Digital twins for Industrial IoT networking

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I4S Project objectives

- Innovative tools and methodologies for the analysis and objective measurement of the cyber risk level associated with connected production plants
- Analysis document related to the implementation of connected industrial plants characterized by a high level of resilience to cyber threats
- Technological solutions to improve the cybersecurity of connected production plants
- Implementation of an innovative system to emulate connected production plants, evaluation of their cybersecurity level and testing of technological solutions for the cybersecurity
Objective

- Combine the principles of:
  - cyber-range
    - Environment for cybersecurity training and technology validation and testing
  - digital twin
    - Realistic virtual replica of a real system
    - The digital twin does not interfere with the «real twin»

- Implement a digital twin of a typical industrial network architecture to be used as cyber-range environment for training, risk analysis and testing
Principles

- Virtualization technologies and NFV, SDN paradigms

- ETSI Management and Orchestration (MANO)
  - Architecture design
  - «Building blocks» and topology description
  - Automated deployment process and configuration
Digital twin reference architecture

- Production Plant
- Production Plant
- IoT connectivity
- Virtualized components (Virtual Machines/Containers)
- Gateway
- VPN
- Firewall
- LAN
- IDS/IPS
- Big Data Analysis
- Virtualized Networking (Network Function Virtualization)

Digital twin
Emulates real life
- Network architectures
- Networks functions
- Applications
Digital twin lifecycle

- Inspired by Network Slicing concept and principles
  - Defined by 3GPP for 5G networks
Software platforms

- Open Source MANO (OSM)
  - NFV-MANO platform

- OpenStack
  - Cloud IaaS platform
  - Virtualized Infrastructure Manager (VIM)
Management and Orchestration

VNF descriptors → Orchestrator → Cloud → Management

NS descriptors → Orchestrator → Cloud → Management

Image Repo. → Orchestrator → Cloud → Management
Digital twin components

- Virtual Network Functions:
  - Deep Packet Inspector
  - IPS/IDS
  - Firewall
  - Traffic shaper
  - VPN server

- Virtual applications:
  - CANopen gateway, OPC UA client
  - MQTT broker
  - Modbus traffic generator
  - LoRa simulator
Current deployment

- LoRaWAN
- MQTT
- Modbus
- OPC UA
- CANopen

With:
- romagnatech
- b3lab

Attacker
- IDS
- Corporate Firewall
- Internet

Traffic generator
- Internal Router
- IoT analytics

Management Console
Time for demo!

https://drive.google.com/file/d/1AoL1p1p4AcUfWJEyruYyUbWsuWeCAi2/view?usp=sharing
Thank you for your attention!

https://www.i4s-project.it