



THE LINUX FOUNDATION
OPEN SOURCE SUMMIT
EUROPE

Zephyr in Education

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About us



- Flavio Felder, Research Associate – felf@zhaw.ch
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- Institute of Embedded Systems
- Zurich University of Applied Sciences (ZHAW), Winterthur, Switzerland

Institute of Embedded Systems, Zurich University of Applied Sciences (ZHAW)

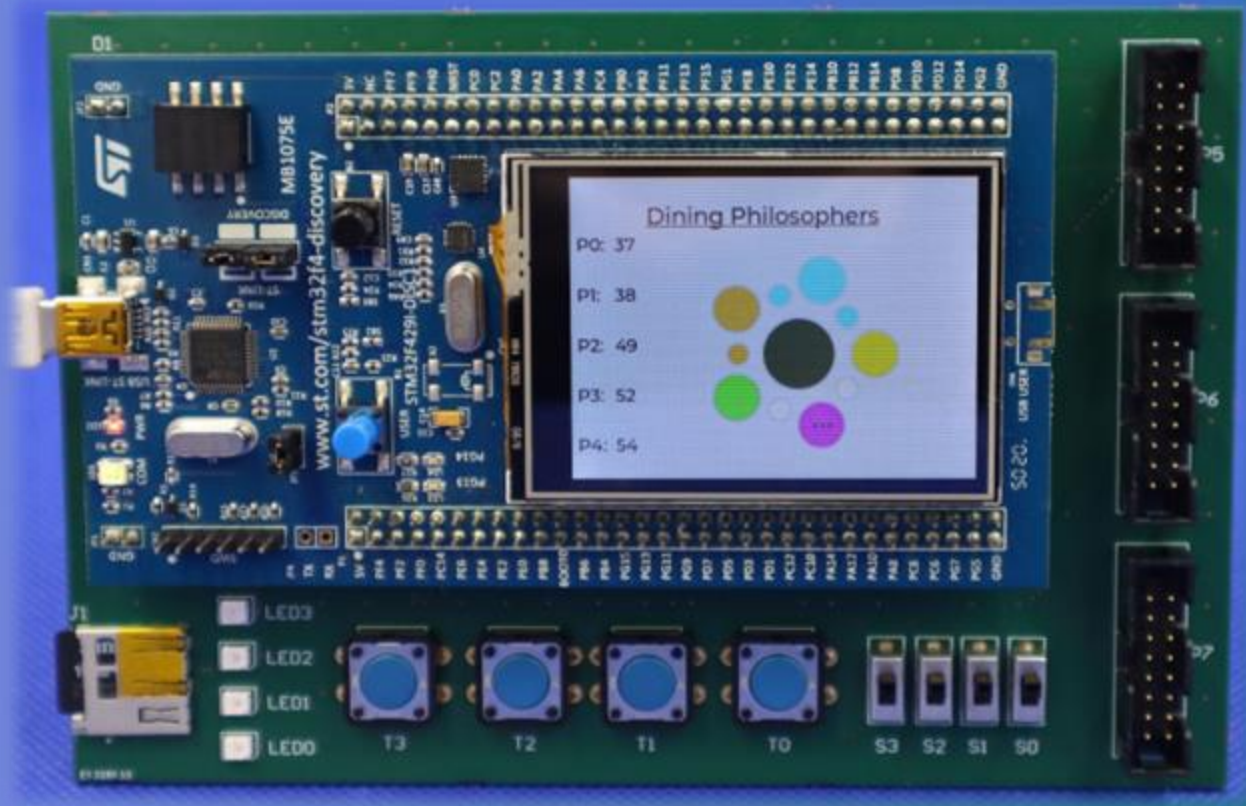
- Zephyr in research projects since 2019 (v1.14)
 - Evaluation of the Zephyr RTOS in a Master's thesis
 - Wide adoption of Zephyr RTOS in research and development projects

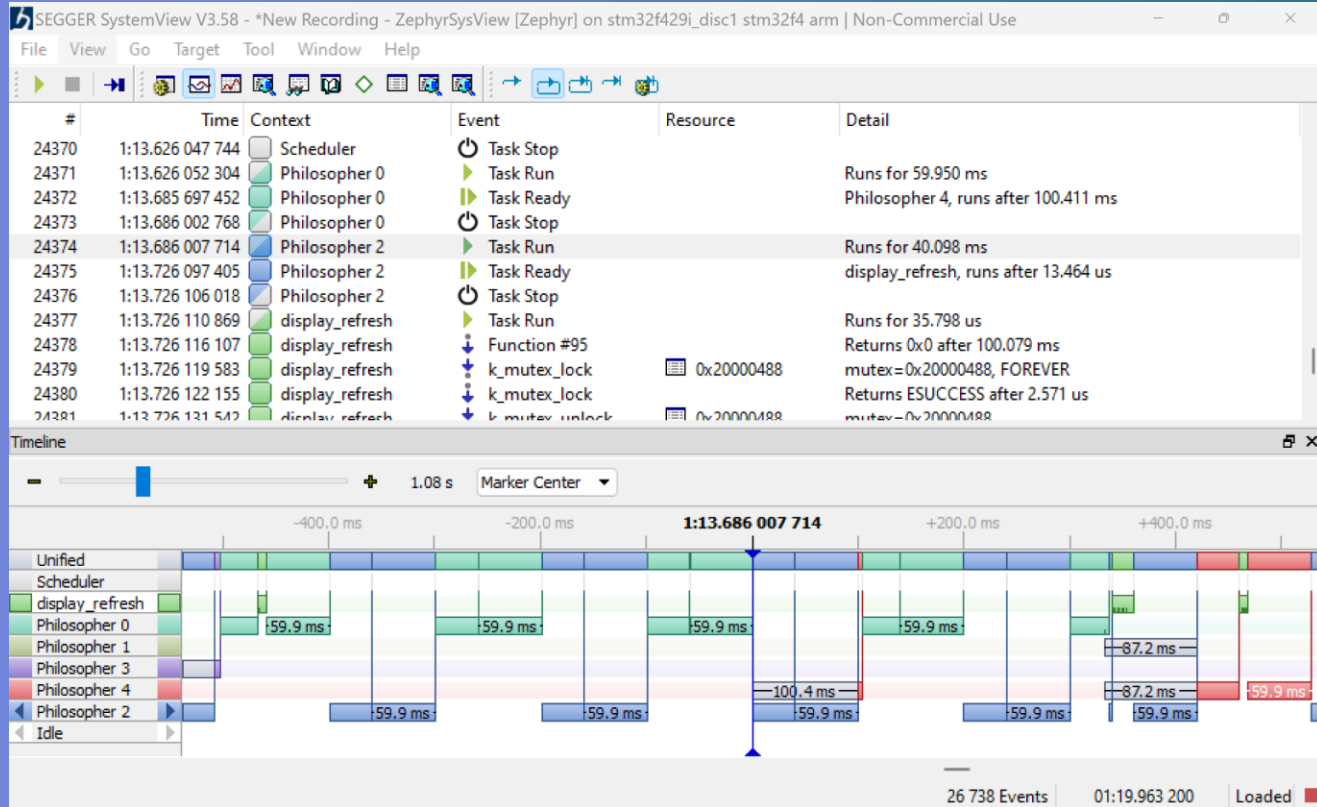
Institute of Embedded Systems, ZHAW

- Now also in education
 - Zephyr RTOS is used in laboratories of several lectures
 - Microcomputing Systems 1 (BSc programme)
 - Embedded Real-Time Software (MSc programme)
 - Embedded Security (continuing education)
 - Firmware of student projects (Bachelor/Master theses)

Embedded Real-Time Software (Master)

- Threads and Scheduling Concepts
- Resource Locks (Mutexes, Semaphores, Dining Philosophers Problem)
- Debugging (SEGGER Ozone, SEGGER SystemView)

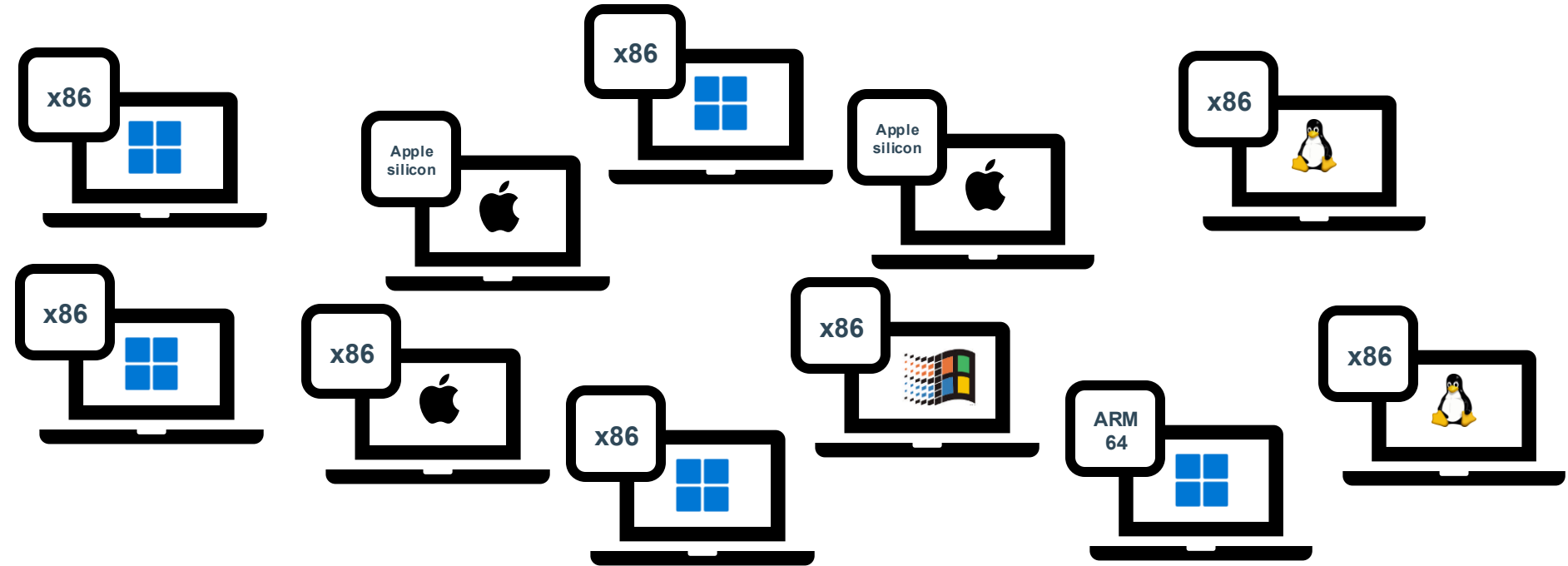




Problems with Zephyr RTOS in Education



Problems with Zephyr RTOS in Education



Development Environment for Students

Goal:

- Works on Windows, macOS and Linux
- Uniform
- Reproducible
- Easy to maintain
- Easy and quick to set up
- Easy to use

Initial Solution: Ubuntu Desktop VM

Identified Problems:

- Not reproducible
- Time consuming to set up and maintain
- Large (≈ 10 GiB)
- Uses a lot of resources (storage, RAM, CPU)
- Forces students to work inside of VM
- File sharing is unreliable
- Prompts the user to install updates

Current Solution: Container / WSL Image

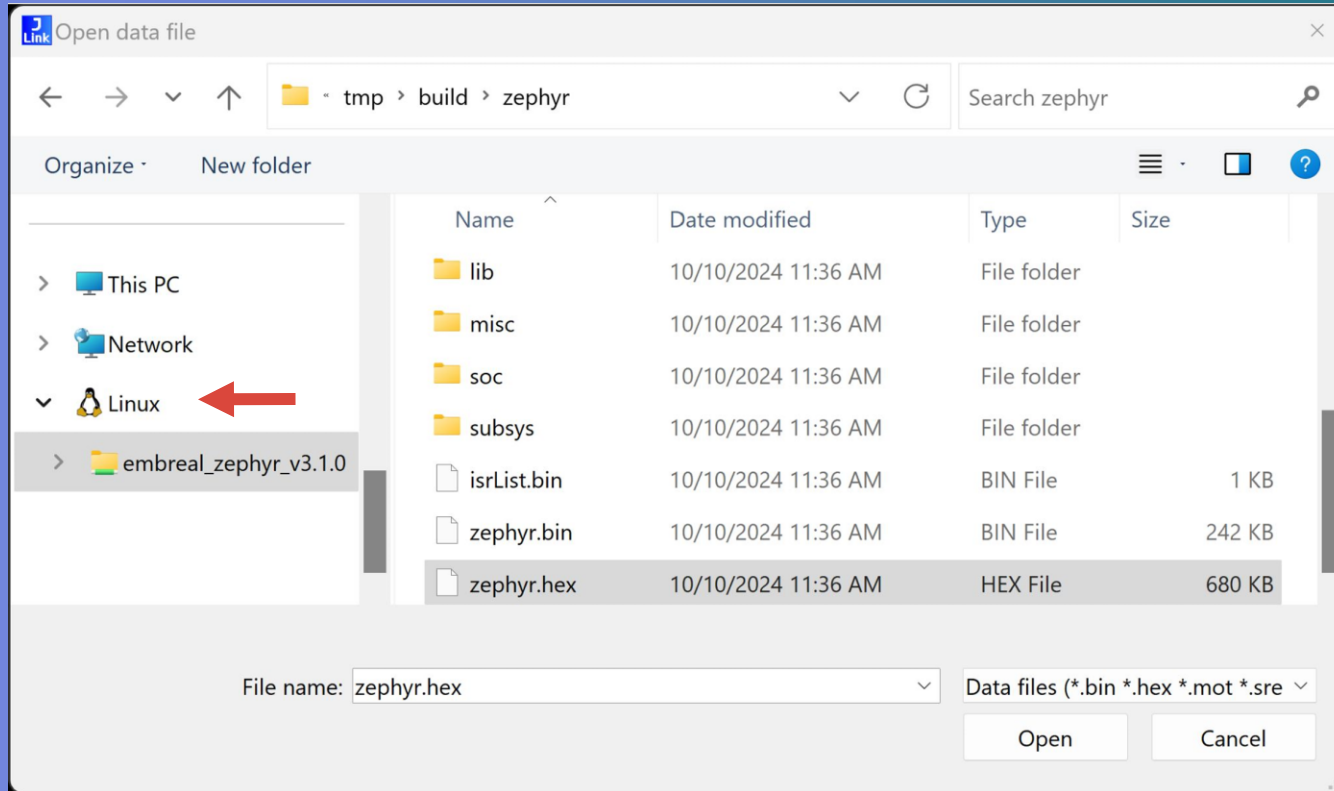
Advantages:

- + Sufficiently reproducible
- + Small (≈ 2 GiB / ≈ 0.5 GiB compressed)
- + Lean resource usage
- + Reliable file sharing
- + Students can use their preferred editor

Disadvantage:

- WSL: hardware is not accessible out of the box

SEGGER tools (J-Flash Lite, J-Link scripts) are used on host for flashing the board



Development Environment for Students

- Simplified Version of a Containerfile

FROM debian:12-slim

```
# Install apt packages
# Install pip packages
# Install Zephyr SDK
# Clone Zephyr
```

WORKDIR /root/dev

CMD ["bash"]

Development Environment for Students

- **Container Build Commands**

```
podman build \  
  --build-arg="ZEPHYR_VERSION=4.2.0" \  
  --build-arg="SDK_VERSION=0.17.2" \  
  --build-arg="MODULES=cmsis hal_nordic mbedtls mcuboot segger" \  
  --build-arg="ADDITIONAL_PYTHON_PACKAGES=imgtool" \  
  --build-arg="ADDITIONAL_APT_PACKAGES=xxd binutils" \  
  . -t zephyr_nrf_v4.2.0
```

Development Environment for Students

- **Export file system of container**

```
cid=$(podman create zephyr_nrf_v4.2.0)
```

```
podman export $cid | zstd -T0 -19 > zephyr_nrf_v4.2.0_wsl.tar.zst
```

```
podman rm $cid
```

- **Import file system as WSL2 distro on Windows**

```
mkdir "C:\WSL\zephyr_v4.2.0"
```

```
wsl --import zephyr_v4.2.0 "C:\WSL\zephyr_v4.2.0" `
```

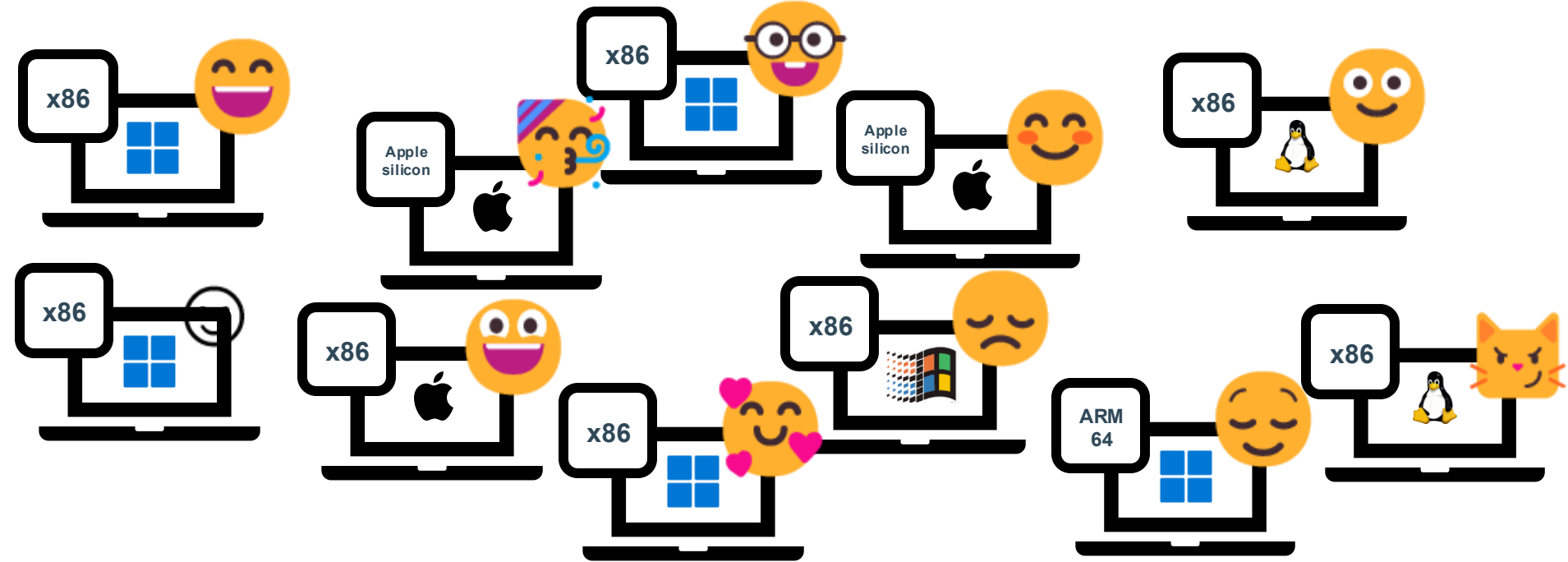
```
zephyr_nrf_v4.2.0_wsl.tar.zst
```

```
wsl -d zephyr_v4.2.0
```

Development Environment for Students

- **Successfully conducted several iterations with container**
 - Pleasant setup experience
 - Could cope with heterogeneity
 - All students had a working setup
 - Positive students feedback

Development Environment for Students



More Information



[GitHub-Repo](#)



[ZHAW InES](#)