



# MAGMA

## Product Overview

February 2019

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## What is Magma?

Magma is an open-source software platform that gives network operators an open, flexible and extendable mobile core network solution. Magma enables better connectivity by:

- Allowing operators to offer cellular service without vendor lock-in with a modern, open source core network
- Enabling operators to manage their networks more efficiently with more automation, less downtime, better predictability, and more agility to add new services and applications
- Enabling federation between existing MNOs and new infrastructure providers for expanding rural infrastructure
- Allowing operators who are constrained with licensed spectrum to add capacity and reach by using Wi-Fi and CBRS

Facebook developed Magma to make deploying wireless access networks easier to deploy and cheaper to maintain, and Magma empowers both existing operators and new entrants to extend mobile coverage to new people. By doing so, we're helping bring more people online to a faster Internet.

## Why Magma?

We run one of the largest networks in the world at Facebook, which has taught us a lot about running networks at scale. With Magma, we have tried to incorporate many of our core learnings around upgradable, software only networks that are managed through a logically centralized cloud. By developing Magma in the open we hope to not just focus the conversation on functionality but also on the equally important aspect of building and operating networks that allow for innovation at scale. We believe this innovation across business and technology will help us and our partners deliver on our collective goal of bringing more people online with faster Internet.

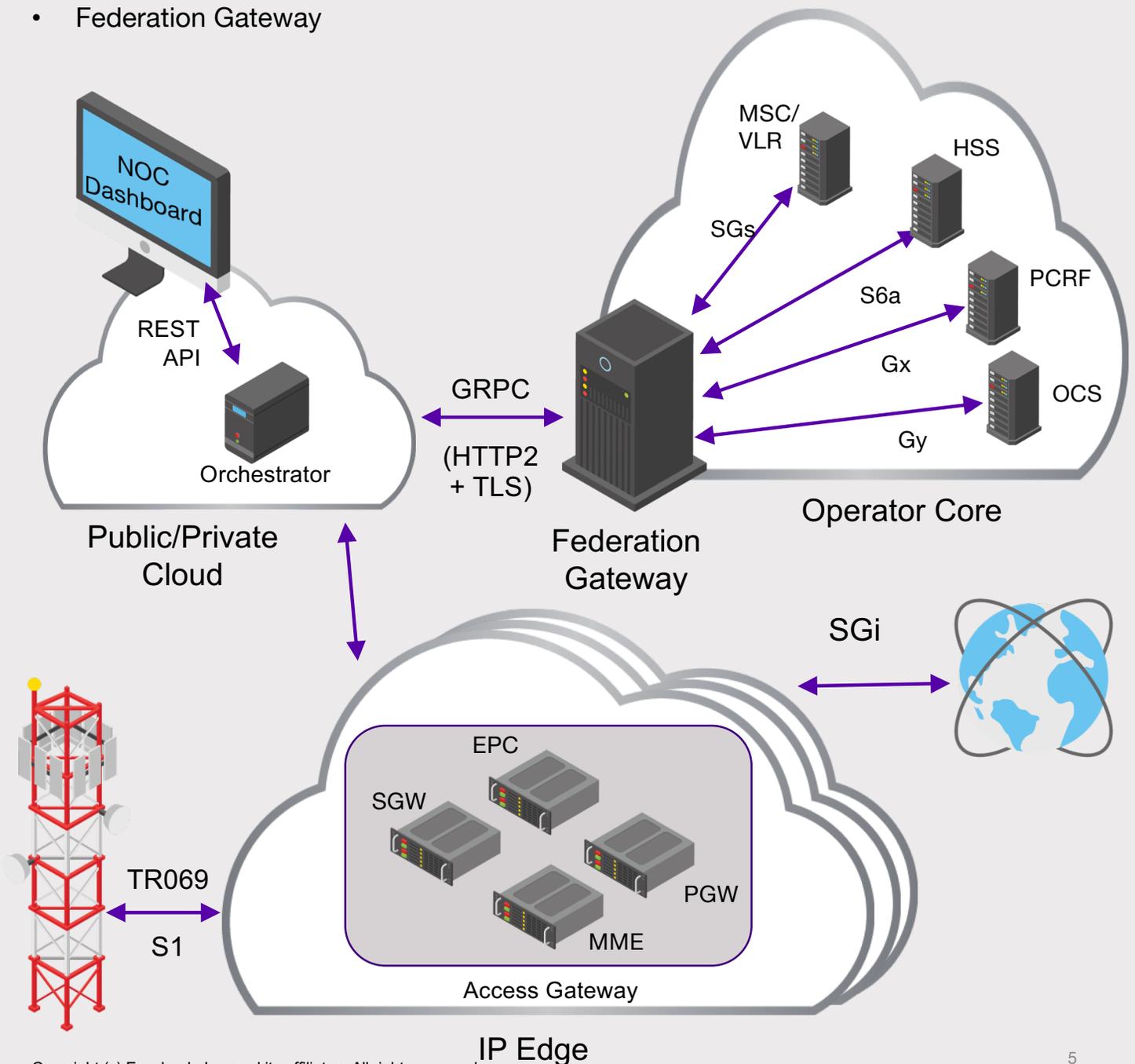
The problem of bringing more people online is a problem of heterogeneity. Heterogeneity in access technologies (4G/5G, WiFi), heterogeneity in deployments (small cells, macros, indoor/outdoor) and business models. Magma decomposes a rigidly standardized, one size fits all architecture into a software centric 3GPP compliant network, with access agnostic distributed policy enforcement points. This flexible network managed through a centralized cloud allows Magma to address the widest possible set of use-cases, without the operational overhead of managing many devices and access technologies.

# What is the Magma Architecture?

The figure below shows the high-level Magma architecture. Magma is 3GPP generation (2G, 3G, 4G or upcoming 5G networks) and access network agnostic (cellular or WiFi). It can flexibly support a radio access network with minimal development and deployment effort.

Magma has three major components:

- Access Gateway
- Orchestrator
- Federation Gateway



## Access Gateway

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In Magma, the Access Gateway (AGW) provides network services and policy enforcement. In an LTE network, the AGW implements an evolved packet core (EPC), and a combination of an AAA and a PGW. It works with existing, unmodified commercial radio hardware.

The AGW is what makes Magma a distributed architecture designed for horizontal scaling with the radio access network. Conceptually, you can think of an AGW as a lightweight *software* element that is co-located “near the edge” (for example, at a cell tower, as software running on an eNodeB, or virtualized in an edge point-of-presence); a typical Magma network will have many AGWs. One of the consequences of this architecture is that Magma supports local breakout of user-level IP traffic with full policy enforcement (unlike LIPA or SIPTO) by default, making 3GPP networks look and feel more like WiFi networks. This simplifies deployment, removes tunneling overhead, and enables mobile edge compute applications.

In addition to implementing core network functionality, the AGW can also manage the device lifecycle of its radio equipment. For example, the AGW implements a TR-69 server to support configuration and monitoring of LTE small cells. This enables automation of site provisioning and operation, while providing a consistent way to monitor performance of heterogeneous network elements.

## Orchestrator

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Access gateways are configured and monitored through the cloud-based Orchestrator. This allows for a consistent way of managing all access gateways abstracting away the distributed nature of the component. The metrics acquired through the platform allows you to see the analytics and traffic flows of the wireless users through the Magma web UI.

Orchestrator is a cloud service that provides a simple and consistent way to configure and monitor the wireless network securely. The Orchestrator can be hosted on a public/private cloud. The Orchestrator has 3 main functions:

- Network Monitoring System (NMS): The NMS provides bootstrap configuration and monitoring of the system. The Network Monitoring System also raises alerts and alarms, logging messages, and reporting events.
- Key Performance Indicators (KPI): The network elements (Radios, Gateways etc.) generate different kinds of KPIs that can be calculated from the data flow across the wireless network. The Orchestrator creates, stores and exports these KPIs for visualization of usage across the network.
- Relay: Orchestrator acts as a relay between gateway nodes allowing for the brokering of trust between nodes running in different domains.

## Federation Gateway

The Federation Gateway integrates the MNO core network with Magma by using standard 3GPP interfaces to existing MNO components. It acts as a proxy between the Magma AGW and the operator's network and facilitates core functions, such as authentication, data plans, policy enforcement, and charging to stay uniform between an existing MNO network and the expanded network with Magma. This federation model also provides mutual transparency of infrastructure quality, traffic volume, and traffic type, which often facilitates the relationship between MNOs and RMIOs. The Federation Gateway is an optional component and Magma can operate in stand-alone mode without federating onto an existing mobile core

## Getting Involved

Facebook believes that everyone can benefit from having access to the Internet. Magma open sourced software plays an important role in this work by enabling network operators to extend their mobile network coverage. Facebook Connectivity projects helps bring more communities online by bringing the cost down and reducing the infrastructure overhead. Facebook is ready to partner with network operators to make this global effort a success.

If you are interested in getting more information about Magma please email [magma-dev@googlegroups.com](mailto:magma-dev@googlegroups.com). For information on other connectivity programs, please email [krantis@fb.com](mailto:krantis@fb.com). Join the [magma-announce@googlegroups.com](mailto:magma-announce@googlegroups.com) or the [magma-dev@googlegroups.com](mailto:magma-dev@googlegroups.com) mailing list to receive announcements of new features. For online tutorials on how to get started with Magma, please visit our Github page at <https://github.com/facebookincubator/magma>. For a broader perspective on how Magma fits into Facebook's other connectivity programs please go to <https://connectivity.fb.com/magma>. Join us in expanding Internet access across the world in order for us to bring the next one billion people online.

## Key terms and Acronyms:

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- 3GPP: 3rd Generation Partnership Project
- AAA: Authentication, Authorization, Auditing
- eNodeB: Evolved Node B is the network hardware communicating directly with UEs, e.g. a base station
- EPC: Evolved Packet Core (SAE Core)
- HSS: Home Subscriber Server
- IMSI: International Mobile Subscriber Identity, identifying a subscriber
- LTE: Long-Term Evolution
- MAI: Mobile Access Infrastructure
- MME: Mobility Management Entity
- Mobilityd: A service handling IP allocation and user movement between eNodeBs
- MSC: mobile switching center
- VLR: visitor location register
- Obsidian: our server/REST service
- OCS: Online charging system
- PCRF: policy and charging rules function
- REST: Representational State Transfer
- RMIO: Rural Mobile Infrastructure Operators
- SAE: System Architecture Evolution
- SGW: Serving Gateway
- PGW: PDN Gateway
- SID: Subscriber Identifier used in Magma, e.g. IMSI20895000000000000001
- SIM: subscriber identity module (SIM card), an IC storing an IMSI number and key
- Subscriberdb: our service tracking users of the network
- TR-069 transport protocol with the eNodeB
- UE: user equipment, e.g. a user's cell phone



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