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P4 for AI/ML Applications – Firewall example

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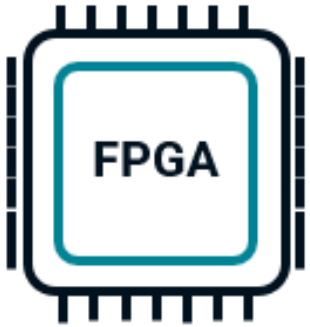
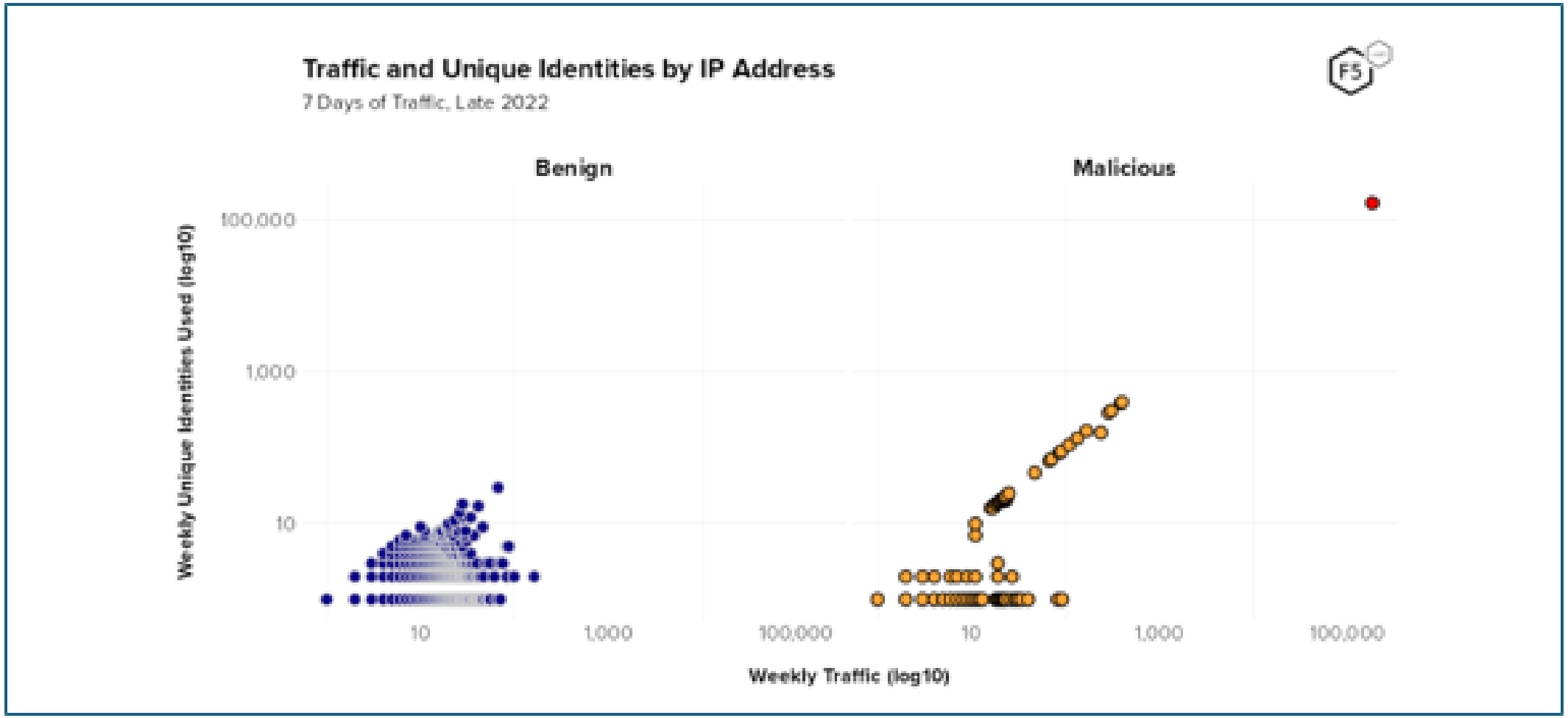
FPGA + P4 + AI/ML



Multi Layer Perceptrons (MLP)

Volumetric Firewall example



Source is F5.com

FPGA + P4 + AI/ML

Firewall applications
User assignment applications
L7 DPI applications
Syn-Flood detection
L7 Malware detection
Predictive failure analisys

Statistics based on:
Packet content
Inter-packet gaps
Packet sizes
Burst detection
Burst sizes
L2-L7 traffic content
Session size
Sensors

LEGITIMATE USER

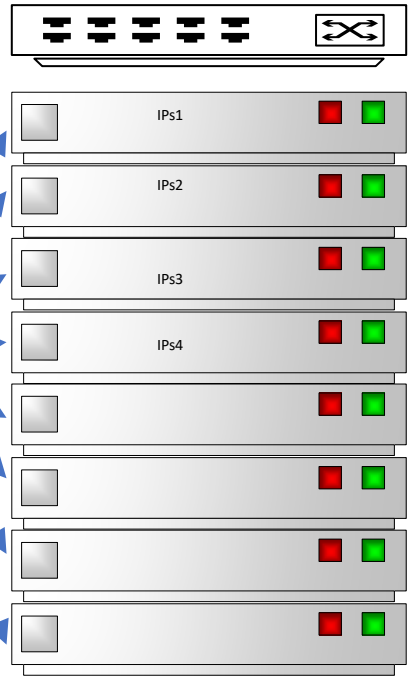
Non-structured traffic

Dataplane Feature Extraction

Packet based Dataplane inference Up to 11Mips Depends on AI model

ATTACKER

FPGA AI Suite



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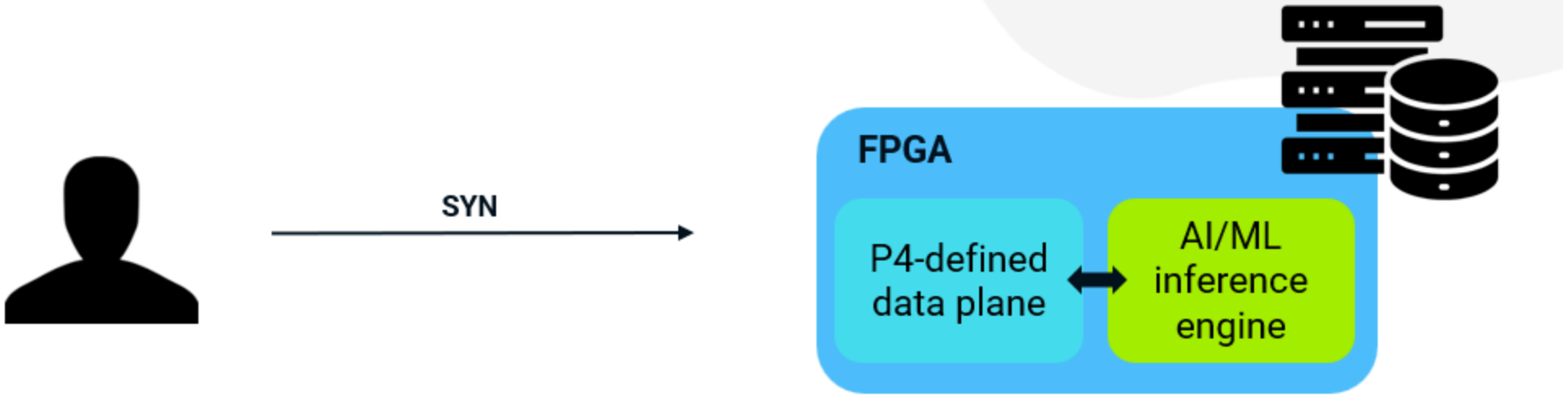
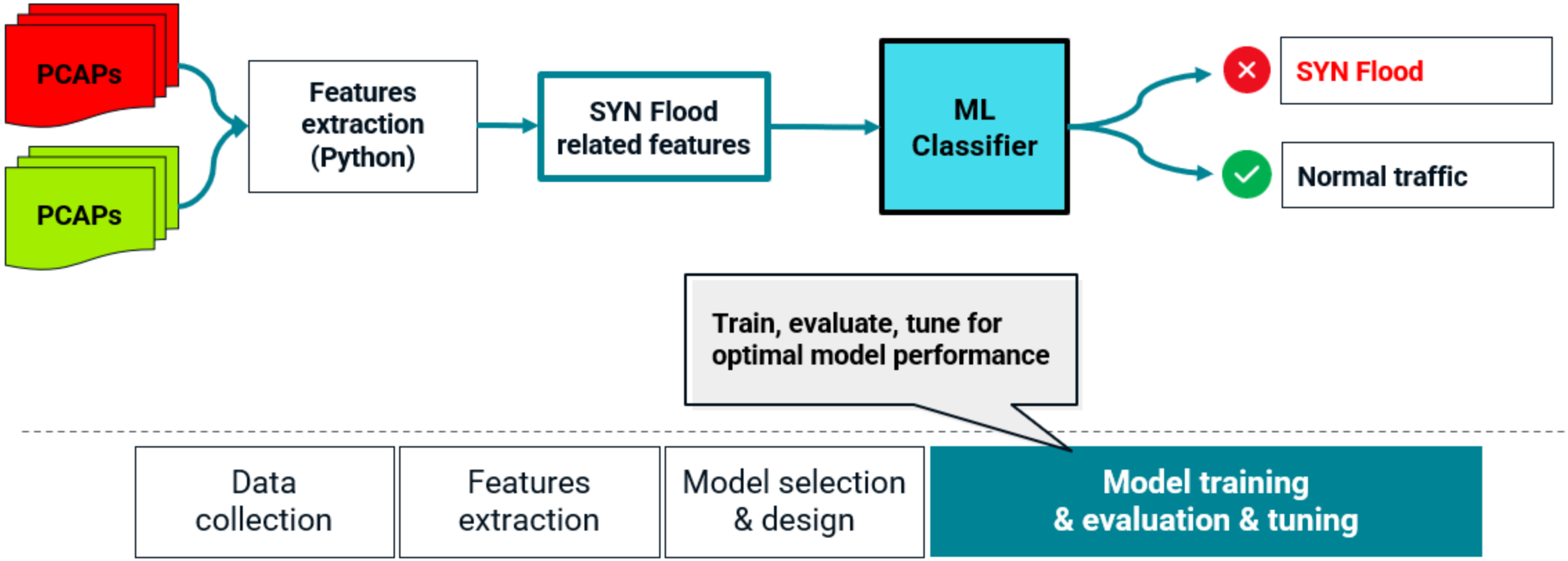
P4 as AI/ML feature extractor

- The **P4-defined data plane** determines the number of **SYN** packets received in a given time (a sampling period)
- The **AI inference engine** decides whether the observed pattern is a **SYN FLOOD** attack or **not,** depending on trained data (**4-11M inferences per second** are made, depending on the ML model used).



Preparing a model for AI/ML



Tools to be used for AI/ML generation for FPGA

- Altera AI Suite for FPGA
- HLS4ML
- Matlab Deep Learning toolbox

What P4 feature are extremely useful?

- Counters (both in the code and used as externs)
- Registers for determining the rate of packets
- Generic externs for connecting some AI/ML stuff
- Arithmetic and logical operations