BERKELEY LAB

YARR SW
- An Introduction

not a lecture - 14.01.2025
ITk Pixel Module QC Workshop

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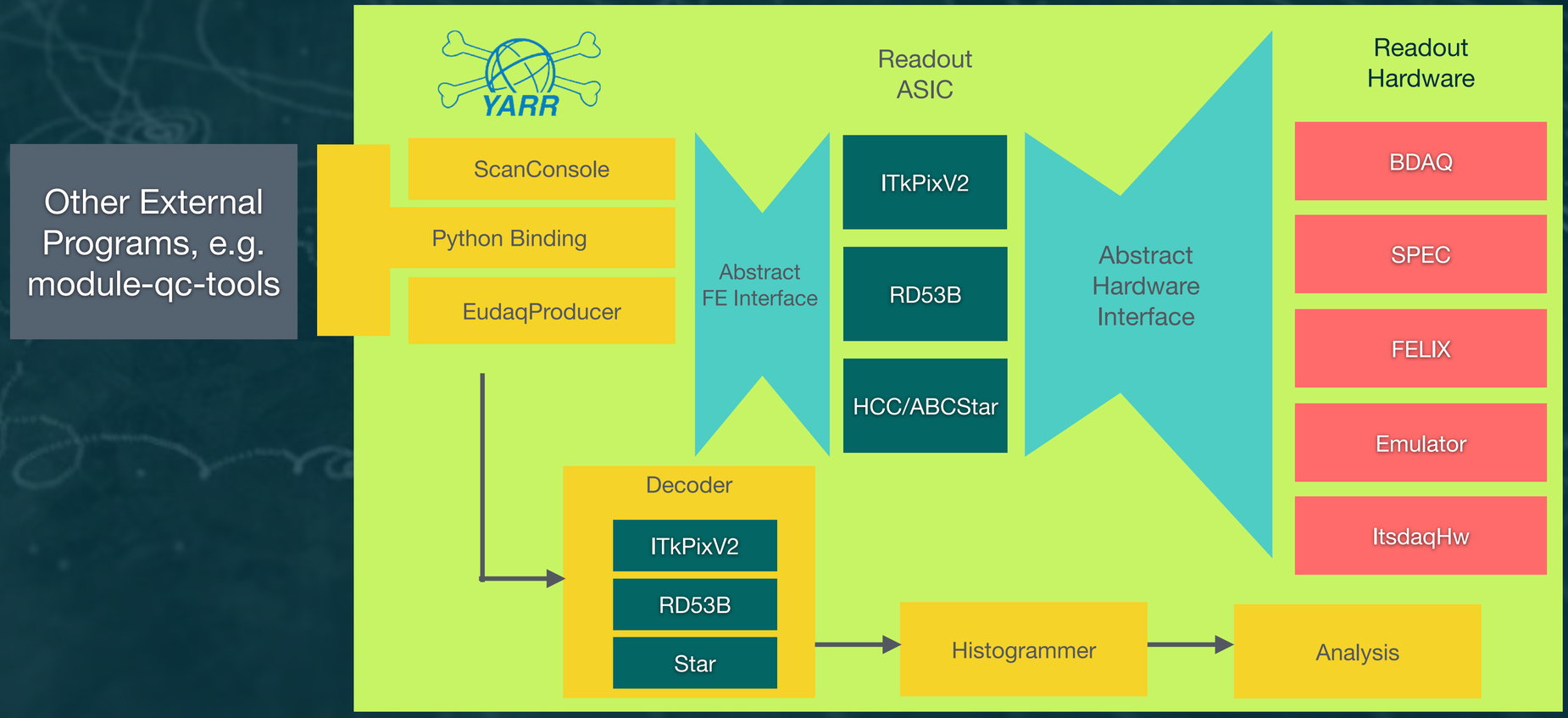
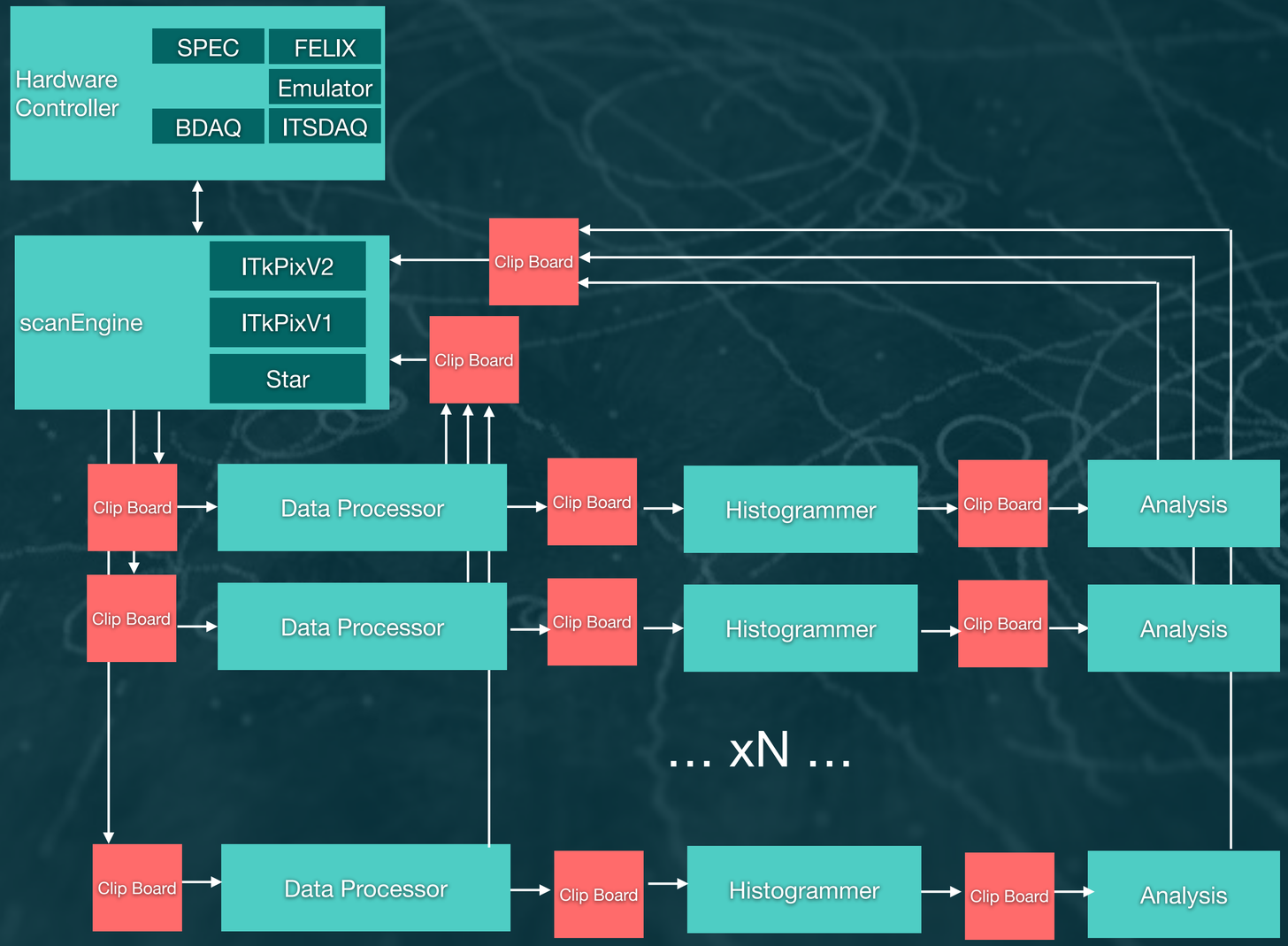
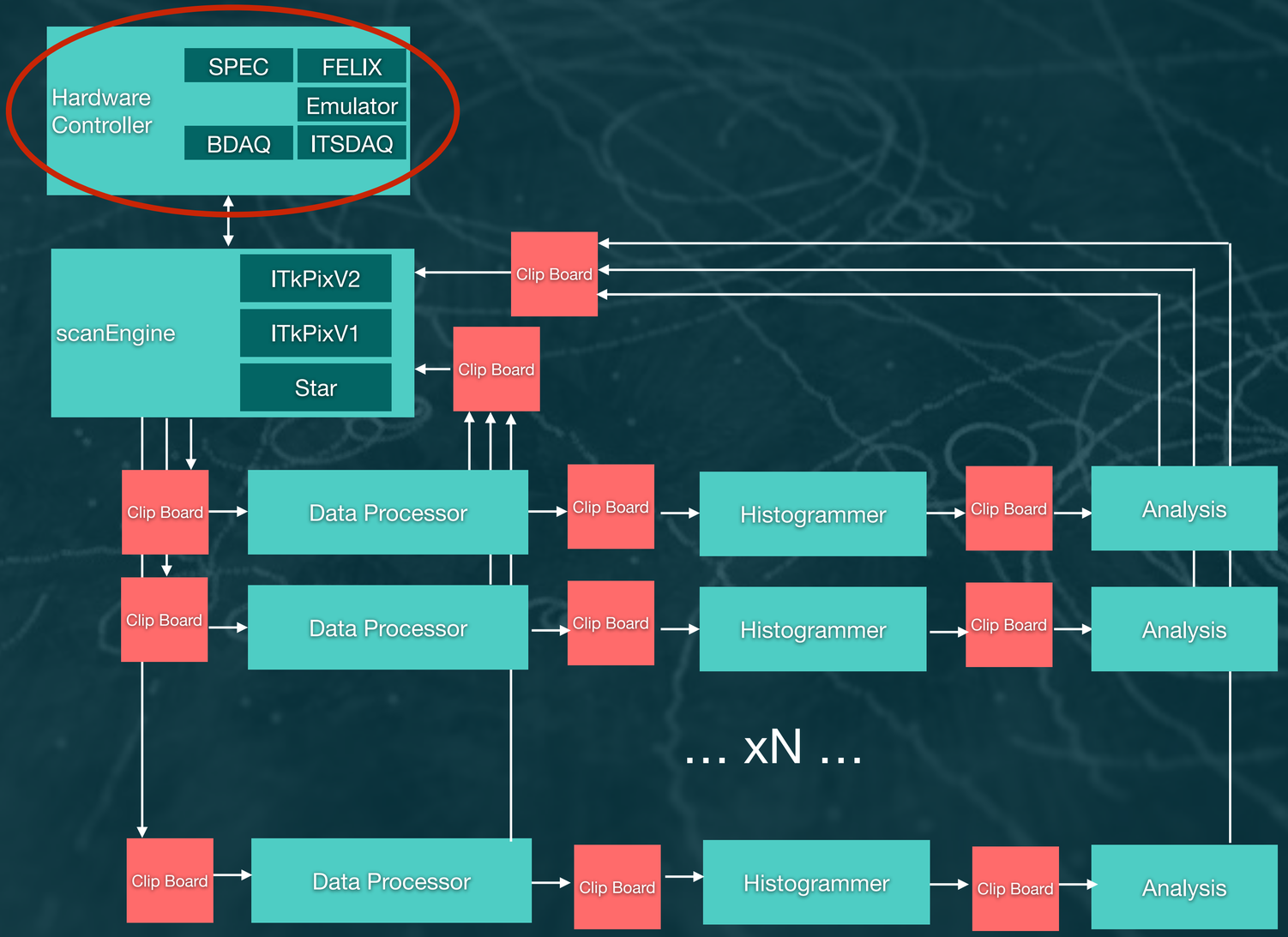
Conceptual Overview



Calibration Data Flow

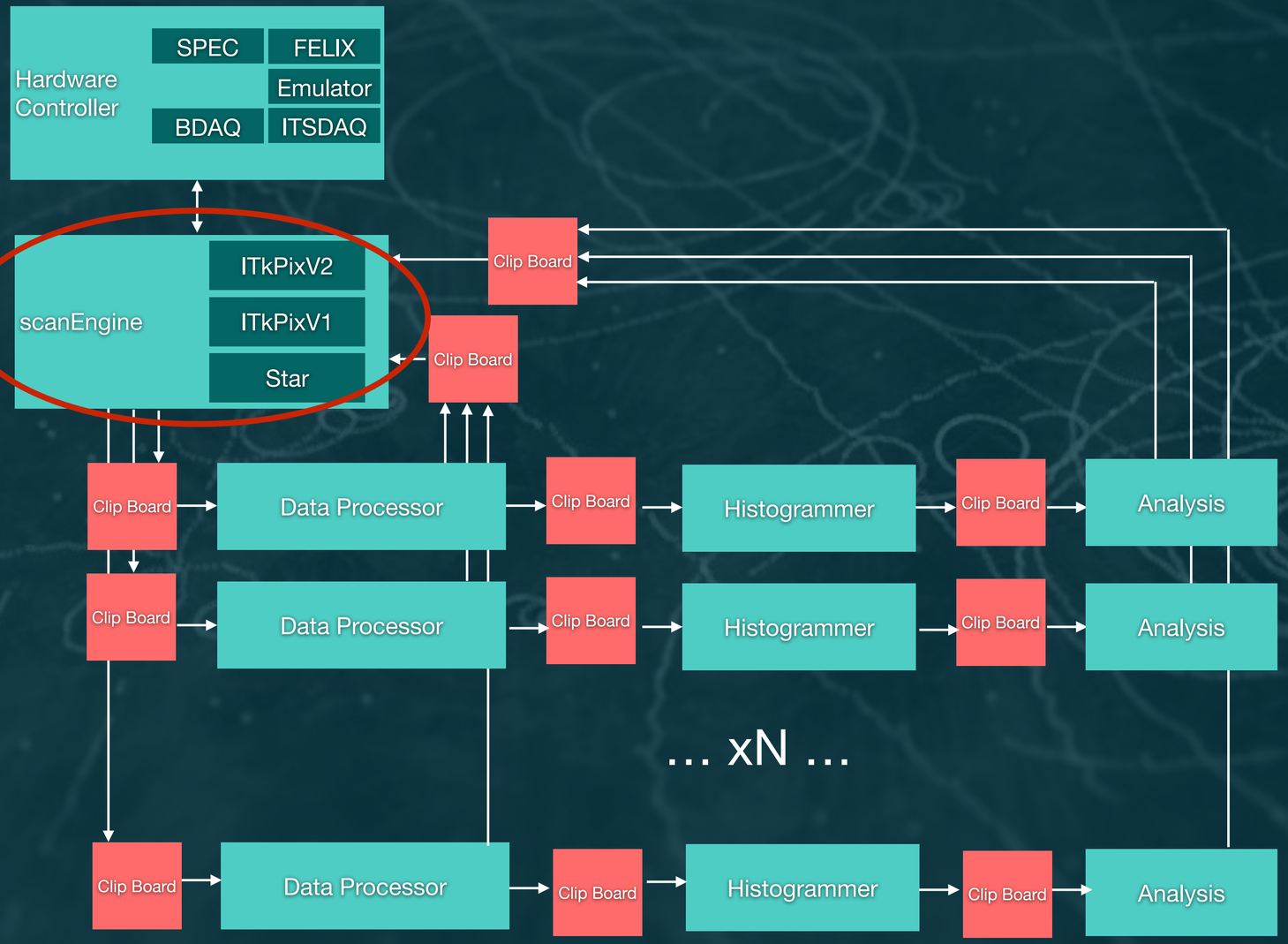


Hardware Controller

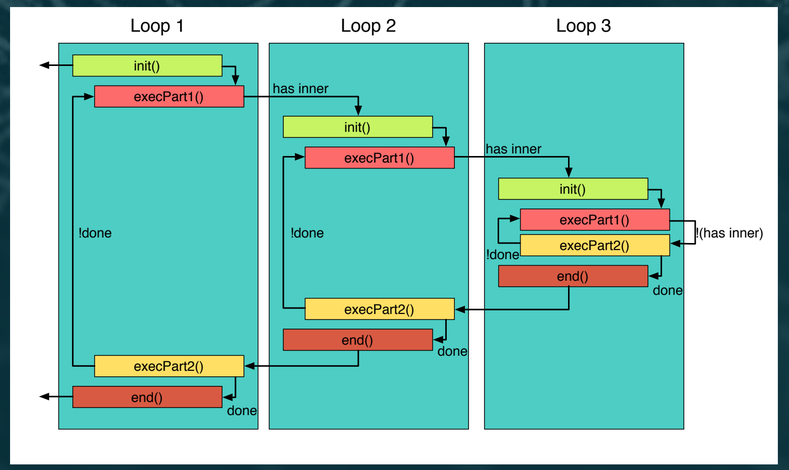


- Code to interface with specific hardware platform
- Translates some hardware specific features or lack of features to generic interface
- Front-end chip agnostic
- Primary purpose is to send CMDs and receive DATA

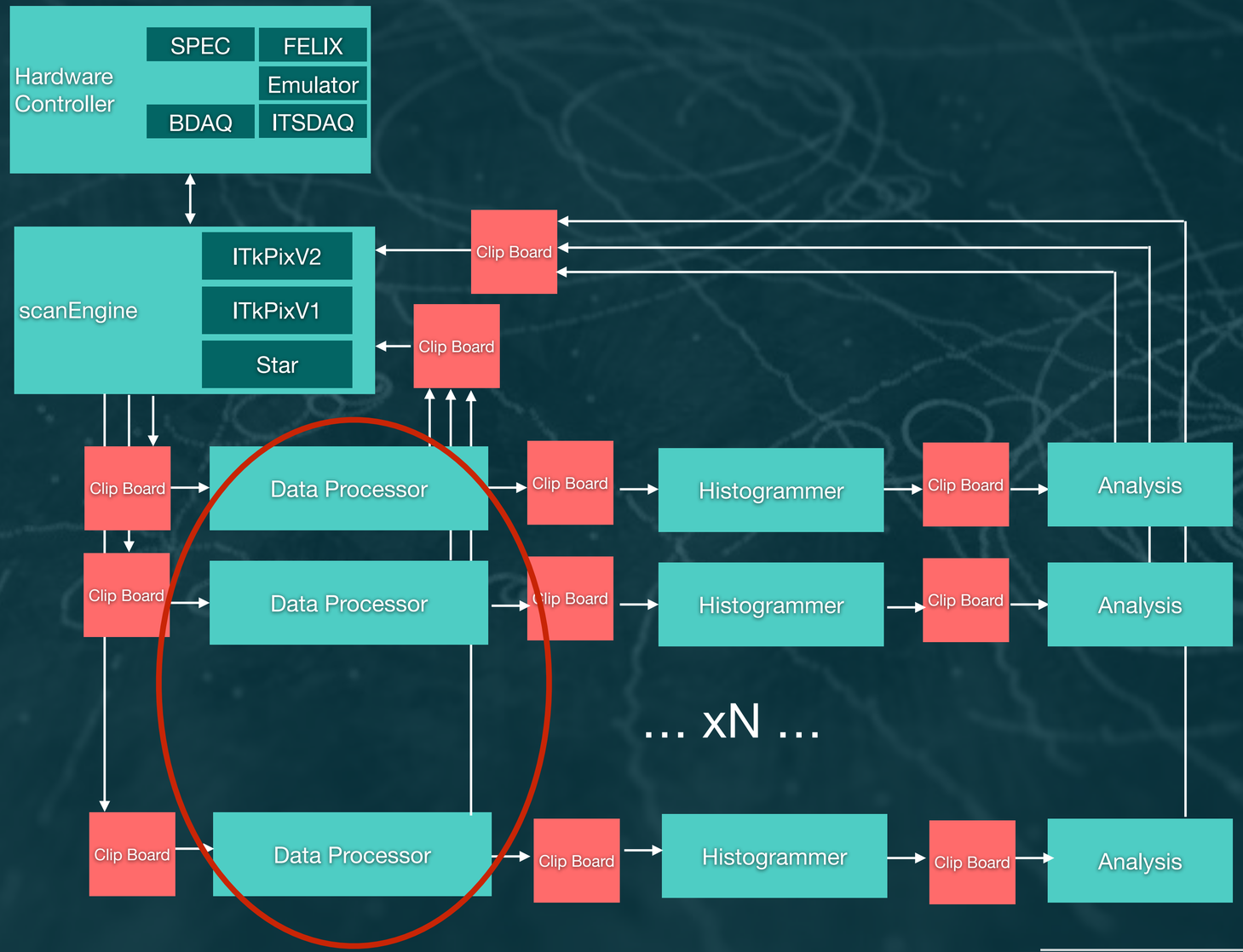
Scna Engine



- Scan engine executes front-end specific scan loop
- Scan loop consists of nested loop defined by scan config
- Loop contain repetitive actions that need to be performed multiple times to perform a scan



Data Processor

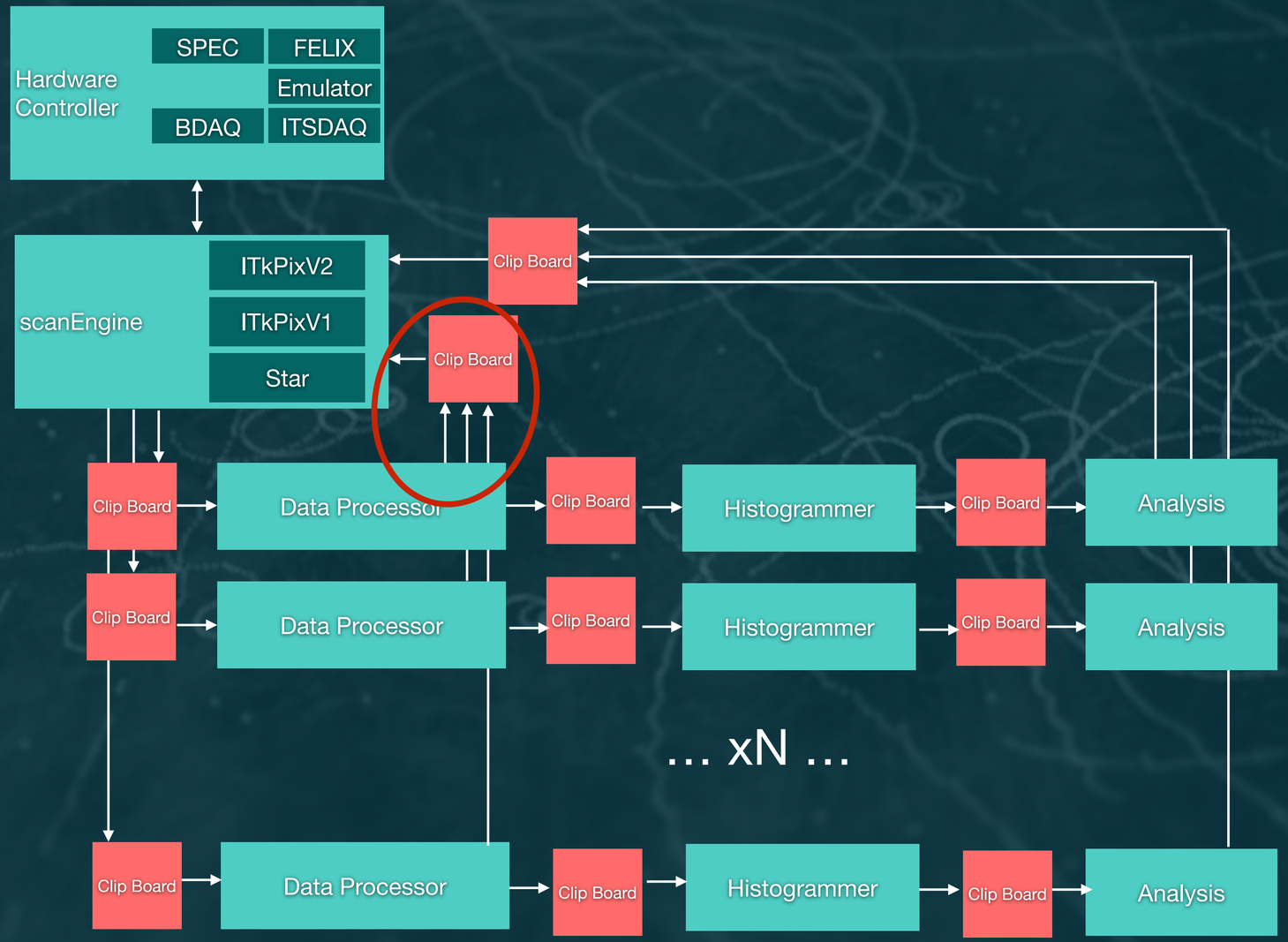


- Data Processor received raw data from inner most scan loop and decodes it into event data
  - Raw data = std::vector<uint32_t>
  - Event data =

```
uint16_t l1id;
uint16_t bcid;
uint16_t tag;
uint16_t nHits;
uint16_t nClusters;
std::vector<FrontEndHit> hits;
```

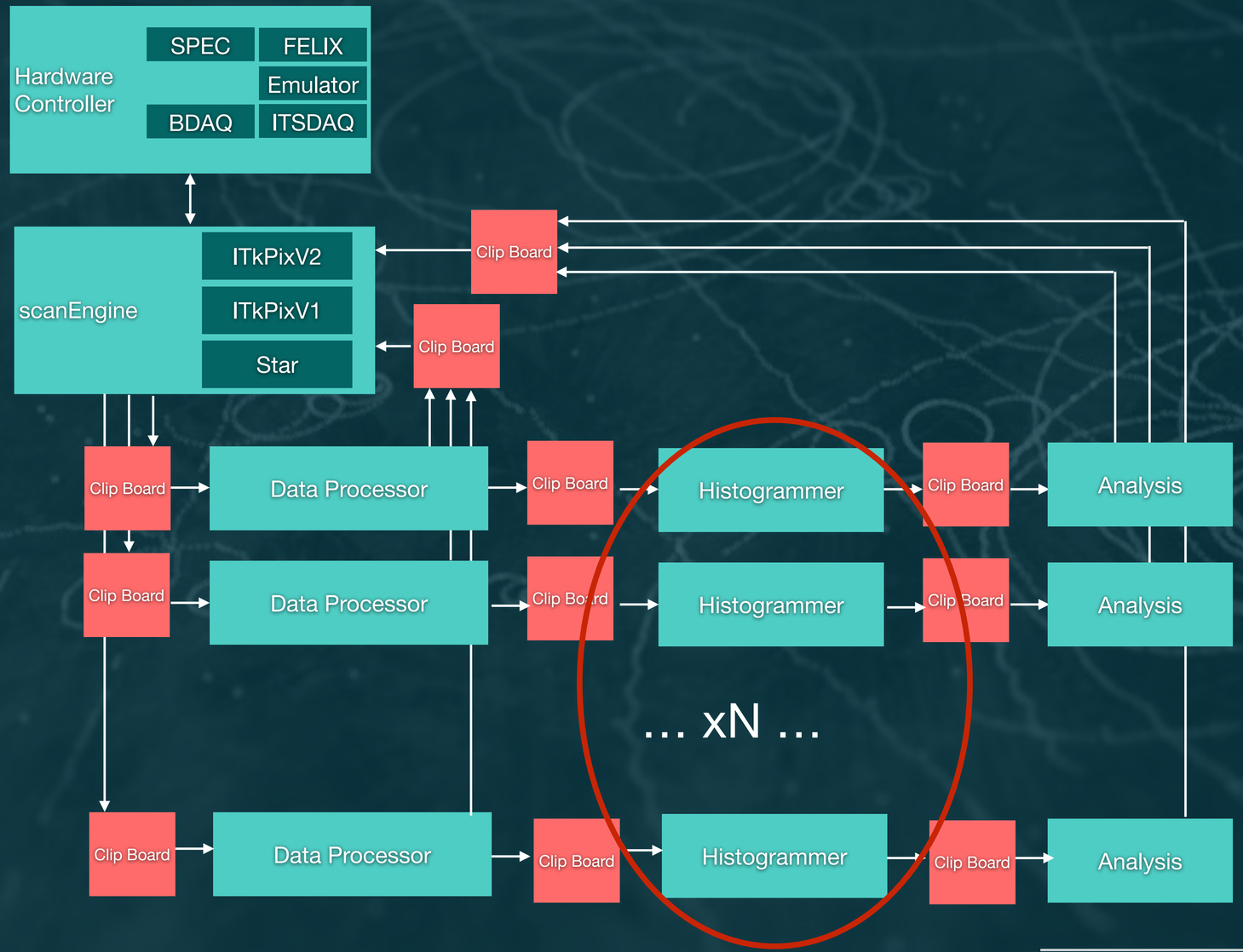
```
struct FrontEndHit {
    uint16_t col : 16;
    uint16_t row : 16;
    union {
        uint16_t tot : 16;
        struct {
            uint16_t ptot : 11;
            uint8_t ptoa : 5;
        };
    };
};
```

Data Processor Feedback



- Data processors feed number of received events back to scan engine
- Scan engine will receive will next inner most loop iteration when all expected events are received
- Helps in case of indeterministic data delay (e.g. FELIX)

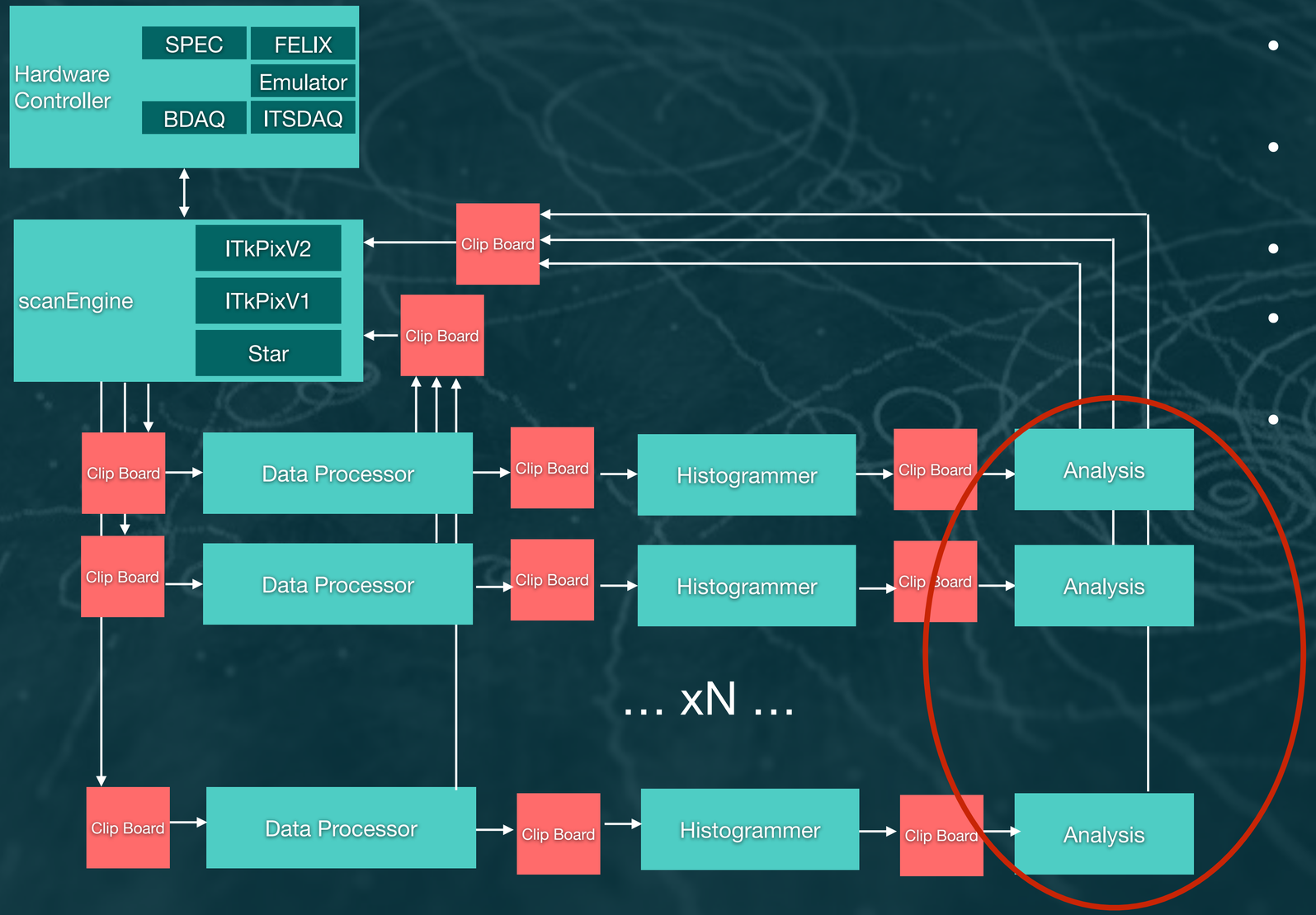
Histogrammer



- Histogrammer processes EventData into various histograms
- Histogram algorithms defined in scan config
- Histograms are published separately for inner loop iteration

```
  "histogrammer": {
    "0": {
      "algorithm": "OccupancyMap",
      "config": {}
    },
    "1": {
      "algorithm": "TotMap",
      "config": {}
    },
    "2": {
      "algorithm": "Tot2Map",
      "config": {}
    },
    "3": {
      "algorithm": "TagDist",
      "config": {}
    },
    "4": {
      "algorithm": "TagMap",
      "config": {}
    },
    "5": {
      "algorithm": "HitsPerEvent",
      "config": {}
    },
    "6": {
      "algorithm": "DataArchiver",
      "config": {}
    },
    "n_count": 5
  },
```

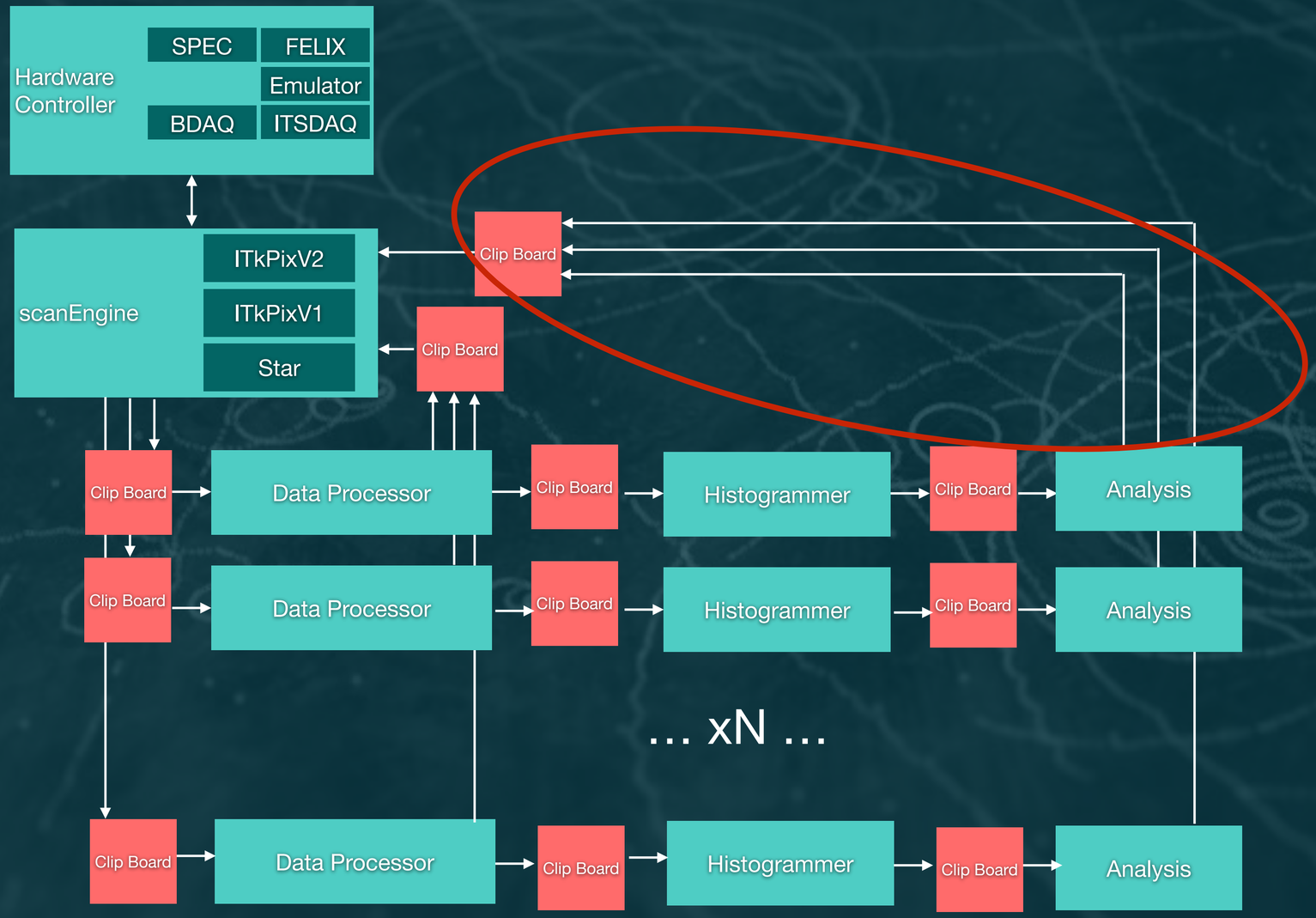
Analysis



- Analysis processes histograms by aggregating them or rebinning them
- Specific analysis algorithms require certain histogram algorithms
- Can chain multiple analyses
- Magical bit: analyses can deal with scans performed with varying loop order
- Analysis delivers final result histograms that will be saved in the output

```
"analysis": {
  "0": {
    "algorithm": "OccupancyAnalysis",
    "config": {
      "createMask": true
    }
  },
  "1": {
    "algorithm": "TagAnalysis"
  },
  "2": {
    "algorithm": "TotAnalysis",
    "config": {}
  },
  "n_count": 3
},
```

Analysis Feedback



- Tunings require feedback from analysis to adjust FE register to the right value
- Analysis determined value or direction, scan engine writes value to chip in next iteration
- Special loops to receive feedback: global and pixel feedback loop
- Feedback loops will block scan if they don’t receive feedback

A Standard Scan

- Simplest scan would be to enable all pixels, inject X times and record response => Trigger Loop
- Cannot for electrical reasons inject into all pixels (analog)
  - Primary issue is number of injected pixels per double column, as biases are distributed along double columns
- Need to scan over pixel matrix activating some portion of pixels at a time
  - Fastest way to enable/disable parts of the chip is enable/disable whole core columns => Core Column Loop
  - Slower but most granular is to write a mask into pixel array (mask stage)
    - Can duplicate mask over all core columns => Mask Loop

```
"loops": [
  {
    "config": {
      "max": 64,
      "min": 0,
      "step": 1
    },
    "loopAction": "Itkpixv2ParMaskLoop"
  },
  {
    "config": {
      "max": 50,
      "min": 0,
      "step": 1,
      "nSteps": 5
    },
    "loopAction": "Itkpixv2CoreColLoop"
  },
  {
    "config": {
      "count": 100,
      "delay": 58,
      "extTrigger": false,
      "frequency": 5000,
      "noInject": false,
      "time": 0,
      "edgeMode": true,
      "edgeDuration": 20
    },
    "loopAction": "Itkpixv2TriggerLoop"
  },
  {
    "loopAction": "StdDataLoop"
  }
```

outermost

innermost

Interactive Part

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