Screen Sharing on Raspberry Pi 5 Using VNC in Weston and Wayland with the Yocto Project and OpenEmbedded

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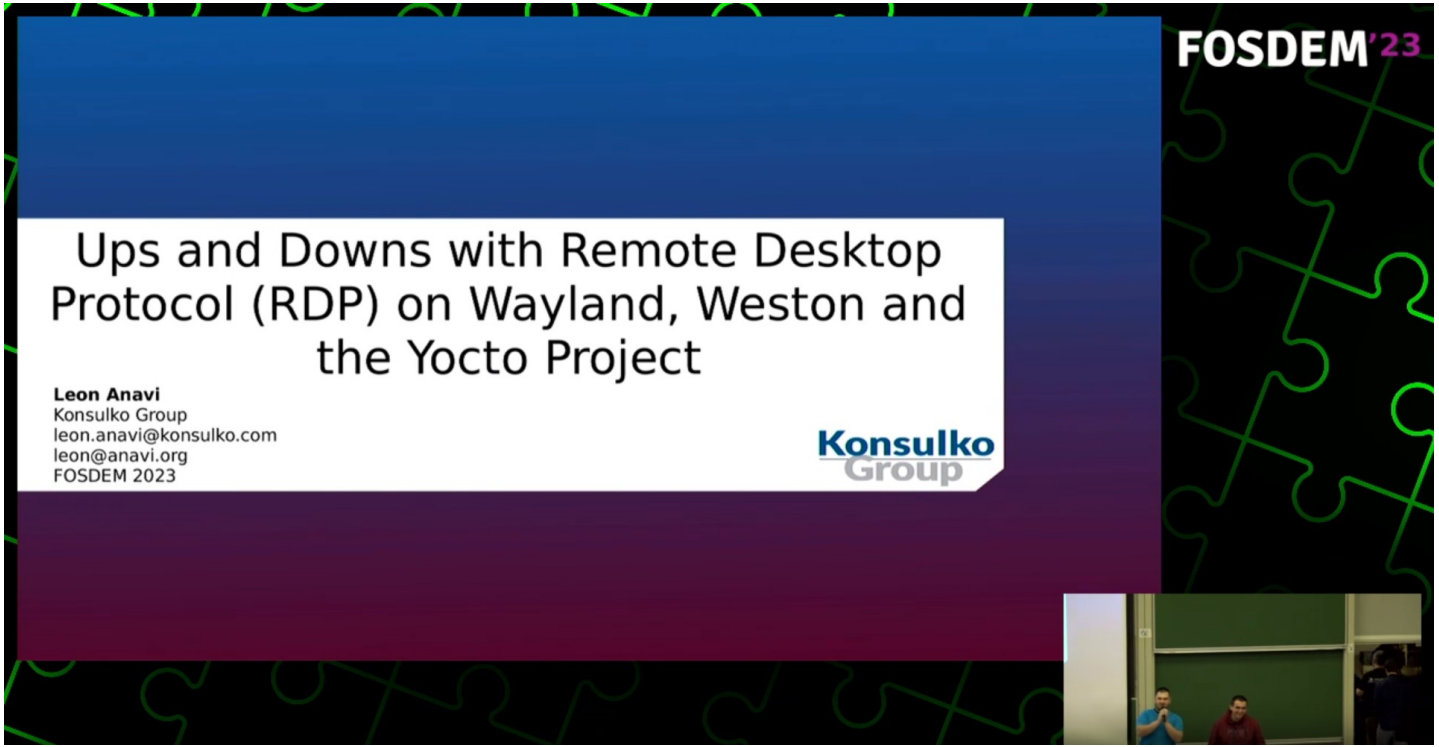
FOSDEM 2024

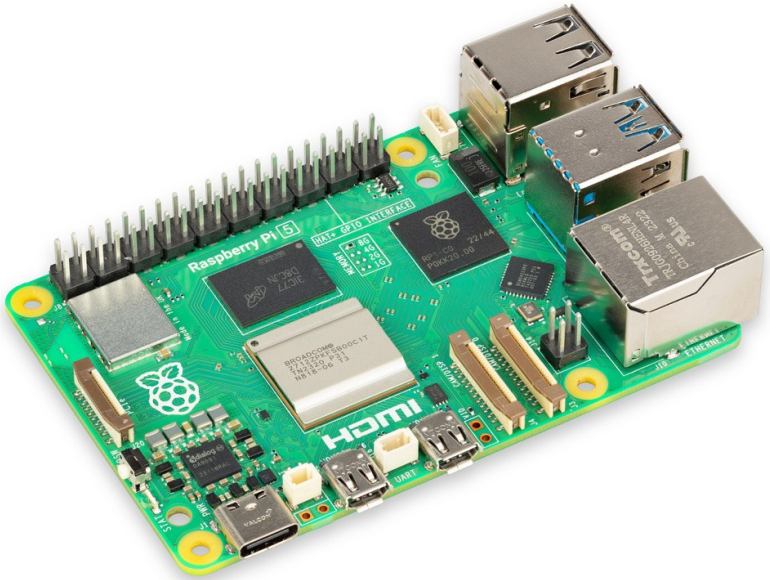
Konsulko Group

In Previous Episode



Agenda

- Wayland and Weston
- VNC
- Weston and the Yocto Project Releases
- core-image-weston with VNC demo on Raspberry Pi 5



Wayland & Weston

- Wayland is a display protocol that specifies the communication between a display server and its clients
- Started in 2008 with the aim to replace the X Window System in GNU/Linux and Unix-based distributions
- Security by design through isolation of the input and output of every window
- Weston is the reference Wayland compositor, there are many other compositors
- Weston 13.0 was released on November 27, 2023

Remote Desktop Options in Weston and Wayland

- Remote Desktop Protocol (RDP)
- Virtual Network Computing (VNC)

Virtual Network Computing (VNC)

- Graphical desktop-sharing system based on Remote Frame Buffer protocol (RFB)
- Initially Olivetti Research Laboratory developed and published RFB in 1998, next versions of the protocol were published by RealVNC Ltd
- Pixel based
- Works with all windowing systems and applications, including MS Windows, Mac OS, X11 and Wayland

RDP vs VNC

	RDP (Remote Desktop Protocol)	**VNC** (Virtual Network Computing)
Protocol	ITU-T T.128	Remote Frame Buffer protocol (RFB)
Type	Semantic (aware of controls, fonts and other graphical primitives)	Pixel based
Weston version	2.0 and newer	12.0 and newer
Weston support since	2016	2022

VNC in Weston

wayland › weston › Merge requests › !362

backend-vnc: add VNC support using Neat VNC library

Closed **Stefan Agner** requested to merge `agners/weston:rfc-vnc-su…` into `main` 3 years ago

Overview 54 | Commits 3 | Pipelines 10 | Changes 10

This adds basic VNC protocol support using the Neat VNC library (https://github.com/any1/neatvnc). This implementation does not support authentication and hardcodes the pixel format currently. It also does more copying then necessary at this point.

Signed-off-by: Stefan Agner stefan@agner.ch

This is a new attempt in trying to implement a (upstreamable) version of the VNC backend (see my previous attempt !279 (closed), I decided to create a new merge request as this is a different approach). This time I make use of the liberally license library Neat VNC which I only found recently.

- VNC in Weston

VNC in Weston

- VNC backend is available in Weston 12 and newer version
- VNC backend for Weston depends on NeatVNC
- NeatVNC is an open source VNC server library with a clean interface, started by Andri Yngvason with code available at GitHub under ISC license
- NeatVNC has build dependencies on libdrm, meson and pkg-config
- NeatVNC has a runtime dependency on aml (Andri's Main Loop)

The Yocto Project

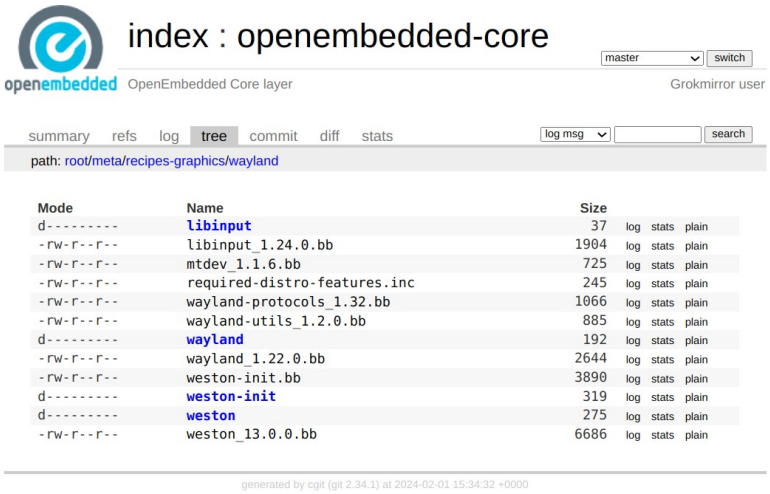
- Open source collaborative project of the Linux foundation for creating custom Linux-based distributions for embedded devices using the OpenEmbedded Build System
- **OpenEmbedded** Build System includes BitBake and OpenEmbedded Core
- **Poky** is a reference distribution of the Yocto Project provided as metadata, without binary files, to bootstrap your own distribution for embedded devices
- Bi-annual release cycle
- Long term support (LTS) release covering two-year period

The Yocto Project Releases

Codename	Version	Release Date	Support Level
Scarthgap	5.0	April 2024	Future – LTS (until April 2028)
Nanbield	4.3	November 2023	Until May 2024
Kirkstone	4.0	May 2022	LTS (until Apr. 2026)
Dunfell	3.1	April 2020	LTS (until Apr. 2024)

Wayland and Weston in Yocto and OpenEmbedded

- OpenEmbedded-Core is a layer containing the core metadata for current versions of OpenEmbedded
- OpenEmbedded-Core provides recipes for Wayland and Weston



The Yocto Project, Wayland and Weston Versions

Codename	Version	Wayland	Weston
Scarthgap	5.0	1.22 (?)	13.0.0 (?)
Nanbield	4.3	1.22	12.0.2
Kirkstone	4.0	1.20	10.0.2
Dunfell	3.1	1.18	8.0.0

Bitbaking Weston with VNC

Extend the recipe for building Weston:

- Enable VNC backend:

```
PACKAGECONFIG:append = " vnc"
```

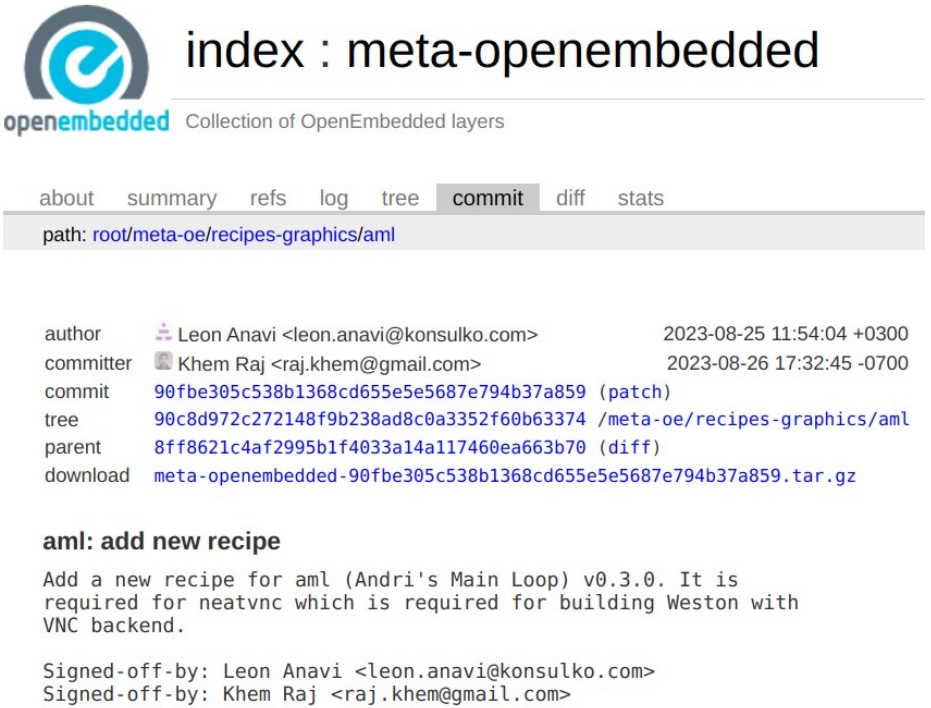
This will enable -Dbackend-vnc=true and add neatvnc (from layer meta-oe) as a build dependency

- Place a PAM configuration file in the package:

```
FILES:${PN}:append = " ${sysconfdir}/pam.d/weston-remote-access"
```

- For example, weston_%.bbappend:
https://github.com/leon-anavi/meta-weston-remote-desktop/blob/main/meta-weston-vnc/recipes-graphics/wayland/weston_%25.bbappend

aml and neatvnc in meta-oe



index : meta-openembedded

Collection of OpenEmbedded layers

about summary refs log tree commit diff stats

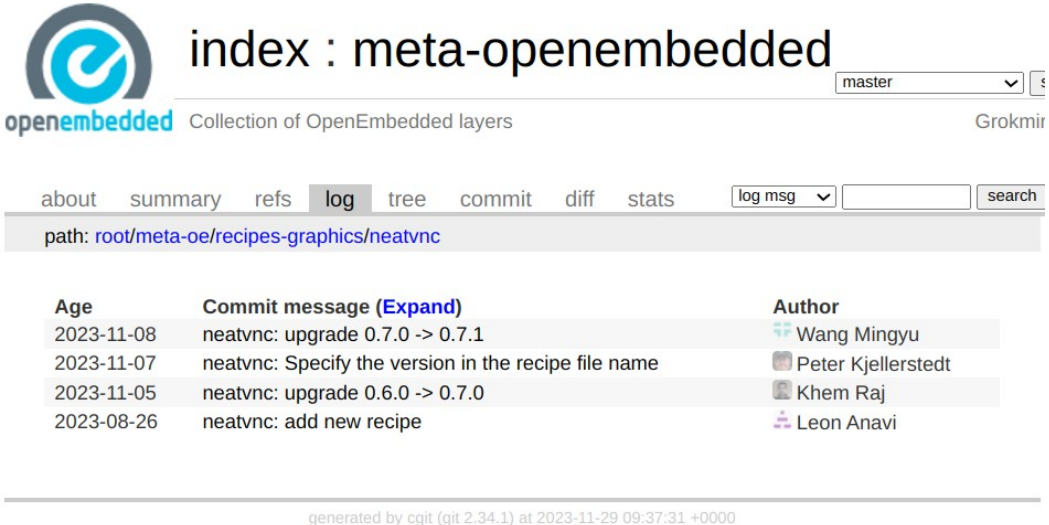
path: root/meta-oe/recipes-graphics/aml

author	Leon Anavi <leon.anavi@konsulko.com>	2023-08-25 11:54:04 +0300
committer	Khem Raj <raj.khem@gmail.com>	2023-08-26 17:32:45 -0700
commit	90fbe305c538b1368cd655e5e5687e794b37a859 (patch)	
tree	90c8d972c272148f9b238ad8c0a3352f60b63374 /meta-oe/recipes-graphics/aml	
parent	8ff8621c4af2995b1f4033a14a117460ea663b70 (diff)	
download	meta-openembedded-90fbe305c538b1368cd655e5e5687e794b37a859.tar.gz	

aml: add new recipe

```
Add a new recipe for aml (Andri's Main Loop) v0.3.0. It is
required for neatvnc which is required for building Weston with
VNC backend.

Signed-off-by: Leon Anavi <leon.anavi@konsulko.com>
Signed-off-by: Khem Raj <raj.khem@gmail.com>
```



index : meta-openembedded

master

Collection of OpenEmbedded layers

Grokmir

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log msg search

path: root/meta-oe/recipes-graphics/neatvnc

Age	Commit message (Expand)	Author
2023-11-08	neatvnc: upgrade 0.7.0 -> 0.7.1	Wang Mingyu
2023-11-07	neatvnc: Specify the version in the recipe file name	Peter Kjellerstedt
2023-11-05	neatvnc: upgrade 0.6.0 -> 0.7.0	Khem Raj
2023-08-26	neatvnc: add new recipe	Leon Anavi

generated by cgit (git 2.34.1) at 2023-11-29 09:37:31 +0000

Bitbaking NeatVNC for Weston with VNC

- Enable TLS:

```
PACKAGECONFIG:append = " tls"
```

- libweston/backend-vnc/meson.build from Weston 12 and 13:

```
dep_neatvnc = dependency('neatvnc', version: ['>= 0.6.0', '< 0.7.0'], required: false, fallback: ['neatvnc', 'neatvnc_dep'])
```

- libweston/backend-vnc/meson.build from Weston branch main:

```
dep_neatvnc = dependency('neatvnc', version: ['>= 0.7.0', '< 0.8.0'], required: false, fallback: ['neatvnc', 'neatvnc_dep'])
```

- Select NeatVNC matching Weston requirements, for example:

```
PREFERRED_VERSION_neatvnc = "git"
```

weston-init.bbappend

- Set password weston (from mkpasswd -m sha256crypt) for user weston:

```
WESTONPASSWD = "\$5\$409x651F5vyY1.4o\$Iuplll7/qNSEcflYNjH..0zwylmyLsbZdZGS6hBcro5"
USERADD_PARAM:${PN} = "--home /home/weston --shell /bin/sh --user-group -G
video,input,render,wayland -p '${WESTONPASSWD}' weston"
```

- Create a directory on the target device to store TLS key and certificate:

```
do_install:append(){
    install -m 0755 -d ${D}${sysconfdir}/vnc/keys/
    chown weston:weston ${D}${sysconfdir}/vnc/keys/
}
FILES:${PN} += "\
    ${sysconfdir}/vnc/keys \
"
```

TLS security

- Generate a key and certificate files to use with TLS security:

```
mkdir -p ~/.pki/CA/private/
cd ~/.pki/CA
openssl genrsa -out private/cakey.pem 2048
openssl req -new -x509 -nodes -days 365000 -key private/cakey.pem -out
cacert.pem
openssl genrsa -out tls.key 2048
openssl req -new -key tls.key -out tls.csr
openssl req -new -key tls.key -out tls.csr -subj "/CN=raspberrypi5"
openssl x509 -req -days 365 -in tls.csr -out tls.crt -CA cacert.pem -CAkey
private/cakey.pem
```

Using VNC on Weston

- Copy tls.crt and tls.key to /etc/vnc/keys on the target device, e.g. Raspberry Pi 5
- Enable VNC screen sharing in /etc/xdg/weston/weston.ini:

```
[screen-share]
command=/usr/bin/weston --backend=vnc-backend.so
--vnc-tls-cert=/etc/vnc/keys/tls.crt --vnc-tls-key=/etc/vnc/keys/tls.key --
shell=fullscreen-shell.so
```

- After loading Weston, press ctrl+alt+s to launch screen sharing

VNC Automatic Startup

- Launch Weston with screen-share.so, for example in Weston systemd service:

```
ExecStart=/usr/bin/weston --modules=systemd-notify.so,screen-share.so
```

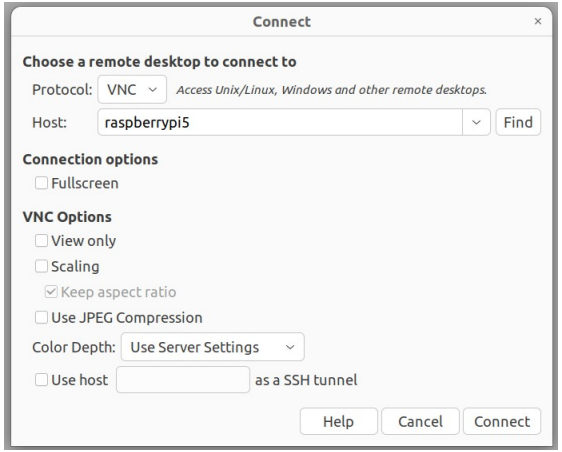
- Add start-on-startup=true to section [screen-share] in weston.ini:

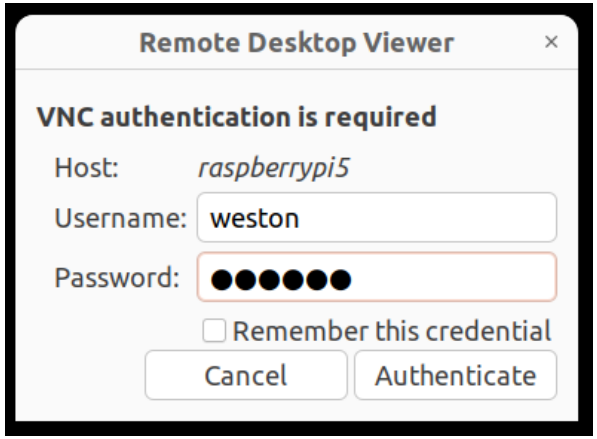
```
[screen-share]
command=/usr/bin/weston --backend=vnc-backend.so
--vnc-tls-cert=/etc/vnc/keys/tls.crt --vnc-tls-key=/etc/vnc/keys/tls.key --
shell=fullscreen-shell.so
start-on-startup=true
```

Remote Connection

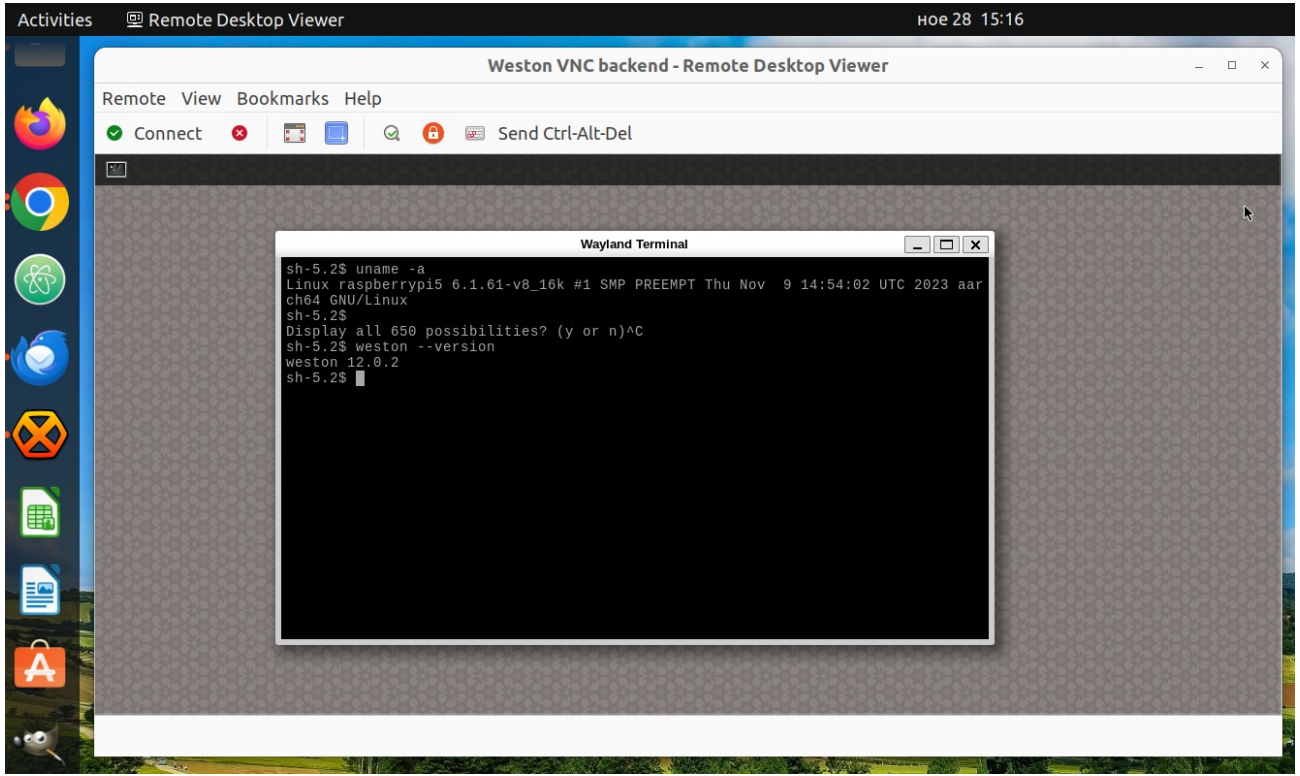
- From another computer in the same network connect to the embedded device using a VNC client, for example with vinagre, an open source remote desktop viewer for Linux and the GNOME Desktop:

```
vinagre --gtk-vnc-debug
```



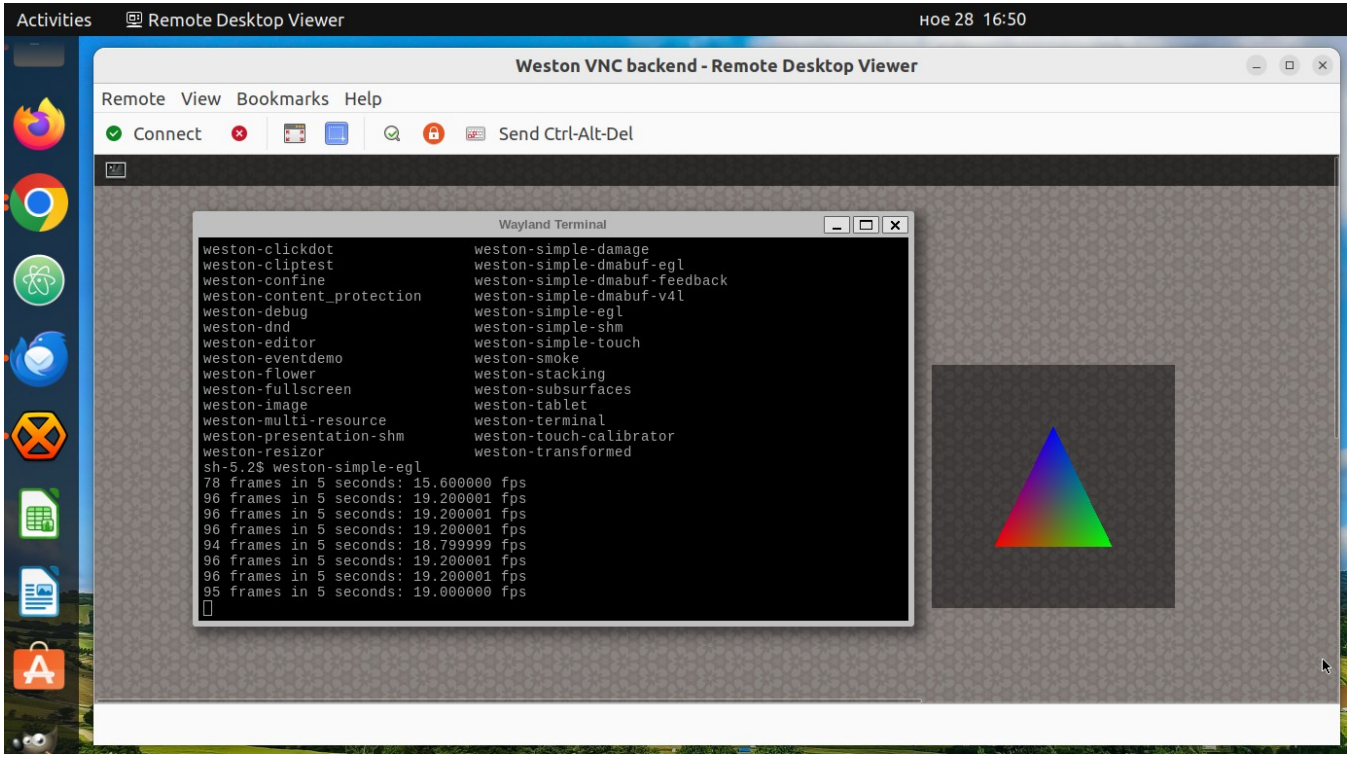


VNC Demo



- Vinagre on Ubuntu 22.04.3 LTS with X11 and GNOME 42.9
- core-image-weston with Weston version 12.0.2 on Raspberry Pi 5 (using BSP layer meta-raspberrypi)

VNC Frames per Second on Raspberry Pi 5



- With VNC enabled weston-simple-egl runs with up to 20fps on Raspberry Pi 5

QA

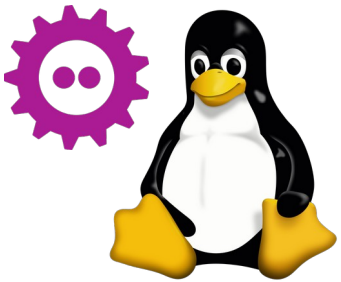
- Raspberry Pi 5
- Raspberry Pi 4
- ROCK Pi 4
- Toradex Verdin i.MX8M Plus SoM

- **Notes:**
  As of the moment Weston 12 (or newer) with etnaviv open source driver should be used on NXP i.MX6, i.MX7, i.MX8, etc.
  The fork weston-imx for Vivante proprietary GPU driver hasn’t been upgraded to Weston 12 yet. Therefore VNC backend is still not available in weston-imx.

Conclusions

- VNC is a pixel based graphical desktop-sharing system
- VNC backend was added in Weston version 12
- VNC backend in Weston depends on NeatVNC and aml
- Generate appropriate key and certificate files for TLS encryption
- The latest versions of the Yocto Project and OpenEmbedded provide the necessary tools and dependencies to build core-image-weston and to enable VNC
- Layer meta-weston-remote-desktop provides example integrations of both VNC and RDP in Weston

Thank You!



yocto PROJECT · openembedded

Useful links

- Wayland
  https://wayland.freedesktop.org/
- Weston source code
  https://gitlab.freedesktop.org/wayland/weston
- The Yocto Project
  https://www.yoctoproject.org/
- The Yocto Project releases
  https://wiki.yoctoproject.org/wiki/Releases
- Simple example Yocto/OE layer for VNC and RDP on Weston:
  https://github.com/leon-anavi/meta-weston-remote-desktop/tree/main