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TOMOYO Linux:
pragmatic and manageable security for Linux

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About

- This is the second part of “secure Linux” session.
- Focused on our work, TOMOYO Linux.
- TOMOYO provides “pragmatic and manageable” security.

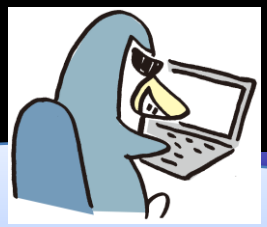
- Let’s get started!

What's TOMOYO Linux?

- A MAC extension for Linux kernel.
  - Other ones: SELinux, Smack, AppArmor
- TOMOYO Linux is NOT a Linux distribution.
- Developed by NTT DATA CORPORATION.
- Freely available under GPL since Nov, 2005.

- TOMOYO hooks various system calls and check whether the request is correct or incorrect.

Normal Linux



User

Application

Application

Application

Kernel

TOMOYO Linux

User

Application

Application

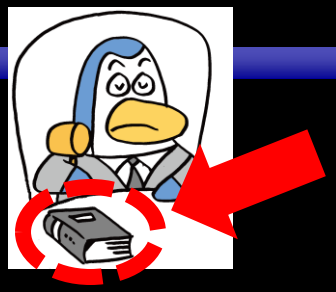
Application

TOMOYO Linux

Kernel

OK?
not OK?

Policy



- Rule book for judging OK/not OK.
  - List of permissions for each context.
- The most significant configuration of MAC.

- In case of TOMOYO,
  - Subject: process.
    - discriminated by its invocation history.
  - Object: file, network, capability, etc.

- I'll show you some examples later.

Pragmatic and manageable?

- Three features of TOMOYO Linux.
  - Readable and understandable policy.
  - Automatic policy learning mode.
  - Interactive judging in enforcing mode.

Readable and understandable policy

```
<kernel> /usr/sbin/sshd /bin/bash
allow_execute    /bin/ls
allow_read       /home/takedakn/.bashrc
allow_read/write /home/takedakn/.bash_history
```

- /bin/bash executed by /usr/sbin/sshd
  - may execute /bin/ls
  - may read /home/takedakn/.bashrc
  - may read and write /home/takedakn/.bash_history .

Readable and understandable policy

```
<kernel> /usr/sbin/httpd
allow_read    /var/www/html/\*
allow_read    /etc/httpd/\*.conf
allow_read    /usr/lib/httpd/modules/\*.so
allow_write   /var/log/httpd/\*_log
allow_create  /var/run/httpd.pid
allow_unlink  /var/run/httpd.pid
allow_network TCP bind   192.168.1.128 80
allow_network TCP listen 192.168.1.128 80
allow_network TCP accept 192.168.0.0-192.168.255.255 1024-65535
```

- /usr/sbin/httpd
  - may read /var/www/html/* and /etc/httpd/*.conf and /usr/lib/httpd/modules/*.so
  - may write /var/log/httpd/*_log
  - may create and unlink /var/run/httpd.pid
  - may bind and listen 192.168.1.128:80
  - may accept connections from 192.168.0.0/16:1024-65535 .

Readable and understandable policy

- It’s easy to read, isn’t it? ☺
- Then, is it easy to write?
  - not difficult, but…
- It’s a pain to write from scratch. ☹

➔Automatic policy learning

Automatic policy learning

- Seeing is believing.

Automatic policy learning

- A kind of access analysis.
- You can understand your Linux deeply by browsing learned policy.
- “Understanding is protecting.”

TOMOYO workflow

- **Set learning mode.**
- Just use your Linux.
- Tune policy.
  - Use wildcard and address/port range.
- **Set permissive mode.**
  - Policy violation won’t be denied, but be reported.
- Use your Linux and watch report.
- **Set enforcing mode!**

People say

- “It sounds great, but the lack of permission causes trouble, doesn’t it?”

- Yes, it does. ☹
  - That’s the way MAC is.
- However, TOMOYO supports you even in enforcing mode.

➔Interactive judging

Interactive judging

- Have you ever seen this?

Interactive judging

- Seeing is believing.

Interactive judging

- You can choose {deny, allow, allow&learn} for policy violation in enforcing mode.
  - deny: deny this request.
  - allow: allow this request (ask me again next time).
  - allow&learn: allow this request and add it into policy (i.e. don’t ask me again).
- Especially suits in system update.

Pragmatic and manageable security

- TOMOYO is NOT for
  - Security wizard.
- TOMOYO is for
  - Averagely experienced Linux administrator.

Possibilities of TOMOYO

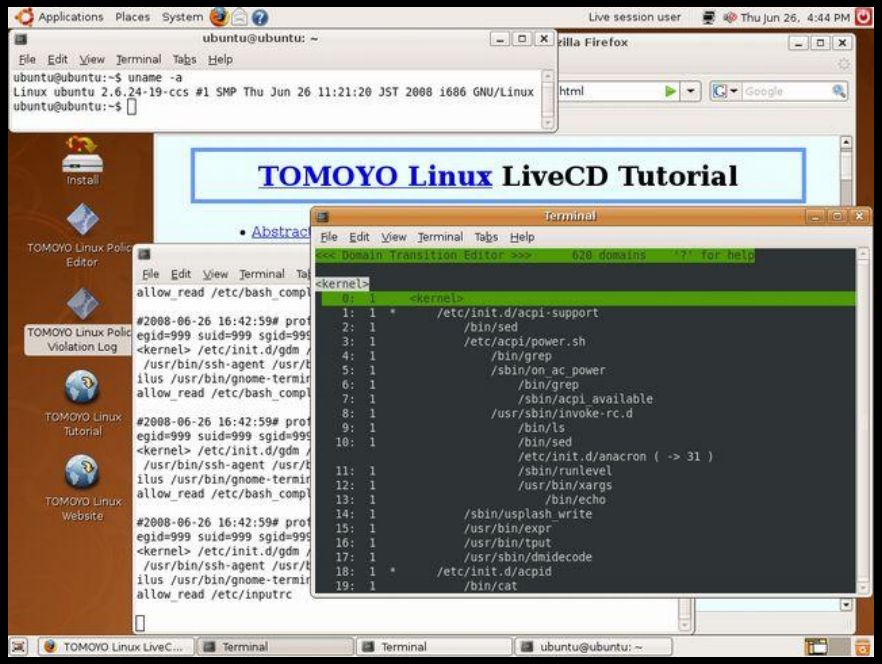
- Security.
  - Of course. ☺
- Application development and debugging.
  - TOMOYO can visualize the behavior of application.
- Education.
  - “How does my Linux work?”
  - You can understand your Linux deeply.

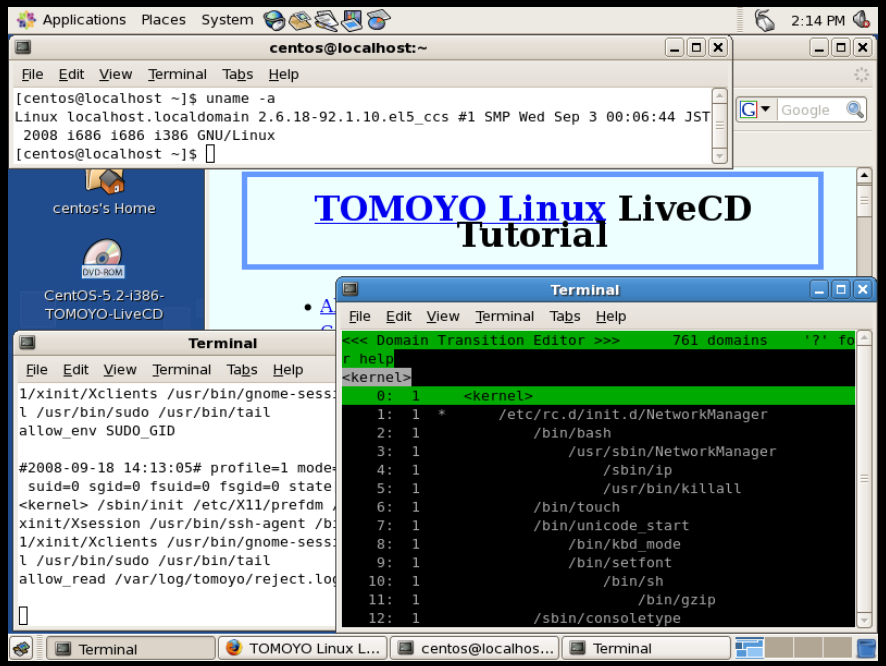
Installation

- Download and install kernel package.
  - For Red Hat (CentOS), SUSE, Ubuntu, Fedora, Debian.
- Download and install tools package.
  - For Red Hat (CentOS), SUSE, Ubuntu, Fedora, Debian, Mandriva, Turbolinux.
- Run /usr/lib/ccs/init_policy.sh .
- Reboot!

Easier way to try

- LiveCD available.
  - Based on Ubuntu, CentOS.





Mainlining

Current Linux kernel source tree

```
$ find linux-2.6/security -type d
linux-2.6/security/
linux-2.6/security/keys
linux-2.6/security/selinux
linux-2.6/security/selinux/include
linux-2.6/security/selinux/ss
linux-2.6/security/smack
```

Future… (our hope)

```
$ find linux-2.6/security -type d
linux-2.6/security/
linux-2.6/security/keys
linux-2.6/security/selinux
linux-2.6/security/selinux/include
linux-2.6/security/selinux/ss
linux-2.6/security/smack
linux-2.6/security/tomoyo
```

- Our current largest mission.
  - Tough work, but now in progress.

Pointers

- [Presentation material]
  - http://sourceforge.jp/projects/tomoyo/docs/freedomhectaipei-tomoyo.pdf
- [Official]
  - http://tomoyo.sourceforge.jp/
- [English portal]
  - http://elinux.org/TomoyoLinux
- [Mailing list]
  - http://lists.sourceforge.jp/mailman/listinfo/tomoyo-users-en
  - low traffic, feel free to post anything ☺
- [LiveCD]
  - http://tomoyo.sourceforge.jp/wiki-e/?TomoyoLive

Thank you!