PCEI R6 Architecture Document
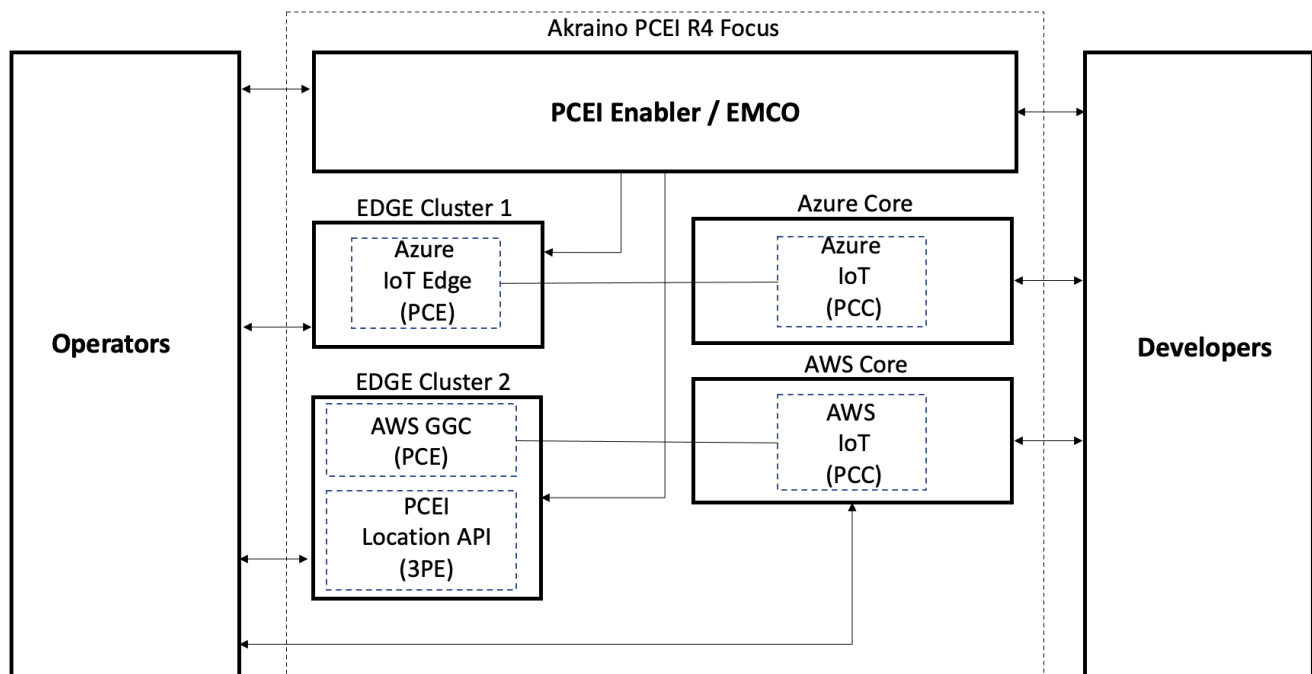
PCEI General Architecture

The general PCEI Architecture Document can be found at this link: https://wiki.akraino.org/x/CAW6AQ

PCEI R4 Architecture and Focus

Public Cloud Edge Interface (PCEI) is implemented based on Edge Multi-Cluster Orchestrator (EMCO). PCEI Release 4 (R4) supports deployment of Public Cloud Edge (PCE) Apps from two Public Clouds (Azure and AWS), deployment of a 3rd-Party Edge (3PE) App (an implementation of ETSI MEC Location API App), as well as the end-to-end operation of the deployed PCE Apps using simulated Low Power Wide Area (LPWA) IoT client

The EMCO-based implementation of PCEI in R4 is shown below:

EMCO 1

P1 Operator

MNO/ Customer

Portal / UI

PCEI Enabler

PCE/3PE App 6
Onboarding /
Service Definition

3 K8S Cluster
Registration/
Provisioning/
Orchestration

App/Func
Placement
and 7
Deployment

5

Developer

4

P3 (K8S API) P5/P7 (Helm Charts)

IoT Device 10

Edge K8s 2
cluster /
Bare Metal

PCE/3PE 8

9

Public Cloud

PCC

IP Network/
vEPC/UPF

Private Interconnect / Internet

MNO DC

Edge DC

Core DC

Architecture and Validation elements used in PCEI R4.

1. Deploy EMCO on K8S
2. Deploy Edge K8S clusters
3. Onboard Edge K8S clusters onto EMCO
4. Provision Public Cloud Core Service and Push Custom Module for IoT Edge
5. Package Azure IoT Edge and AWS GGC Helm Charts into EMCO application tar files
6. Onboard Azure IoT Edge and AWS GGC as a service/application into EMCO
7. Deploy Azure IoT Edge and AWS GGC onto the Edge K8S clusters
8. All pods came up and register with Azure cloud IoT Hub and AWS IoT Core
9. Deploy a custom LPWA IoT module into Azure IoT Edge on the worker cluster
10. Successfully pass LPWA IoT messages from a simulated IoT device to Azure IoT Edge, decode messages and send Azure IoT Hub

PCEI R5 Architecture and Focus

Public Cloud Edge Interface (PCEI) is implemented based on Edge Multi-Cluster Orchestrator (EMCO) and Controller Design Studio (CDS).

Key features and implementations in Akraino Release 5:

1. **Controller Design Studio (CDS) Terraform Executor**. Enables automatic and North Bound Interface (NBI) API driven pull from Gihub and execution of Terraform plans, including:
    a. Public Cloud Core orchestration (e.g., AWS, Azure, GCP).
    b. Equinix Interconnect and Infrastructure Orchestration (Fabric l2/L3, Network Edge, Bare Metal).
    c. Openstack orchestration (VM deployments).
2. **CDS Helm Chart Processor**. Allows automatic and NBI API driven pull from Github of Composite Application Helm charts for:
    a. Onboarding Services and Apps to ONAP (a.k.a., EMCO – Edge Multi-Cluster Orchestrator).
    b. Creation of Service Instances and Deployment of Kubernetes Apps on target Kubernetes clusters.
3. **CDS Kubernetes Cluster Registration Processor**. Allows NBI API driven automatic target cluster registration with ONAP (EMCO) for:
    a. Kubernetes application deployment on registered target clusters.
4. **North Bound Interface APIs** for:
    a. Cluster Registration into ONAP
    b. Terraform Plan Execution against target providers (Cloud, Equinix, Openstack).
    c. Helm Chart Onboarding into ONAP for Service and App Registration.
    d. Service Instance creation in ONAP and App deployment onto target Kubernetes clusters.
5. **Application and Network Function Deployments**. NBI API triggered deployment of Cloud Native Apps and Network Functions on target Kubernetes Edge Clusters:
    a. Azure IoT Edge.
    b. Free 5G Core.
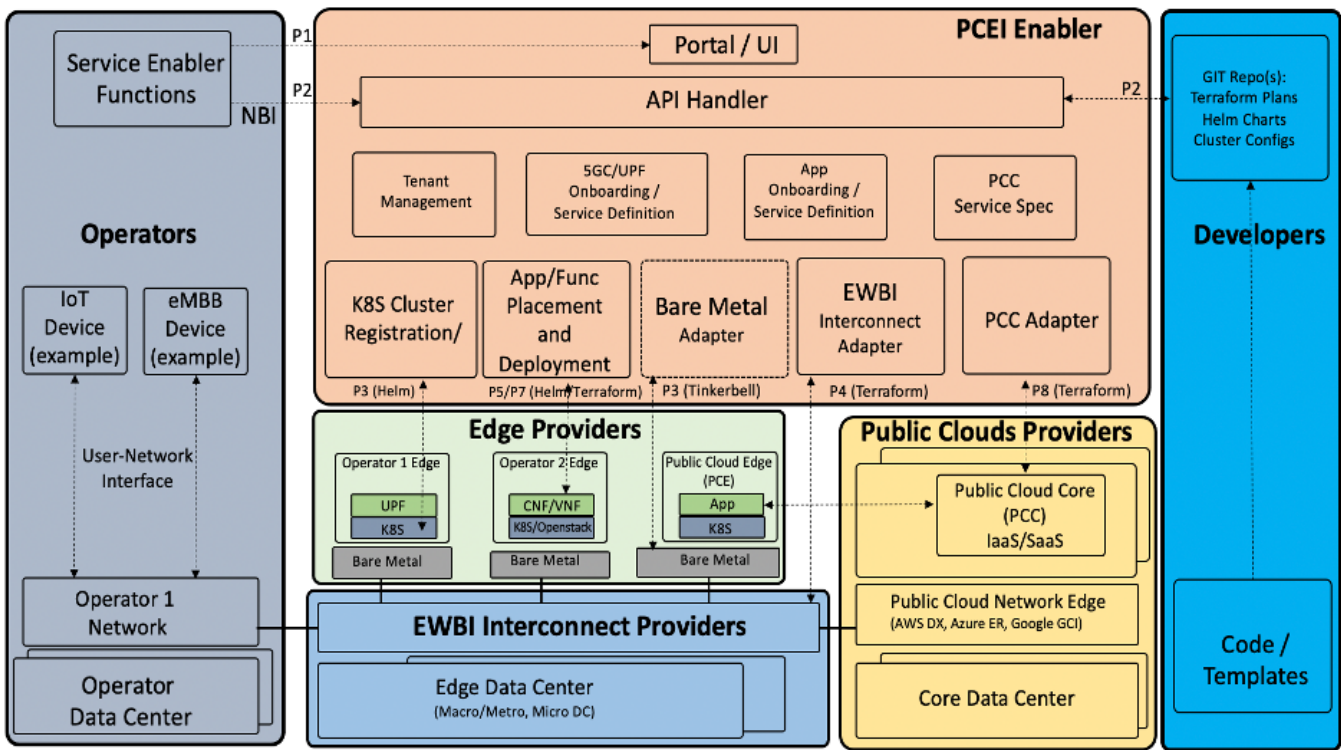
PCEI R6 Architecture and Focus

PCEI R6 Architecture view
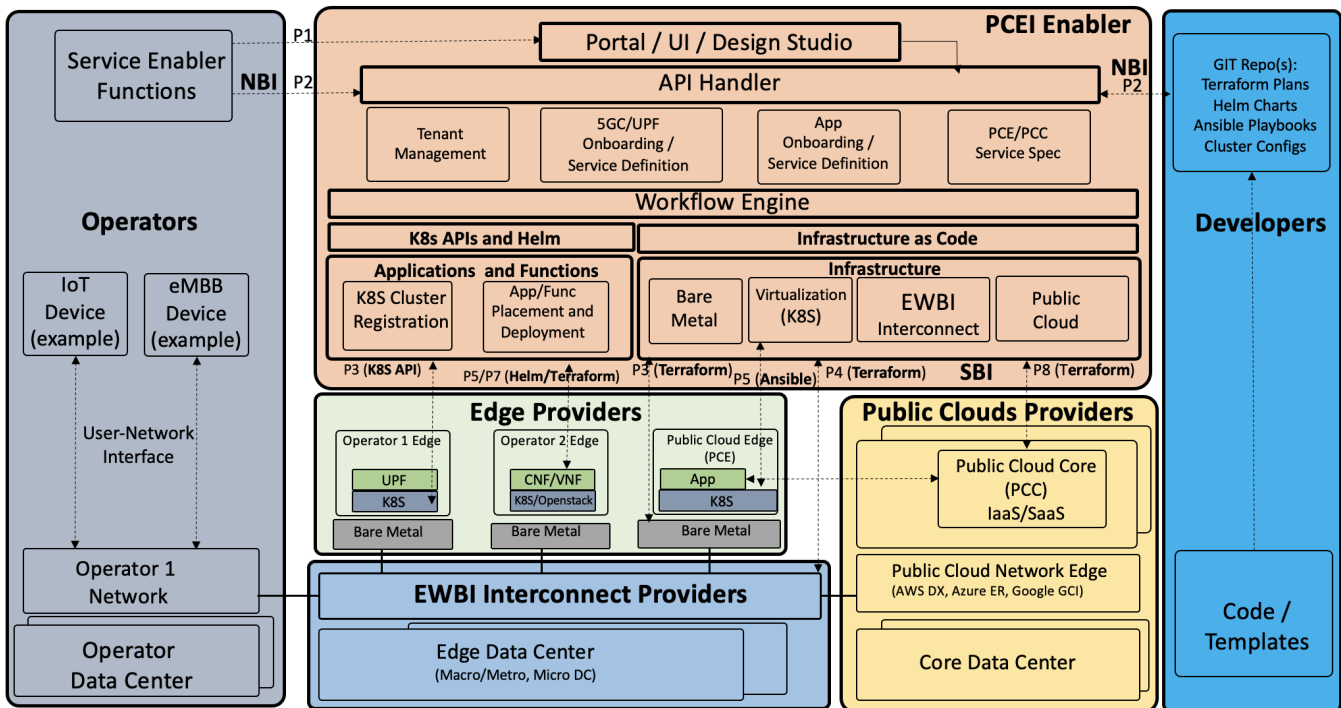
The architecture of the Akraino PCEI project enables the interactions between:

- Developers and Architects (Blue) – who write Infra-as-code programs, app deployment charts and configuration playbooks

- Public cloud providers – who provide IaaS and SaaS services
- Edge cloud providers – who provide edge data center and bare metal resources and ability to orchestrate bare metal hardware
- EWBI interconnection providers – who enable L1/L2/L3 interconnection and orchestration of connectivity
- Operators – who can orchestrate and interconnect MEC infra as well as deploy apps and function on top of it

The Akraino PCEI Enabler R6 orchestrator is built using open-source components:

- EMCO – the LFN project that allows to deploy Apps and Functions on Kubernetes clusters EMCO (Edge Multi Cluster Orchestrator)
- CDS – a component of the LFN ONAP project that implements microservices Controller Design Studio (CDS):
    - Terraform processor Helm processor
        - Terraform
    - Ansible processor (New in R6)
        - Ansible
    - Camunda workflow engine (New in R6)
        - Camunda
- CDS also enables integration with Git for retrieval of code and storage of state

PCEI R6 architecture mapping to ETSI MEC architecture

PCEI R6 and ETSI MEC Architecture
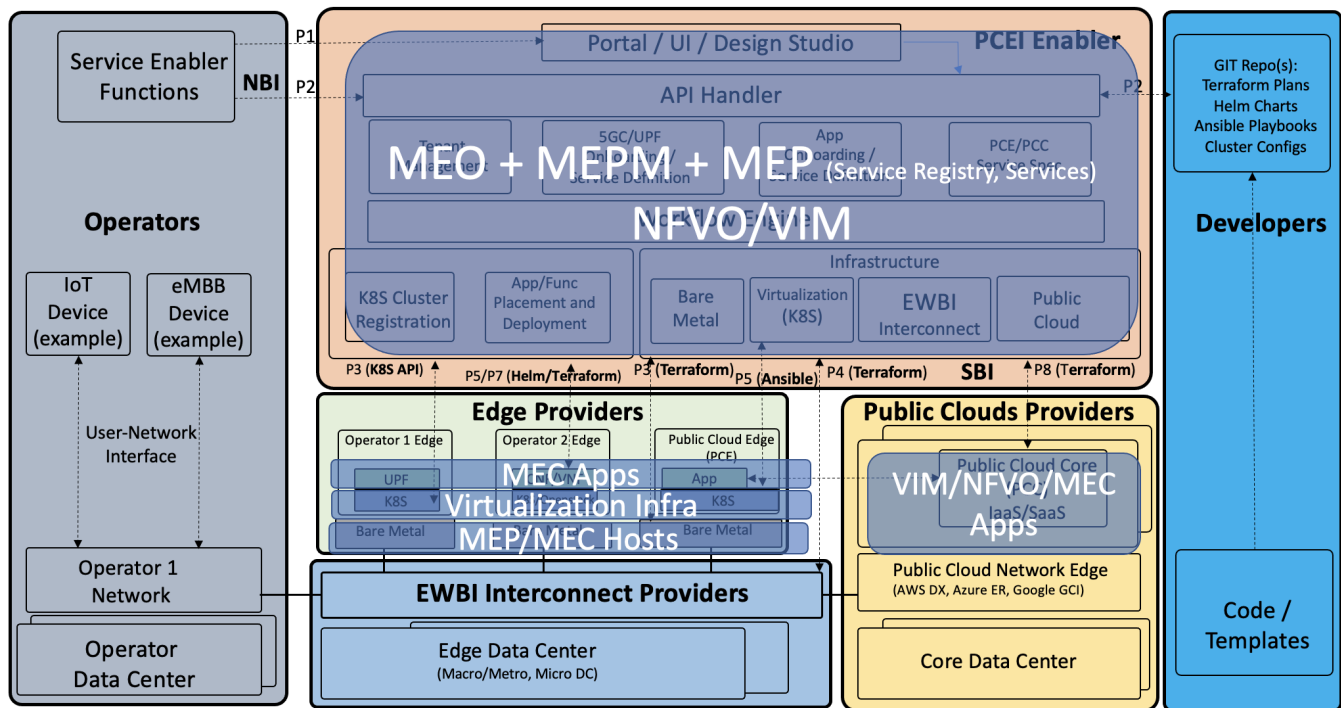
PCEI R6 architecture can be mapped to both ETSI MEC and ETSI MEC Federation architectures.

For reference, the ETSI MEC Architecture is shown below:
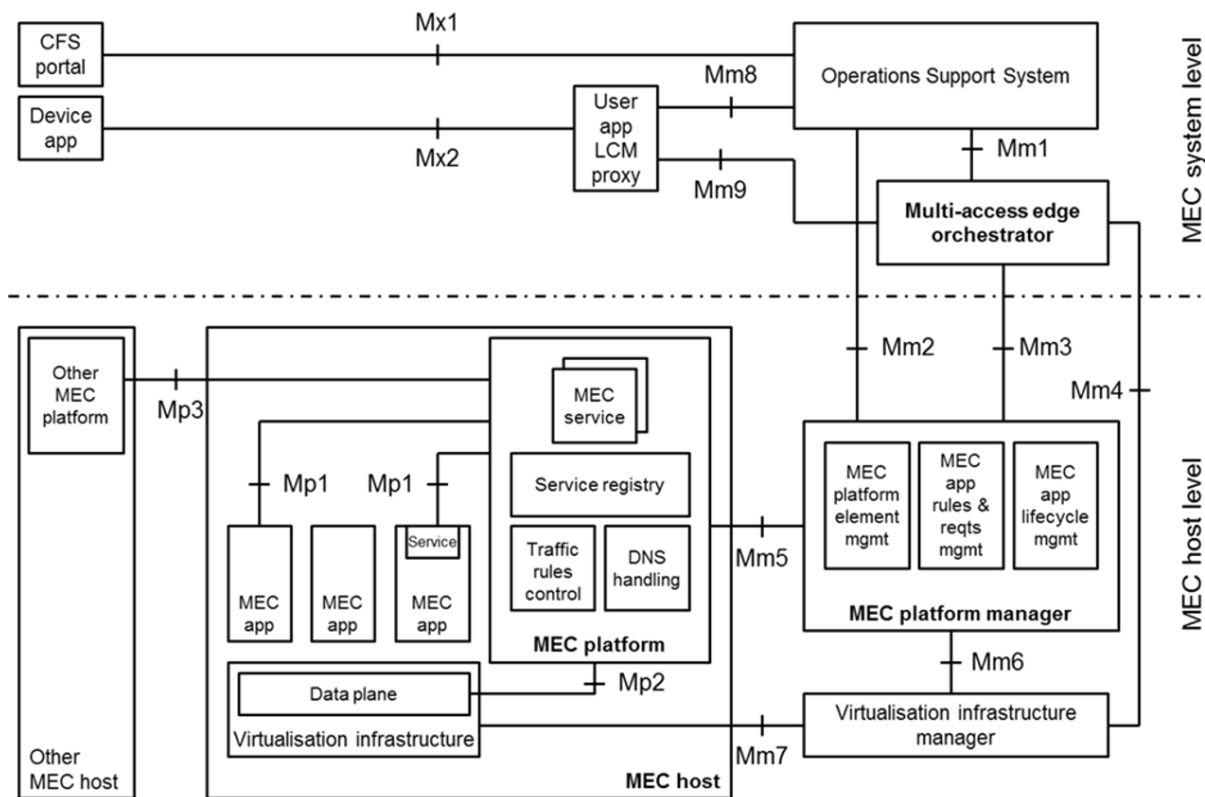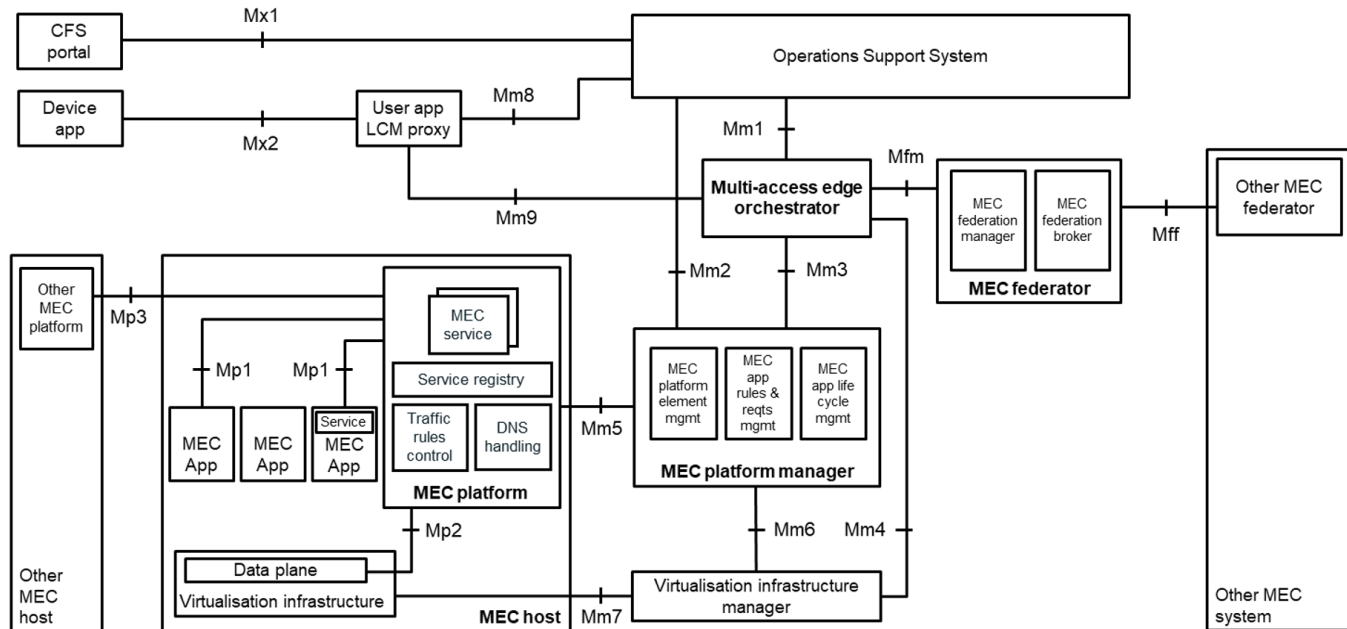

The PCEI R6 to ETSI MEC architecture mapping is shown below:

PCEI R6 and ETSCI MEC Federation Architecture

ETSI MEC Federation Architecture is shown below:

The PCEI R6 to ETSI MEC Federation architecture mapping is shown below:

MEC Federator — Mfm

PCEI Enabler

Portal / UI / Design Studio — MEO/MEPM/VIM

API Handler — NBI

| Tenant Management | 5GC/UPF Onboarding / Service Definition | App Onboarding / Service Definition | PCE/PCC Service Spec |

Workflow Engine

Applications and Functions
- K8S Cluster Registration
- App/Func Placement and Deployment

Infrastructure
- Bare Metal
- Virtualization (K8S)
- EWBI Interconnect
- Public Cloud

Mm6 (K8S API)   Mp1(Helm/Terraform)   Mm5 (Terraform)   Mm6 (Ansible)   SBI-NR (Terraform)   **SBI**   SBI-CR (Terraform)

Operator

OSS — Mm1

- IoT Device (example)
- eMBB Device (example)

User-Network Interface

Operator 1 Network

Operator Data Center

Edge Providers — **MEP/MEC Hosts**

- Operator 1 Edge
  - UPF
  - K8S
  - Bare Metal
- Operator 2 Edge
  - CNF/VNF
  - K8S/Openstack
  - Bare Metal
- Public Cloud Edge (PCE)
  - App
  - K8S
  - Bare Metal

EWBI Interconnect Providers

Edge Data Center (Macro/Metro, Micro DC)

Public Clouds Providers

Public Cloud Core (PCC) IaaS/SaaS

MEP/MEC Hosts

Public Cloud Network Edge (AWS DX, Azure ER, Google GCI)

Core Data Center

App Provider (Developers)

GIT Repo(s): Terraform Plans Helm Charts Ansible Playbooks Cluster Configs

Code / Templates