



**InkBridge
Networks**

We Authenticate The Internet

FreeRADIUS Overview

A white paper which describes the features, benefits, and high level architecture of the InkBridge Networks server.

DISCLAIMER

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Background

FreeRADIUS is the worlds leading RADIUS server. It is used by organizations such as banks, universities, Internet Service Providers (ISPs), Telephone companies, and enterprises. it is the basis for multiple commercial RADIUS server offerings, include token card manufacturers, and network equipment vendors.

The server scales from a small home network of ten people, to ISPs which have tens of millions of users. It is used daily in Fortune 500 enterprises to authenticate every user who needs network access, for each of ten thousand network switches.

The FreeRADIUS project was started in 1999 by Alan DeKok. In 2008, he started InkBridge Networks, which is the only company dedicated to FreeRADIUS development and support. InkBridge Networks is privately held, profitable, and growing at better than the industry average.

Standards compliance

FreeRADIUS supports all of the relevant industry standards for RADIUS. This includes the following RADIUS specifications, and related standards:

RFC 2865, 2866, 2867, 2868, 2548, 2869, 2882, 3162, 3576, 3579, 3580, 4372, 4668, 4669, 4670, 4671, 4675, 4679, 5080, 5176, 5607, 5997, 6158, 6613, 6614, 6911, 6929, 8044, and 8559.

FreeRADIUS also supports the WiMAX Network Working Group standards, and the RADIUS attributes necessary for 3GPP and 3GPP2.

Alan DeKok has written approximately a quarter (25%) of the RADIUS standards. In many cases, the standards are first implemented in FreeRADIUS, and then later in other products.

Compatibility

FreeRADIUS is compatible with all known equipment and products which implement the RADIUS standards. Where there are compatibility issues, it is because the third-party vendors do not properly implement the relevant standards.

As FreeRADIUS is Open Source, most vendors will test their products with FreeRADIUS before releasing them to the wider public. It is therefore extremely rare to see issues in production environments.

Features

FreeRADIUS has a wide range of features, including features not found in most commercial products.

Authentication Protocols

The server supports the following authentication protocols:

- PAP
- CHAP
- MS-CHAP
- EAP
 - EAP-GTC
 - EAP-MD5
 - EAP-TLS
 - EAP-PEAP (with MS-CHAP and EAP-GTC)
 - TTLS (with PAP, CHAP, MS-CHAP, and EAP)
 - EAP-FAST
- TOTP (Google Authenticator)

The passwords needed for these authentication protocols can be taken from any database. The passwords can be in almost any form, subject only to the limitations of the underlying authentication protocol.

Databases

FreeRADIUS supports the following databases:

- SQL
 - MySQL / MariaDB / NDB
 - PostgreSQL
 - Oracle
 - SQLite
 - UnixODBC / iODBC
 - IBM DB2
- MongoDB
- LDAP
 - OpenLDAP
 - Active Directory
- Redis
- MemcacheDB

The server can read or write to any database, in any combination. Both LDAP and SQL can be used in the same configuration, at the same time.

The database queries are easily customizable, and can trivially adapt to any custom schema used at a customers site.

The server supports fail-over and load balancing across multiple databases. There are no pre-set limits to the number, or type, of databases used.

Proxying

As with databases, FreeRADIUS supports any number of home servers when performing RADIUS proxying. These home servers can be arranged in a fail-over or load-balance configuration. This configuration is under complete control by the local administrators.

There is also no pre-set limit to the number or type of home servers used by the server.

Policies

The server includes a robust and feature-rich policy language. Attributes in a packet can be examined, edited, re-written, and used as part of database

queries. The language supports a wide range of operations on data, including string splitting, concatenation, regular expressions, along with packing and unpacking binary data.

In most cases, there is no need to use features from a complex programming language such as Python, Perl, or Lua.

However, FreeRADIUS also includes native support for those languages. If required, the internal policy language can make calls to Python, Perl, or Lua, in order to gain additional functionality not supported by the native policy language.

The policies also allow nearly unlimited “mix and match” of databases, authentication methods, and combinations of policies.

Virtual Servers

FreeRADIUS supports the concept of “virtual servers”. This functionality is similar to that used in web servers, where one web server can host web sites for multiple domain names.

In FreeRADIUS, virtual servers can be used to separate traffic based on origin, such as separating WiFi authentication from VPN logins, from DSL connections. Each type of traffic can be assigned its own set of policies, which can be updated independently of any other type of policy.

This functionality allows each policy to be simpler and more understandable.

The server includes many worked examples of virtual servers, which can be used as the basis for further customization.

Architecture

The server is written in a “plug in” model. The server core does the basic RADIUS and network handling. Almost everything else is managed as a plug-in module. This design is what enables the policy language to be incredibly flexible. The policy language can simply run one or more plug-in modules, in any order. Each plug-in module can be responsible for one logical unit of functionality.

For example, each of the authentication methods (PAP, CHAP, MS-CHAP, TOTP, and EAP) are individual plug-in modules. Similarly, each database connector (SQL, Redis, LDAP, etc.) are individual plug-in modules.

This design allows the server to be almost infinitely configurable. In many cases, no code changes to the server core have to be made in order to support complex new functionality.

RADIUS Systems

At InkBridge Networks, we build full RADIUS systems. Our expertise is not just FreeRADIUS, but all aspects related to RADIUS systems. This includes databases, fail-over, redundancy (both local and geographic).

We have built and/or maintain systems for national banks, ISPs, universities, and Fortune 50 companies. Our clients are world-wide, as is our team.

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