

# Beyond Trust

## PostgreSQL Client Authentication

Christoph Mönch-Tegeder

2ndQuadrant  
<http://www.2ndquadrant.com/>

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# Part I

## Authentication

# Why Authentication?

- ▶ *Too complicated*
- ▶ *Nobody knows my database*
- ▶ *Nobody will attack us*



CYBERCRIME | HACKING

## COMELEC breach data released online, fully searchable


Posted April 21, 2016 by [Christopher Boyd](#)

On March 27, the [COMELEC](#) (Philippines' Commission on Elections) website was defaced and data on up to 55 million registered voters in the Philippines was [compromised](#).

<https://blog.malwarebytes.com/cybercrime/2016/04/comelec-breach-data-released-online-fully-searchable/>

## Rich Data (2)



 DATA CENTRE SOFTWARE SECURITY TRANSFORMATION DEVOPS BUSINESS PERSONAL TECH SCIENC

### Security

## 'No password' database error exposes info on 93 million Mexican voters

[https://www.theregister.co.uk/2016/04/25/mexico\\_voter\\_data\\_breach/](https://www.theregister.co.uk/2016/04/25/mexico_voter_data_breach/)

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PostgreSQL

## Krebs on Security

In-depth security news and investigation

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### 10 Extortionists Wipe Thousands of Databases, JAN 17 Victims Who Pay Up Get Stiffed

<https://krebsonsecurity.com/2017/01/extortionists-wipe-thousands-of-databases-victims-who-pay-up-get-stiffed/>

## Racketeering (2)



### Security

## MongoDB ransom attacks soar, body count hits 27,000 in hours

Aussie comms watchdog reporting exposed databases.

9 Jan 2017 at 02:26, [Darren Pauli](#)

<https://www.theregister.co.uk/2017/01/09/mongodb/>


It's not only that database



[Home](#) > [News](#) > [Security](#) > [MongoDB Hijackers Move on to ElasticSearch Servers](#)

## MongoDB Hijackers Move on to ElasticSearch Servers

By [Catalin Cimpanu](#)

 January 13, 2017

<https://www.bleepingcomputer.com/news/security/mongodb-hijackers-move-on-to-elasticsearch-servers/>

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# Why Authentication?

- ▶ Not the Open Data we wanted!
- ▶ Not the kind of support we want to pay!

# Why Authentication?

- ▶ Not the Open Data we wanted!
- ▶ Not the kind of support we want to pay!
- ▶ Regulations
- ▶ Nobody wants to explain these incidents

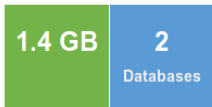
# You cannot hide

Added on 2017-01-27 14:24:05 GMT

 Netherlands, Amsterdam

**Details**

database



Database Name	Size
og	1.4 GB
PLEASE_READ	32.0 kB

MongoDB Server Information

```
{
  "metrics": {
    "commands": {
      "updateUser": {
        "failed": 0,
        "total": 0
      },
      "dropRole": {
        "failed": 0,
        "total": 0
      },
      "renameCollection..."
    }
  }
}
```

- ▶ <https://www.shodan.io>
- ▶ <https://www.zoomeye.org>

# So... Secure Your Database!

- ▶ Network Security and Firewalls
  - ▶ keep unauthorized users out
  - ▶ PostgreSQL listens on localhost only by default
- ▶ Fine Grained Access Control
  - ▶ do not run your app as postgres
- ▶ Secure your application
- ▶ Authenticate legitimate users

# Some Definitions

- ▶ **Identification** declaration of identity
  - ▶ "I am user42"
- ▶ **Authentication** proof of identity
  - ▶ what (only) you know, have, are
- ▶ **Authorization** allows actions on objects
  - ▶ GRANT SELECT ON tbl TO user42, RLS, ...
- ▶ **Audit Log** who did what and when
  - ▶ log\_connections, pgaudit

# Secret Handling

- ▶ Shared Keys, Asymmetric Secrets
  - ▶ hardcoded, configuration files, ...
- ▶ How to change secrets?
- ▶ Do not put secrets on Github!
- ▶ To Backup or Not To Backup?
  - ▶ how to guard backups? how to restore secrets?
- ▶ Hardware Security Module (HSM)
  - ▶ what if lost/destroyed?

# Authentication Security

- ▶ Passive Attacks
  - ▶ sniffing authentication info off the net
  - ▶ and all other traffic
- ▶ Active Attacks
  - ▶ Man in the Middle (MitM)
  - ▶ may modify traffic
- ▶ *There is no safe authentication unless you authenticate whom you're authenticating against first. (Martin Seeger)*

# PostgreSQL Authentication

- ▶ Highly configurable, well documented
- ▶ Flexible: up to 13 methods
- ▶ Per database, user, source and connection type
  - ▶ `pg_hba.conf`, Host Based Authentication
  - ▶ checked from top to first match
- ▶ Document your configuration, check if it still matches reality
- ▶ Users always have to exist in PostgreSQL
  - ▶ only authentication can be handled externally



# Host Based Authentication Configuration

```
# IPv4 local connections:  
host all all 127.0.0.1/32 md5
```

- ▶ type of connection
  - ▶ local on unix-like platforms only
- ▶ database (all, @file, replication, sameuser, samerole)
- ▶ user (all, +group, @file)
- ▶ non-local: source network
- ▶ authentication method and options

## Identification mapping

- ▶ `pg_ident.conf` allows mapping of external usernames to PostgreSQL usernames
- ▶ mappings selected by `map` parameter in `pg_hba.conf`
- ▶ regular expression support

# MAPNAME	SYSTEM-USERNAME	PG-USERNAME
<code>sslmap</code>	<code>"Test User"</code>	<code>ssluser</code>
<code>krbmap</code>	<code>/^([\^@]+)@MY.KRB5.REALM</code>	<code>\1</code>

## Part II

# Authentication Mechanisms

# Trust - there is none

- ▶ no authentication - just identification
- ▶ **do not use on servers**
- ▶ for testing, some embedded systems
- ▶ sometimes used in initial `pg_hba.conf`

## Ident - ask remote

- ▶ contact source host, ask for local user name
- ▶ uses *Identification Protocol* (RFC1413) - less common today
- ▶ additional TCP connection
- ▶ relies on security of source host

*The Identification Protocol is not intended as an authorization or access control protocol.*

**RFC1413** <https://www.rfc-editor.org/rfc/rfc1413.txt>

## Peer - Unix Credentials

- ▶ on local connections only
- ▶ get system user name from unix socket
- ▶ great for local administration
- ▶ as secure as the host OS
- ▶ limited use - no remote support, inflexible

## Reject - Blacklisting

- ▶ explicitly reject access
- ▶ reject one, allow all
- ▶ temporary block during maintenance
- ▶ *non-authentication* method

## Password - clear as text

- ▶ password authentication
- ▶ hashes stored in PostgreSQL – pg\_authid
- ▶ sends password in clear
- ▶ **do not use**
- ▶ use md5 instead



## MD5 - hashed password

- ▶ password authentication reloaded
- ▶ hashes stored in PostgreSQL – pg\_authid
- ▶ on the wire:  
`'md5' + md5(md5(password + username) + salt)`
- ▶ replay: 50% chance after 2 billion connections (4 byte salt)
- ▶ MD5 hash considered broken – regulatory problems
- ▶ does not authenticate server

# LDAP - Lightweight Directory Access Protocol

- ▶ authenticates against LDAP backend (not included)
- ▶ simple mode: use credentials to *bind* (authenticate) to the LDAP server
- ▶ search+bind mode: bind to LDAP server and search for user with given credentials
- ▶ can use TLS connection to the LDAP server
  - ▶ STARTTLS only (as per RFC 5413) - no LDAP over SSL
  - ▶ some servers do not support STARTTLS
- ▶ cleartext password, does not authenticate server
- ▶ TLS for PostgreSQL connection recommended

## PAM – Pluggable Authentication Modules

- ▶ *modules* (plugins) handle authentication (and more)
- ▶ configuration in `/etc/pam.d/` or similar
- ▶ cannot access `/etc/shadow` (when running in PostgreSQL)
- ▶ can be used to lock out clients or accounts after failed logins
- ▶ cleartext password, does not authenticate server
- ▶ TLS for PostgreSQL connection recommended

## GSS - Generic Security Services API

- ▶ uses KerberosV (Kerberos infrastructure not included)
  - ▶ realm, principal, ticket, TGT
- ▶ client authenticates Key Distribution Center (KDC)
- ▶ *Service Server* PostgreSQL must be known to KDC
- ▶ requires accurate time across all systems
- ▶ periodic *ticket* renewal
- ▶ no clear text passwords on the network, all entities authenticated

## GSS (2)

- ▶ KDC password store: local databases, LDAP, ...
- ▶ Client-KDC authentication: password (most common), PKINIT (public key), ...
- ▶ keytab files for non-interactive processes: **stored secrets**
- ▶ mapping of Kerberos principals to PostgreSQL users

```
# MAPNAME      SYSTEM-USERNAME      PG-USERNAME
krbmap         /^([\^@]+)@MY.KRB5.REALM \1
```

## GSS (3)

- ▶ Simple configuration on the PostgreSQL side
- ▶ `postgresql.conf`

```
krb_server_keyfile = 'krb5.keytab'
```

- ▶ `pg_hba.conf`

```
host all all 10.0.1.0/24 gss krb_realm=MY.KRB5.REALM
```

- ▶ DSN: `krbsrvname=postgres`

## Cert - TLS Client Certificate

- ▶ only for TLS connections (`hostssl`)
- ▶ as the client verifies the server's certificate, the server verifies the client's certificate
- ▶ requires: PKI (not included)
- ▶ possible to create and sign certificates by hand
- ▶ for more than a few hosts, use real CA software

## Cert (2)

- ▶ minimal server configuration

```
ssl = on
ssl_cert_file = 'server_cert.pem'
ssl_key_file = 'server_cert.key'
ssl_ca_file = 'user_ca.pem'
```

- ▶ recommended: do not re-use server CA for user certificates
- ▶ does not require external CA for users
- ▶ DSN: sslcert=cert.pem sslkey=cert.key



## Cert (3)

- ▶ private keys are **stored secrets**
- ▶ client certificates expire: can be changed on the fly
- ▶ server certificates and CAs expire: change needs restart
- ▶ disable client certificate: Certificate Revocation List (CRL)
  - ▶ `ssl_crl_file`
  - ▶ requires restart in PostgreSQL < 10
- ▶ map certificate Common Name (CN) to PostgreSQL user

# MAPNAME	SYSTEM-USERNAME	PG-USERNAME
<code>sslmap</code>	<code>"Test User"</code>	<code>ssluser</code>

## Other Mechanisms

- ▶ `radius` Remote Authentication Dial-In User Service
  - ▶ RADIUS uncommon, except for telco environments
- ▶ `sspi` Security Support Provider Interface
  - ▶ Windows Single Sign On, Kerberos with NTLM fallback
- ▶ `bsdauth` OpenBSD authentication framework
  - ▶ OpenBSD only, ideas like PAM

# Part III

## Considerations

## Some Notes on TLS

- ▶ default cipher list too broad, set `ssl_ciphers`
- ▶ generate your own DH-parameters
- ▶ recent PostgreSQL supports ECC (ECDSA)
- ▶ new connections are expensive
- ▶ not that much overhead once connection is up

# Connection Pooling

- ▶ Clients authenticate to pooler
- ▶ Pooler authenticates to PostgreSQL
- ▶ Forwarding of authentication with plaintext password only
- ▶ Terminates TLS

# Summary

- ▶ Secure your databases
- ▶ Authenticate clients (and servers)
- ▶ At least, use passwords
- ▶ Encrypt connections (use TLS)
- ▶ Always verify certificates

Questions?