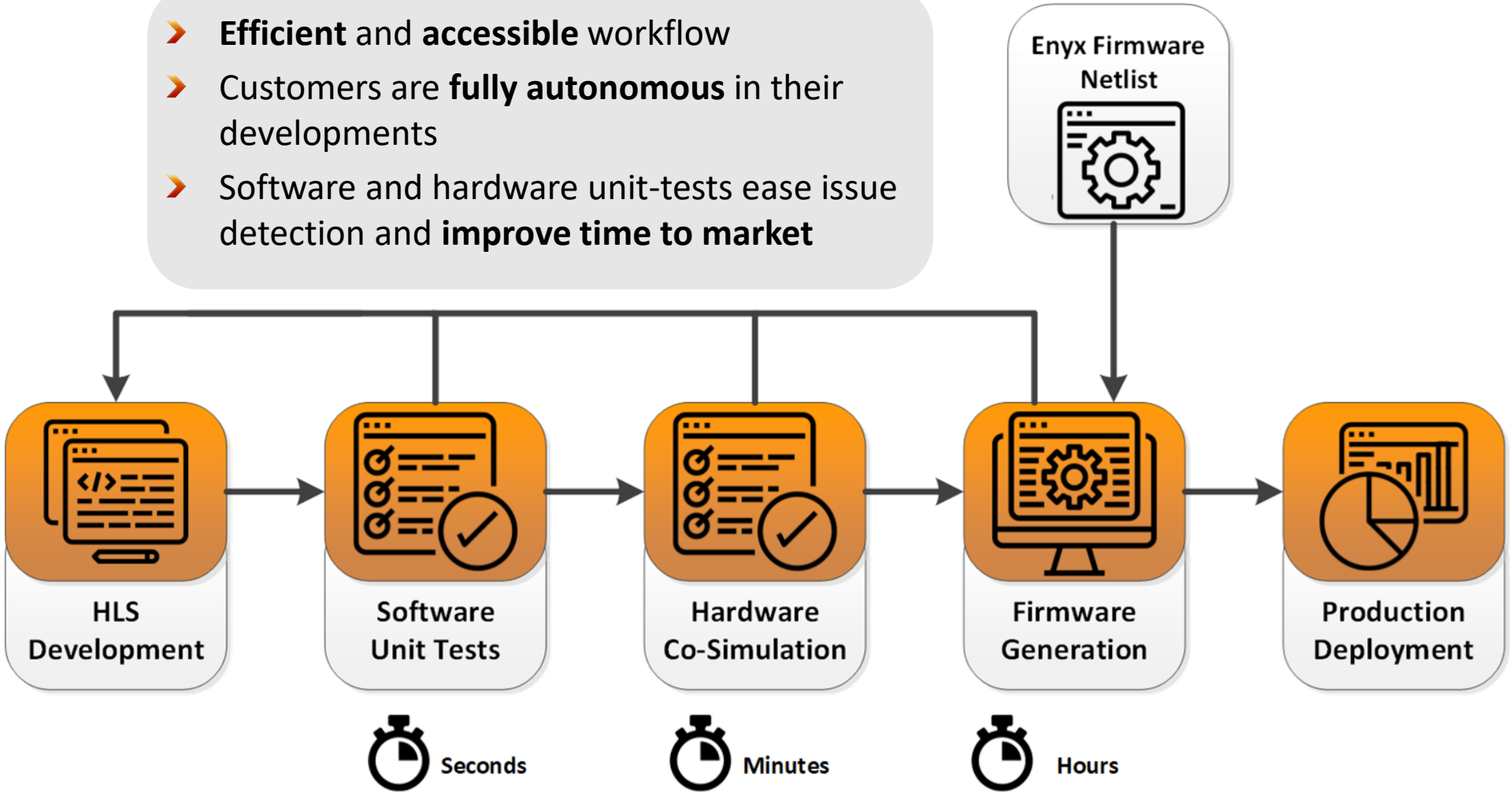
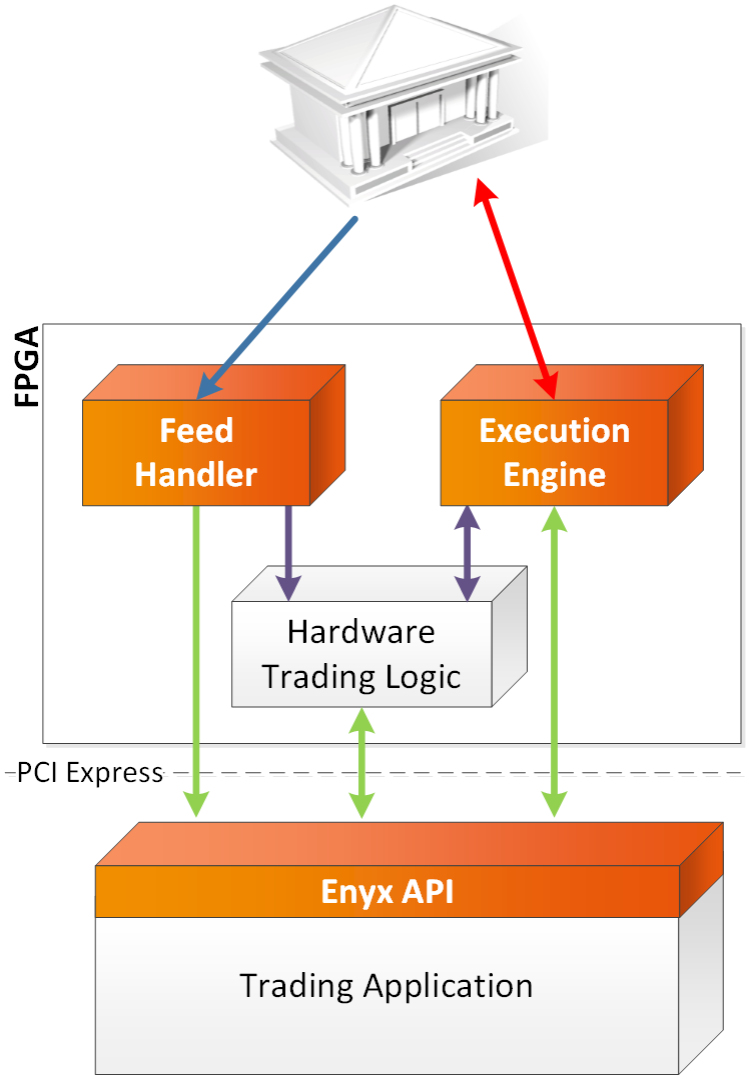
nxAccess | HLS Development Workflow

Advantages

- **Efficient** and **accessible** workflow
- Customers are **fully autonomous** in their developments
- Software and hardware unit-tests ease issue detection and **improve time to market**



nxAccess | A Full Hardware Tick-to-Trade



Summary

- Solution compatible with our **coverage of 50+ venues**
- **Full featured Feed Handler** and **Execution Engine** simplifying the development of your algorithm
- Open Hardware and Software API allows **autonomous development** and **preserves the customer's IP**

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Thank you

Tick the Enyx box to request more information and an evaluation

nxAccess | HLS Code Example

Market Data Update Management:

```
Void handle_nxbus_update(hls::stream<nxbus_word> & axi_ingress_nxbus) {
  #pragma HLS INLINE recursive
  #pragma HLS PIPELINE enable_flush

  if (! nxbus_update_in.empty()) {
      // valid data word on the ingress AXI stream bus
      nxbus_command_t const nxbus_command_in = axi_ingress_nxbus.read();

      switch (nxbus_command_in.opcode) {
          case NXBUS_OPCODE_BOOK_UPDATE:
          case NXBUS_OPCODE_BOOK_SNAPSHOT:
              handle_book_update(nxbus_command_in.data);
              break;

          case NXBUS_OPCODE_TRADE_SUMMARY:
          case NXBUS_OPCODE_TRADE_SUMMARY_BREAK:
          case NXBUS_OPCODE_TRADE_SUMMARY_CORRECTION:
              handle_trade_summary(nxbus_command_in.data);
              break;

          default:
              break;
```

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nxAccess | HLS Code Example

Book Update:

```
Void handle_book_update(nxbus_word_t & nxbus_word) {
  if (is_instr_subscribed(nxbus_word)) {
      Nxbus_instr_id_t const instr_id = get_instr_id(nxbus_word);
      order_book_index_t const index = get_book_index(nxbus_word);
      order_book_limit_t const limit = get_book_limit(nxbus_word);

      switch (nxbus_word.side){
          case BUY_SIDE:
              order_book_bid_[instr_id][index] = limit;

          case SELL_SIDE:
              order_book_ask_[instr_id][index] = limit;

          case default:
              assert(!"Unexpected side");
      }
   }
}
```

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nxAccess | HLS Code Example

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  if (is_instr_subscribed(nxbus_word)){
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              }
          case default:
              assert(!"Unexpected aggressor side");
      }
  }
}
```

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nxAccess | HLS Code Example

Trigger “Modify Order” with New Price:

```
Void price_collar_scenario(nxbus_instr_id_t & instr_id, nxbus_price_t
trade_price, bool is_bid){
  buffer_id_t const buffer_id = get_buffer_id(instr_id, is_bid);
  order_price_t const order_price;

  // Follow the price of the last trade
  order_price = get_buffer_id(trade_price)

  // Send a modify order with the new price
  trigger_order(buffer_id, order_price);
}
```

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