Rinnovo ed evoluzioni di un prodotto

Trasformare il codice del passato in soluzioni future

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xedotnet.org

Un ringraziamento a...

Chi siamo...

Mirco Vanini
Microsoft MVP Developer Technologies

Consulente con oltre 35 anni di esperienza, specializzato in soluzioni industriali ed embedded, cofondatore della community XeDotNet, relatore e Microsoft MVP dal 2012

Simone Tolotti
Software and Firmware Architect @ Schneider Electric

Sviluppatore Firmware Embedded: C/C++ su piattaforme ARM ed Embedded Linux per prodotti industriali con più di 15 anni di esperienza

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Most Valuable Professional

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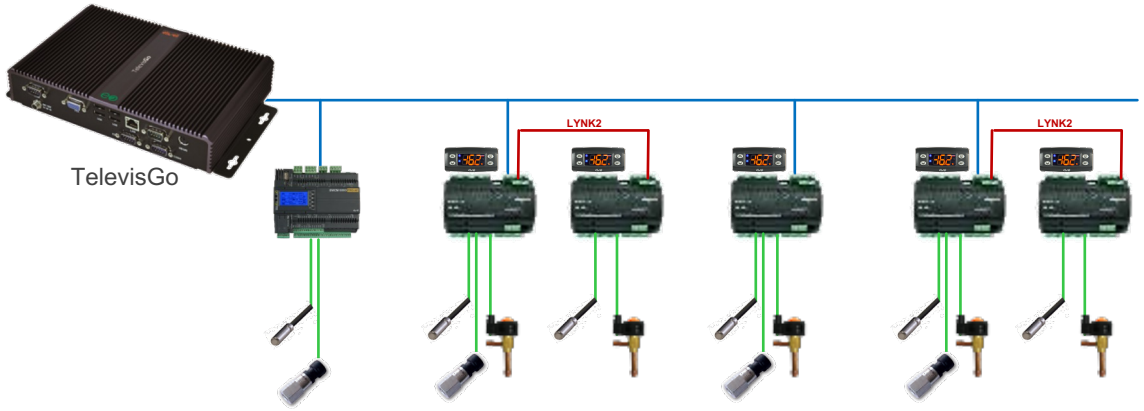
Prodotto Televis Go 1/2

- Qual è l'applicazione?
  - Supervisore per Refrigerazione Commerciale
  - Dominio Food Retail / **Supermarket**
  - Tecnologia bus di campo come per l'Industrial Automation



- Cosa fa
  - Acquisizione dati, monitoraggio strumenti e allarmistica
  - Salvataggio dati (DB)
  - Reportistica e HACCP
  - Analisi dati con grafici e logs
  - Manutenzione remota e integrazione con sistemi di Building

Prodotto Televis Go 2/2

- Piattaforma Tecnologica
  - CPU Intel Celeron @ 1.83 GHz (N2930)
  - RAM 4GB
  - HD 200GB+
  - Win 10 Enterprise (64 bit)

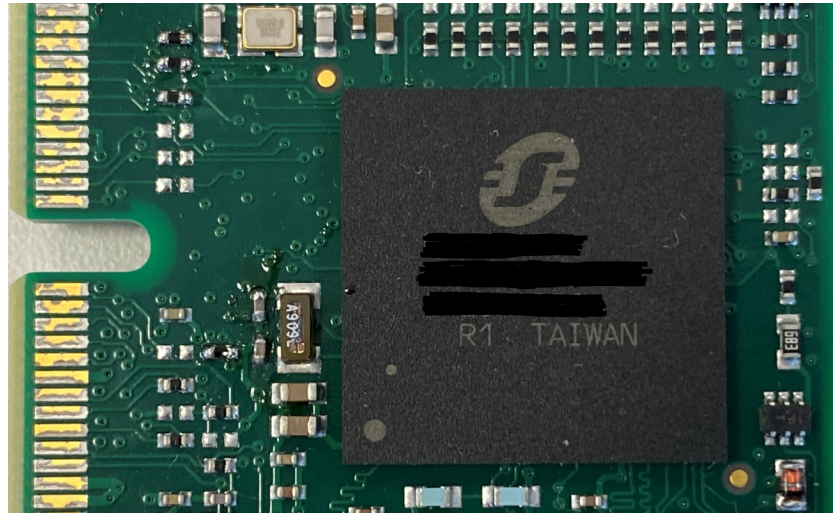
- Software
  - .Net Framework v4.8
  - Database SQL
  - Monolite Data Acquistion + Business Logic + Asp .Net

- Aggiornamenti negli anni
  - HW (start x86…)
  - OS (start Windows CE, Windows XP Embedded…)
  - .NET (Compact Framework 2.0, Net Framework 3.5…)
  - SW (Refresh alcune pagine in React)

Nuove esigenze…

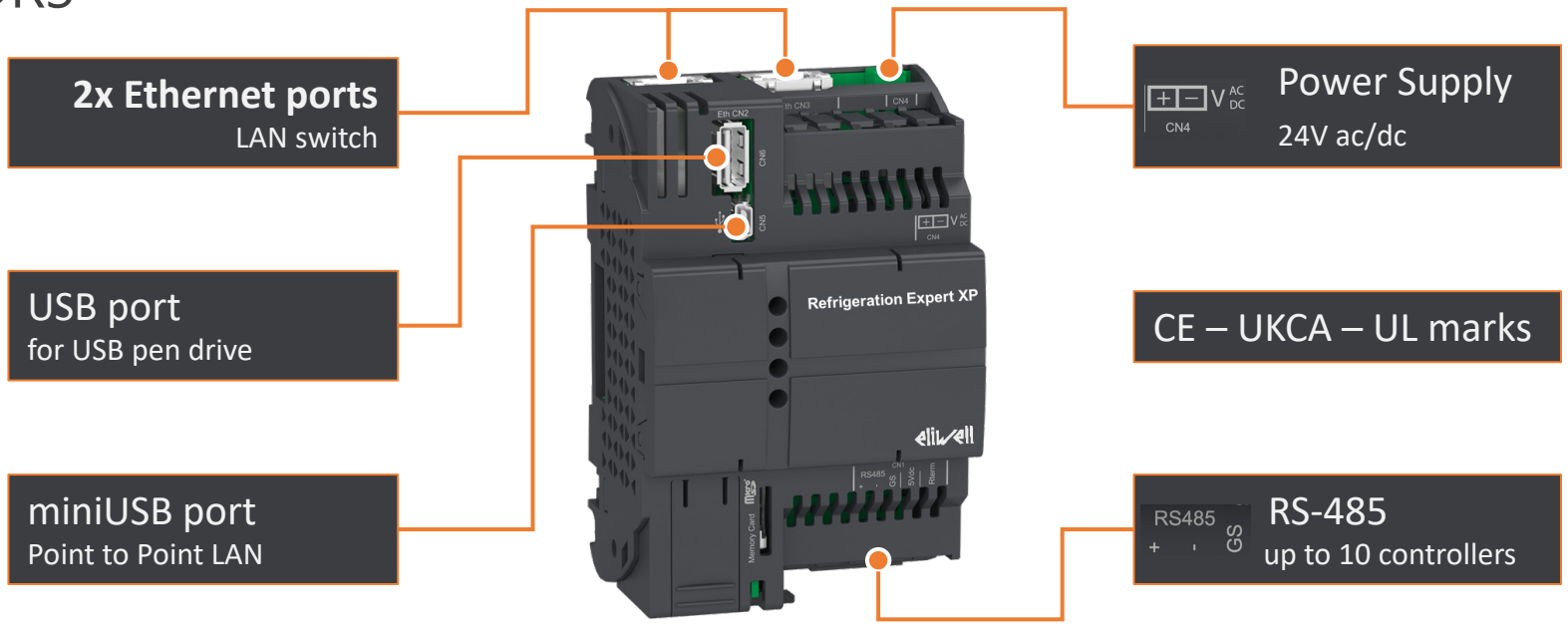
- Dopo 15 anni, i limiti:
  - Architettura PC → HW soggetto ad obsolescenza
  - Soluzione competitiva per supermarket meno food retail
  - Dimensioni e consumi
  - UI da svecchiare
  - Licenza di Windows
  - Gestione macchina Windows
  - Cybersecurity

Nuova Architettura HW/FW di Gruppo



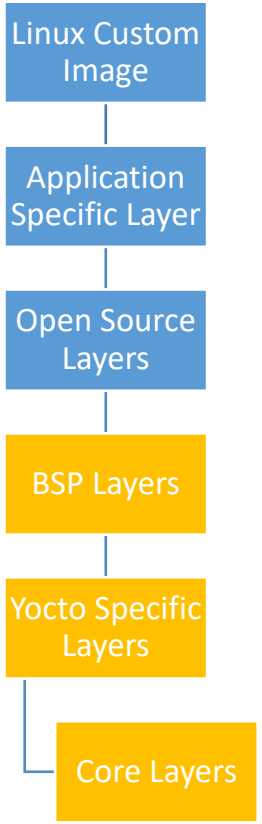
Cambio Tecnologico 1/2

- HW
  - SoC: dual Cortex A7 (ARMv7) @ 500MHz
  - 1024 MB RAM DDR3
  - 1024 MB Nand



Cambio Tecnologico

- OS
  - Yocto Linux



Vantaggi nuova architettura

- HW in «casa»
  - Progettazione e Produzione
- Design in «casa»
  - 4 din
- SoC in «casa»
  - Documentazione non pubblica
  - Architettura Arm
- OS in «casa»
  - Personalizzato per il domino
  - Uso di Yocto

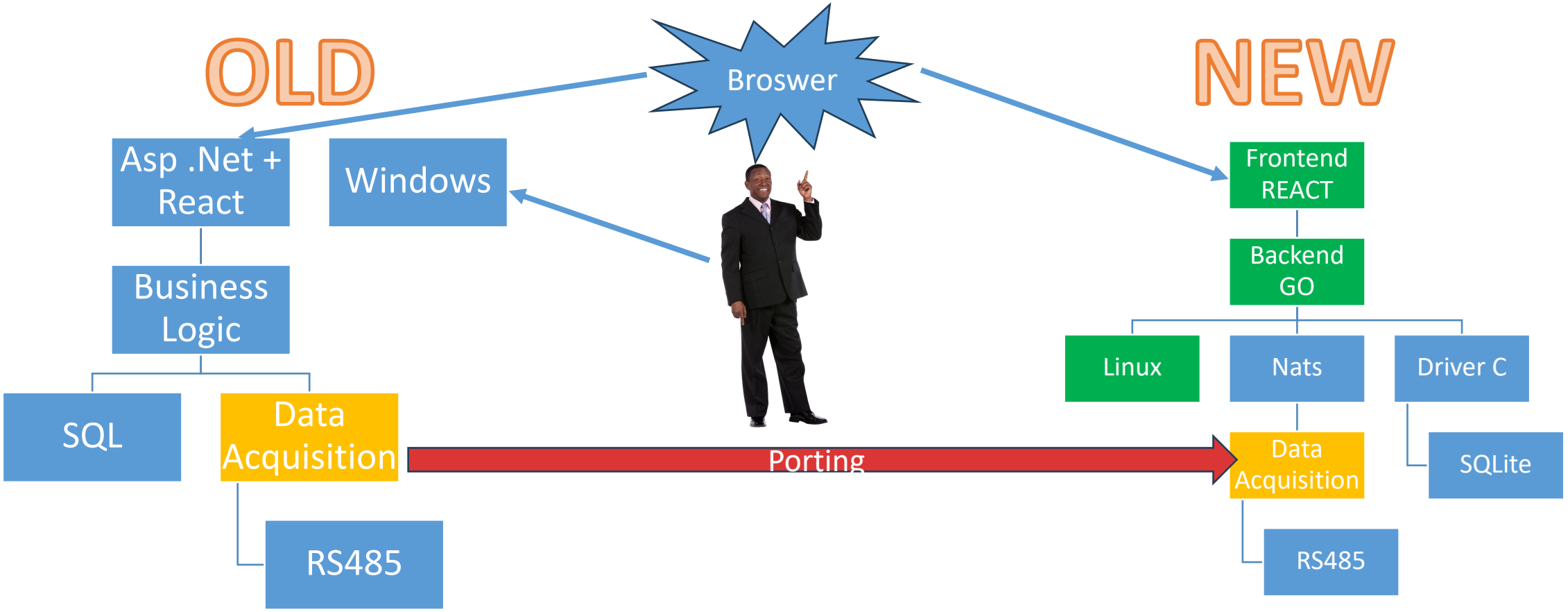
- Maggior controllo produzione
- Prodotto Compatto
- Cybersecurity
- Efficientamento energetico
- No licenza Windows
- Scalabile

+ Efficiente

Miglior Target per «Piccoli»

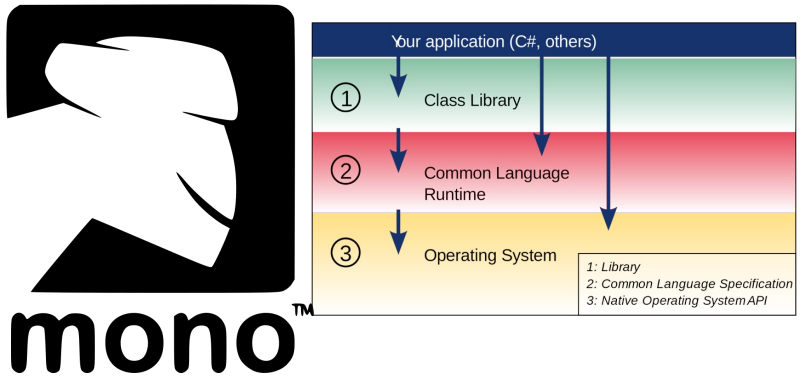
E il Software ??? 3 Obiettivi:

- Riciclare tutti i driver per la comunicazione di centinaia di strumenti
- Riciclare l'Expertise del team Webapp sulla stessa piattaforma Linux
- Utente per alcune opzioni amministrative, non dovrà più accedere al OS ma solo tramite la Webapp



Porting codice Data Acquisition

- Mono Project
  - Esiste dal 2004, ex Mono hanno fondato Xamarin*…
  - Esegue applicazioni .Net Framework multipiattoforma
  - Install Mono on Linux
  - ARM | Mono

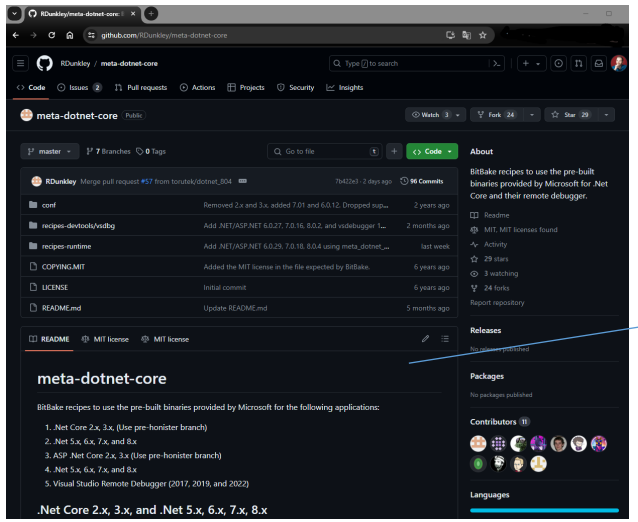


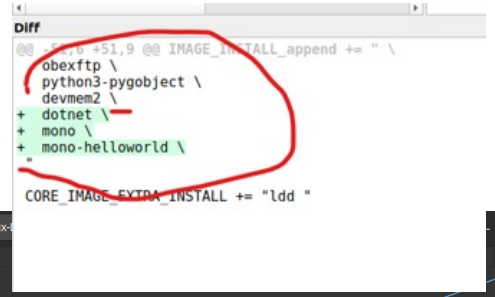
- .NET Core 6.0 LTS
  - 13 December 2022
  - Finalmente Multipiattoforma
    - Windows, Linux, macOS, Android and iOS
    - IA-32, x86-64, s390x and ARM
  - Install .NET on Linux by using an install script or by extracting binaries
  - Dependencies

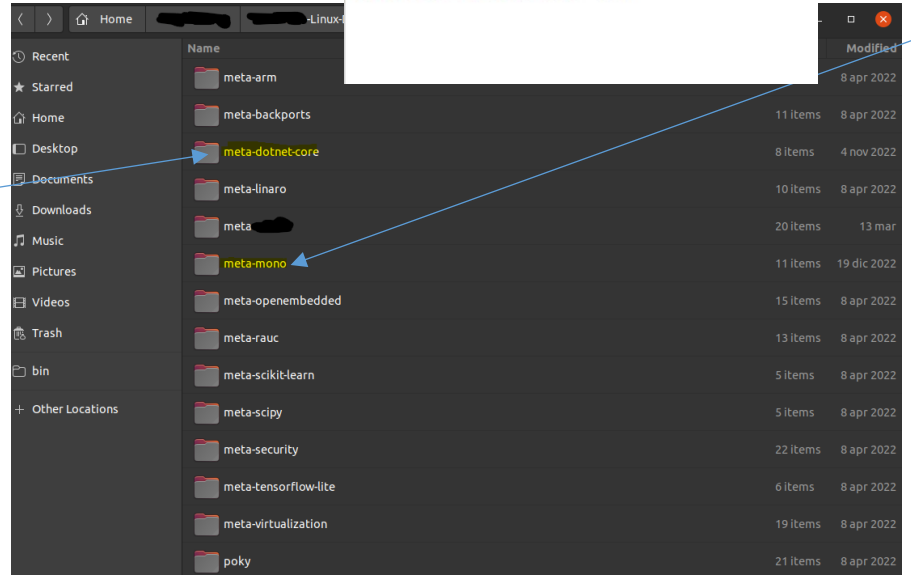
*ma questa è un'altra storia

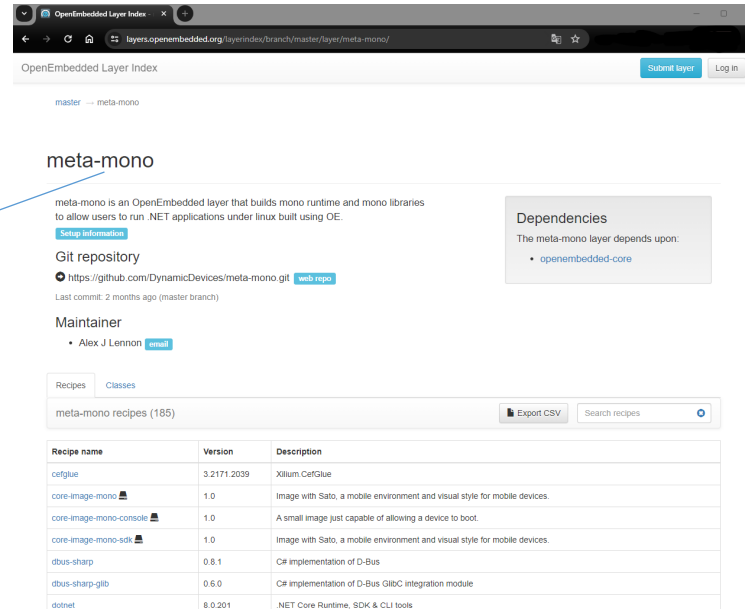
Yocto & .Net

- Aggiunta Meta-layers:
  - Mono: https://layers.openembedded.org/layerindex/branch/master/layer/meta-mono/
  - .net Core: https://github.com/RDunkley/meta-dotnet-core
- Aggiunta Ricette

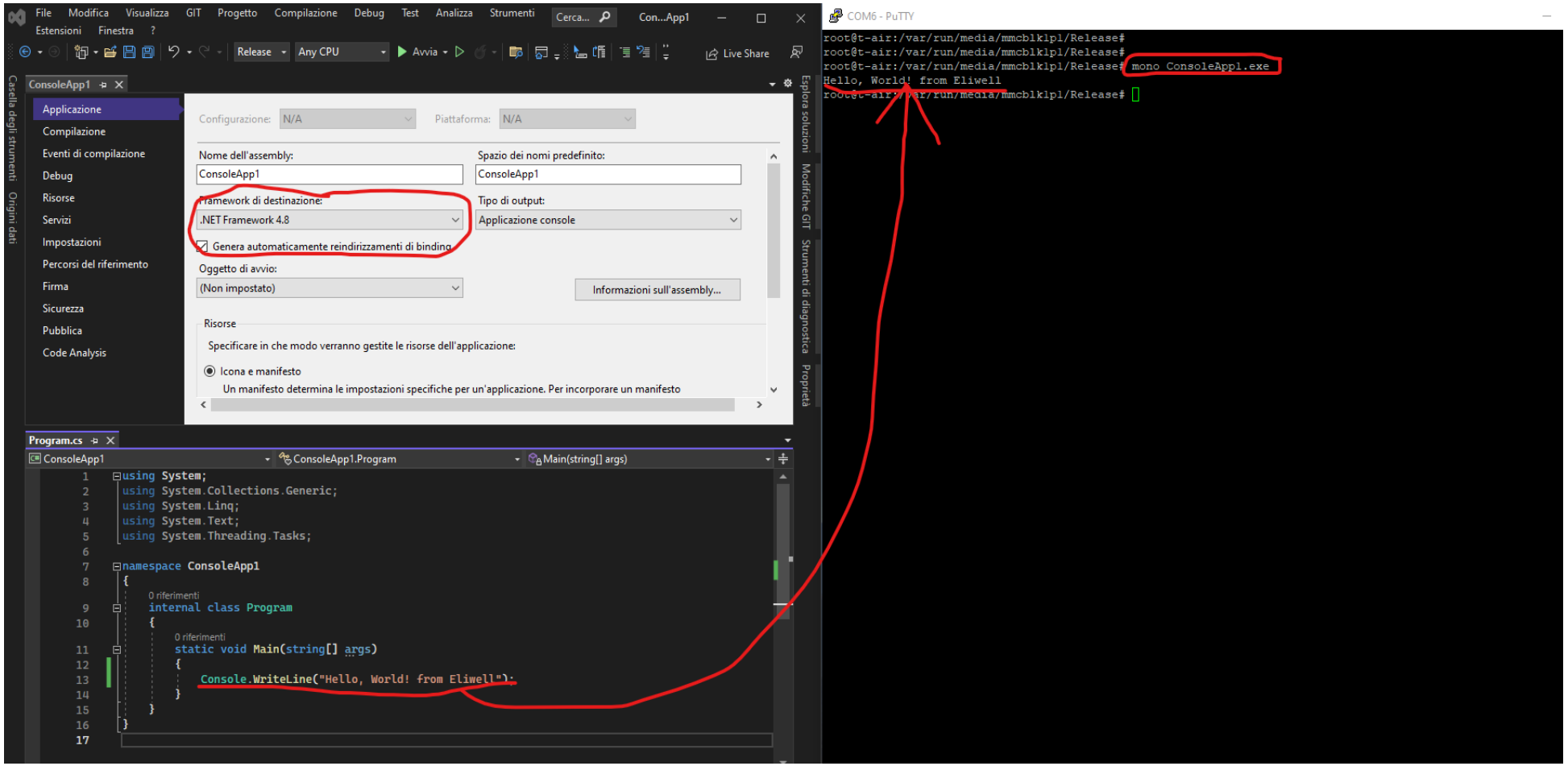






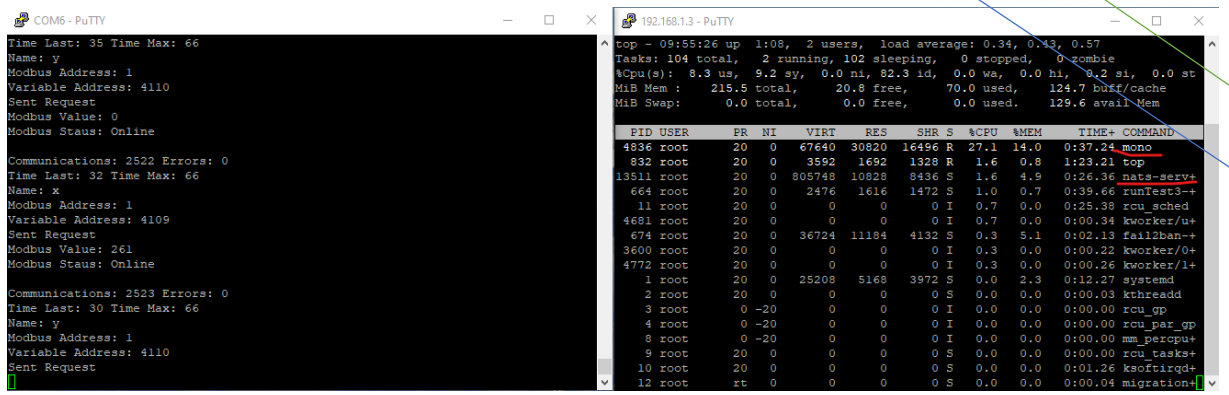


Hello world, «Mono»



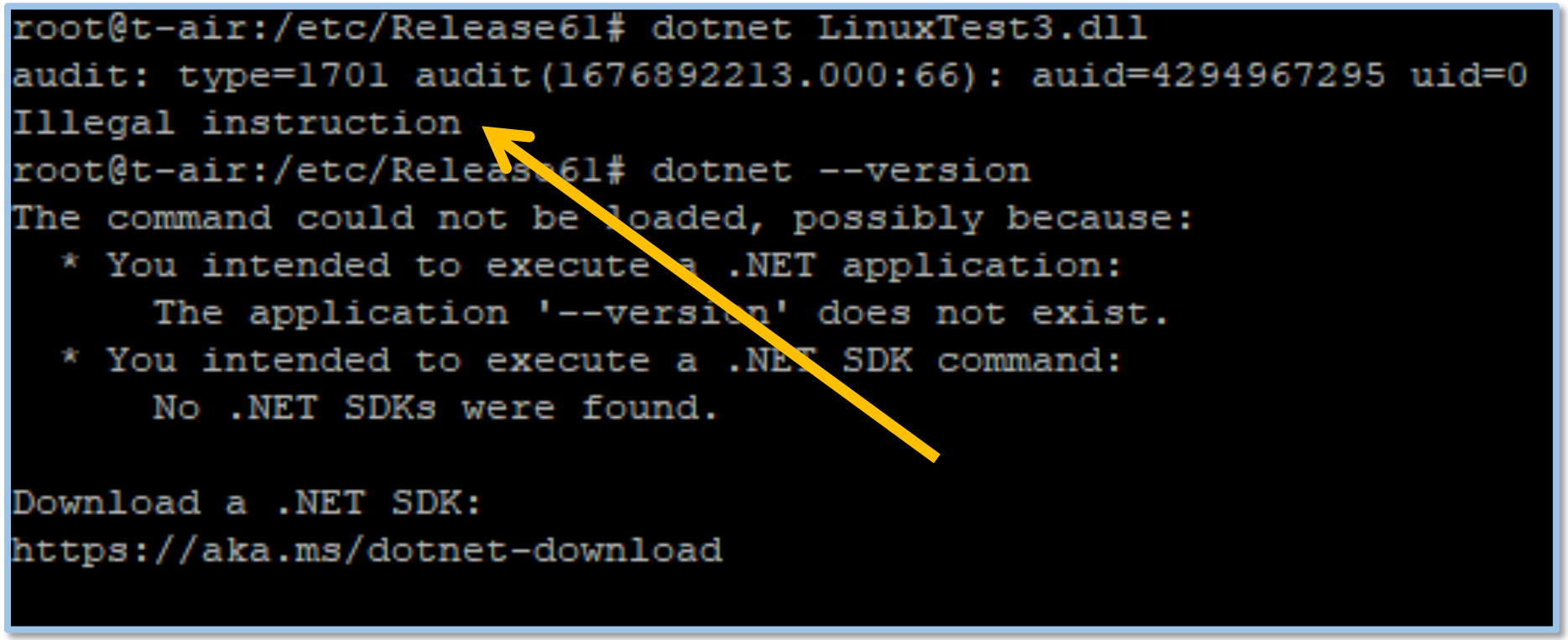
POC Data Acquisition «Mono»

- Deserialization parameters from Json
- Continuos Loop
  - read from Modbus RS485
  - @9600, parity none, 1 stop
  - No delay beetwen packet (maximum bandwith)
  - Approximately 7+3,5*+5+3,5 ms /resource
  - Total cycle: 2 resources (50ms)
- Push data to Nats server
  - Create and push Json
  - Send packet 1 each 10 read from field (push every 250ms)




```
foreach (var device in devices)
{
    Console.WriteLine("Name: " + device.Name);
    Console.WriteLine("Modbus Address: " + device.ModbusInstrumentAddress);
    Console.WriteLine("Variable Address: " + device.ModbusVariableAddress);

    long unixtime;

    device.Status = DeviceStatus.Offline;

    if (modBus.ModbusRequest03((byte)device.ModbusInstrumentAddress, (ushort)device.ModbusVariableAddress, 1))
    {
        Console.WriteLine("Sent Request");

        while (modBus.Ready != true)
        {
            // do nothing !!!
            Thread.Sleep(10);
        }

        unixtime = DateTimeOffset.UtcNow.ToUnixTimeSeconds();

        if (modBus.Valid)
        {
            int bufferValue = ModbusConverter.Bytes_to_Integer(modBus.ReceivedFrame[3], modBus.ReceivedFrame[4]);

            device.Value = bufferValue;
            device.Status = DeviceStatus.Online;
            Console.WriteLine("Modbus Value: " + device.Value);
        }
        else
        {
            Console.WriteLine("Received bytes: " + modBus.ReceivedFrame.Length);

            foreach (byte b in modBus.ReceivedFrame)
            {
                Console.WriteLine(b);
            }
        }

        Console.WriteLine("Modbus Staus: " + device.Status);
        Console.WriteLine();
        Console.WriteLine("Communications: " + modBus.Statistics.NumberOfCommunication.ToString() + " Errors: " + modBus.Statistics.NumberOfError.ToString());
        Console.WriteLine("Time Last: " + modBus.Statistics.TimeLast.ToString() + " Time Max: " + modBus.Statistics.TimeMax.ToString());

        if (device.Cycle++ >= serialSettings.DecimationCycle)
        {
            var meta = device.Status == DeviceStatus.Online ? 0 : 1;
            var realValue = device.Value * 100;

            var jsonToRedis = "{\"name\":\"" + device.Name + "\",\"value\":" + realValue + ",\"timestamp\":" + unixtime + ",\"meta\":" + meta + "}";

            c.Publish("ModbusResource", Encoding.UTF8.GetBytes(jsonToRedis));

            Console.WriteLine(jsonToRedis);
            device.Cycle = 0;
        }
    }
    else
        Console.WriteLine("Error Sent Request");
```

Hello world, «.net Core»



- Illegal instruction on ARM Cortex-A5 #9969
- armv6: Segmentation fault while running dotnet

CPU ARM con vfpv3d16 e .NET Core

```
root@m172-si:/etc/labs# cat /proc/cpuinfo
processor       : 0
model name      : ARMv7 Processor rev 5 (v7l)
BogoMIPS        : 12.50
Features        : half thumb fastmult vfp edsp thumbee vfpv3 vfpv3d16 tls vfpv4 idiva idivt lpae evtstrm
CPU implementer : 0x41
CPU architecture: 7
CPU variant     : 0x0
CPU part        : 0xc07
CPU revision    : 5
```

.NET: “Floating-point support in the form of VFPv3-D32 or later must be present in hardware”

Build dotnet runtime

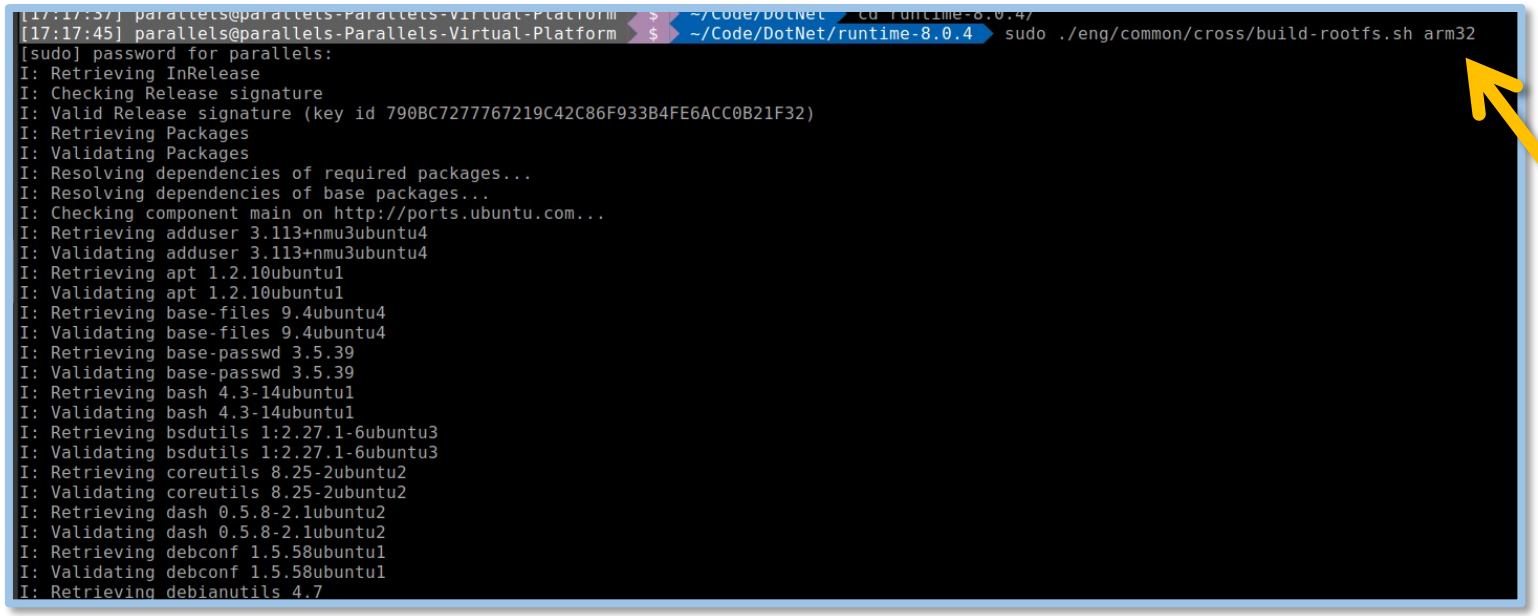
- Building CoreCLR
  - Build CoreCLR on Windows
  - Build CoreCLR on macOS
  - Build CoreCLR on Linux
  - Build CoreCLR on FreeBSD

- Requirements to build dotnet/runtime on Linux
  - CMake 3.20 or newer
  - llvm
  - lld
  - clang
  - build-essential
  - python-is-python3
  - Curl
  - git
  - lldb
  - libicu-dev
  - liblttng-ust-dev
  - libssl-dev
  - libkrb5-dev
  - zlib1g-dev
  - ninja-build (optional, enables building native code with ninja instead of make)

How do I install the latest version of cmake from the command line?

Build dotnet runtime

- dotnet runtime github (.NET 8.0.4)
- Linux Cross-Building
  - Cross-Building for Different Architectures and Operating Systems
    - Generating the ROOTFS (*Before you can attempt to do any Linux cross-building, you will need to generate the ROOTFS corresponding to the platform you want to target.)*



Build dotnet runtime

- Cross-Compiling CoreCLR

```
export ROOTFS_DIR=/home/parallels/Code/DotNet/runtime-8.0.4/.tools/rootfs/arm
```

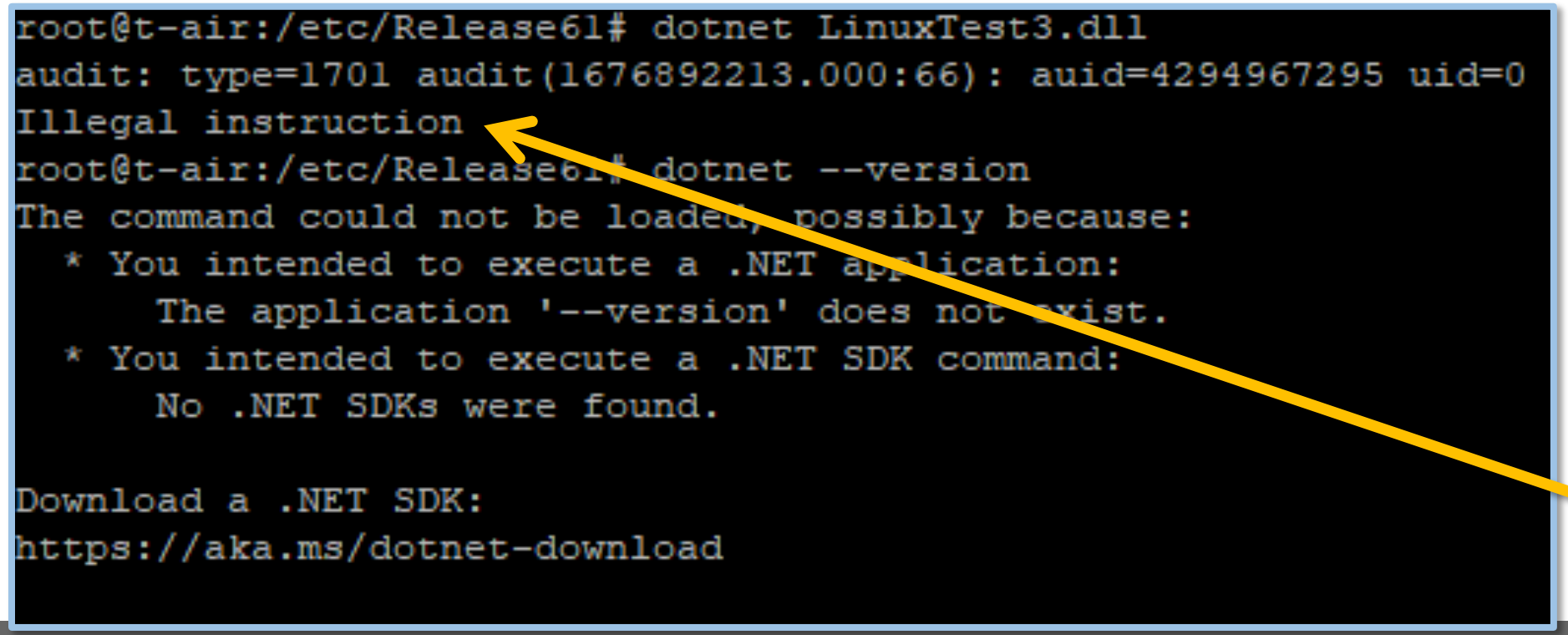
- Cross-Compiling CoreCLR for other VFP Configurations
  - The default ARM compilation configuration for CoreCLR is armv7-a with thumb-2 instruction set, and VFPv3 floating point with 32 64-bit FPU registers.
  - **CoreCLR JIT requires 16 64-bit or 32 32-bit FPU registers.**

  `CLR_ARM_FPU_CAPABILITY` Used by the PAL code to decide which FPU registers should be saved and restored during context switches (the supported options are 0x3 and 0x7):

  Bit 0 unused always set to 1.
  Bit 1 corresponds to 16 64-bit FPU registers.
  Bit 2 corresponds to 32 64-bit FPU registers.

Build dotnet runtime

```
./build.sh --clean --subset clr+libs --configuration Release --cross --arch arm

./build.sh --subset clr+libs --configuration Release --cross --arch arm --cmakeargs
"-DCLR_ARM_FPU_CAPABILITY=0x3" --cmakeargs "-DCLR_ARM_FPU_TYPE=vfpv3-d16" --
framework "net7.0"
```



Build dotnet runtime

- Unable to cross-compile CoreCLR for Linux ARM vfpv4-d16

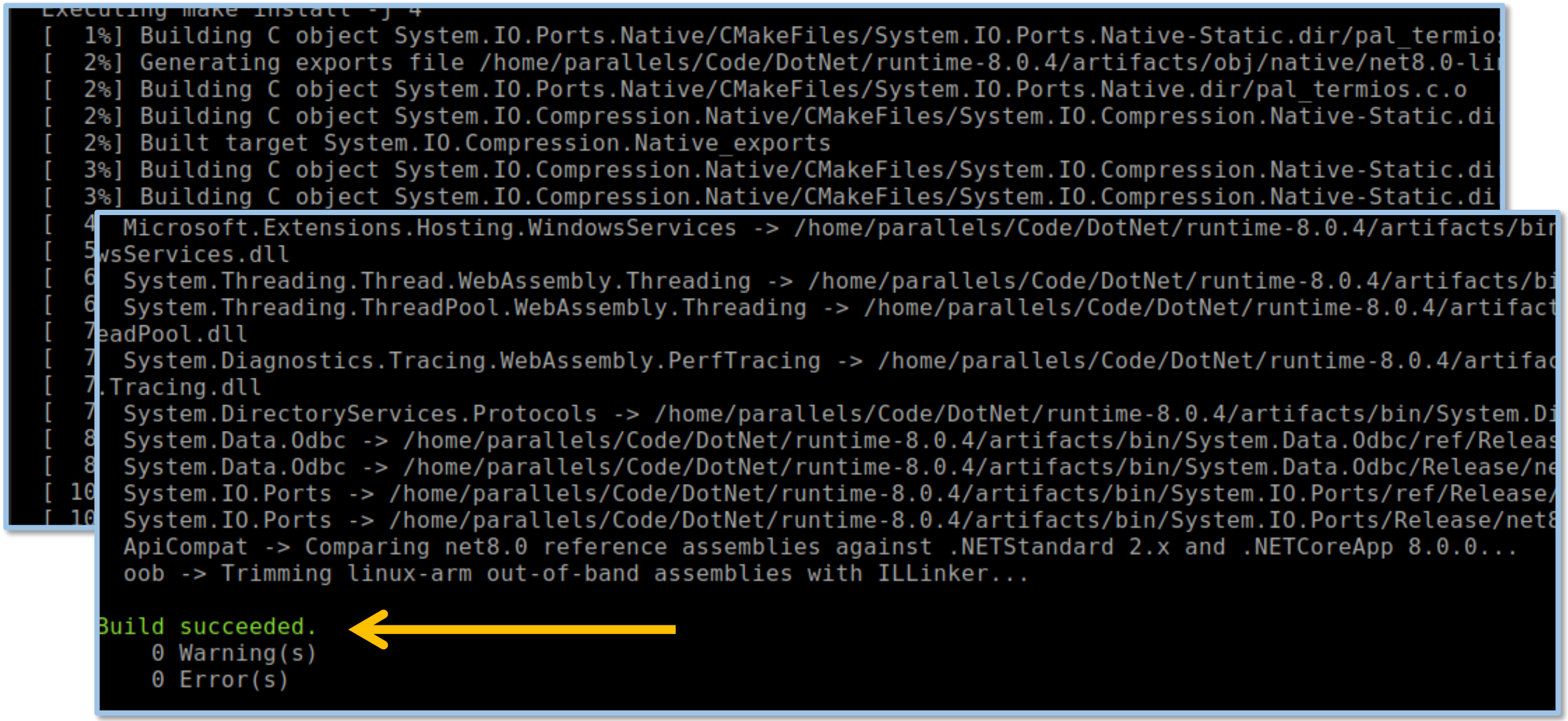
  src/native/corehost/corehost.proj

  src/native/libs/build-native.proj

```
78    <BuildArgs Condition="'$(CrossBuild)' == 'true'">$(BuildArgs) -cross</BuildArgs>
79    <BuildArgs Condition="'$(Compiler)' != ''">$(BuildArgs) $(Compiler)</BuildArgs>
80-   <BuildArgs Condition="'$(CMakeArgs)' != ''">$(BuildArgs) $(CMakeArgs)</BuildArgs>
81    <BuildArgs Condition="'$(Ninja)' == 'true'">$(BuildArgs) -ninja</BuildArgs>
82    <BuildArgs>$(BuildArgs) -runtimeflavor $(RuntimeFlavor)</BuildArgs>
```

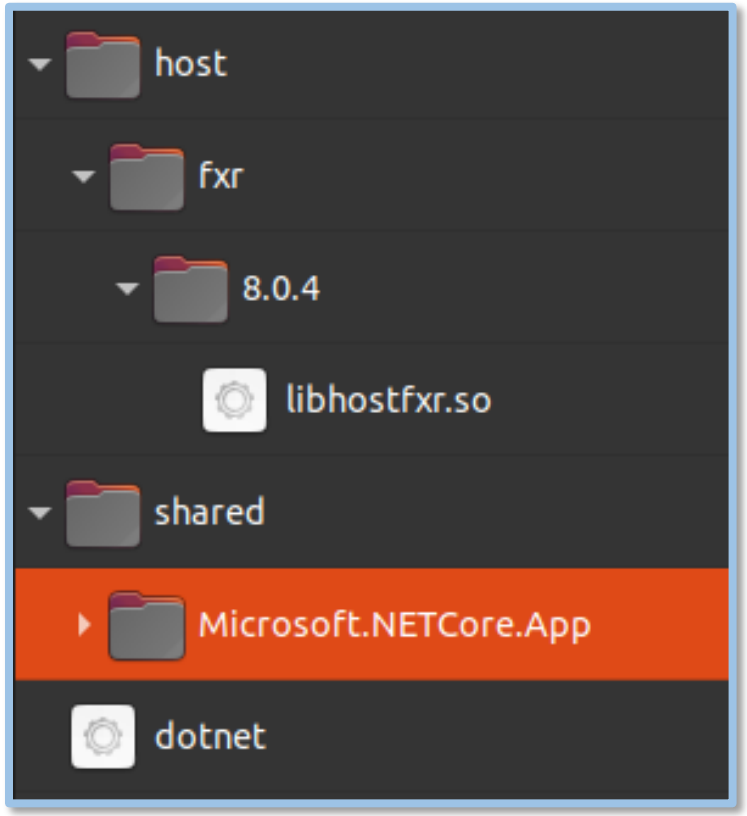
```
78    <BuildArgs Condition="'$(CrossBuild)' == 'true'">$(BuildArgs) -cross</BuildArgs>
79    <BuildArgs Condition="'$(Compiler)' != ''">$(BuildArgs) $(Compiler)</BuildArgs>
80+   <BuildArgs Condition="'$(CMakeArgs)' != ''">$(BuildArgs) -cmakeargs "$(CMakeArgs)"</BuildArgs>
81    <BuildArgs Condition="'$(Ninja)' == 'true'">$(BuildArgs) -ninja</BuildArgs>
```

Build dotnet runtime

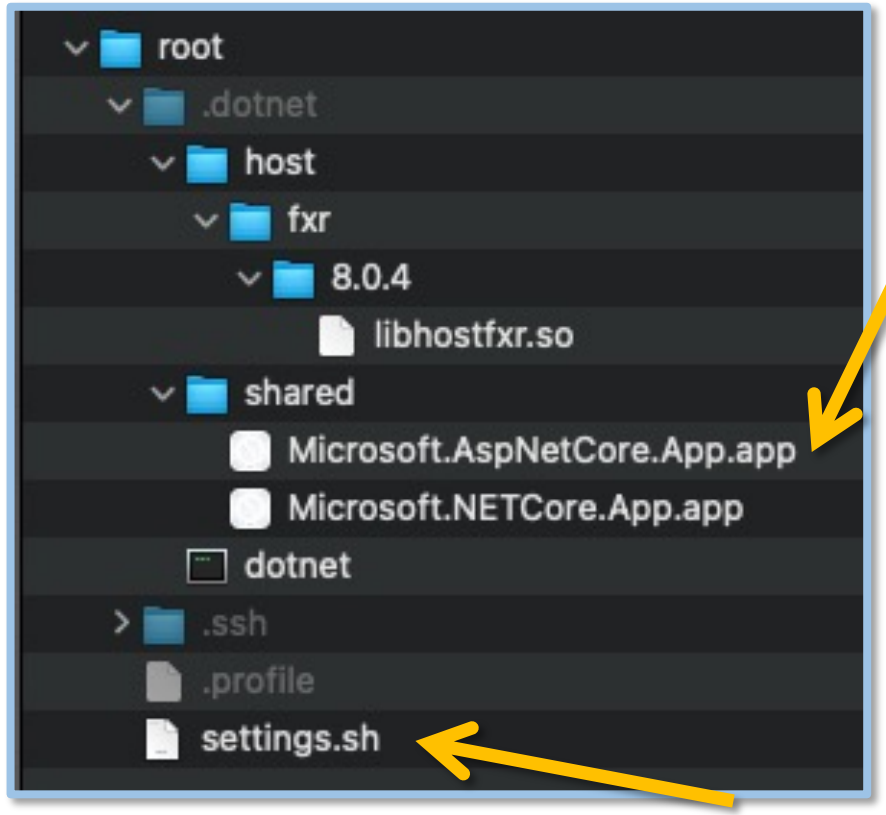


Build dotnet runtime

- /Code/DotNet/runtime-8.0.4/artifacts/bin/testhost



aspnetcore-runtime-8.0.4-linux-arm.tar.gz




```
export DOTNET_ROOT=/home/root/.dotnet
export PATH=$PATH:$DOTNET_ROOT:$DOTNET_ROOT/tools
```

.NET on target

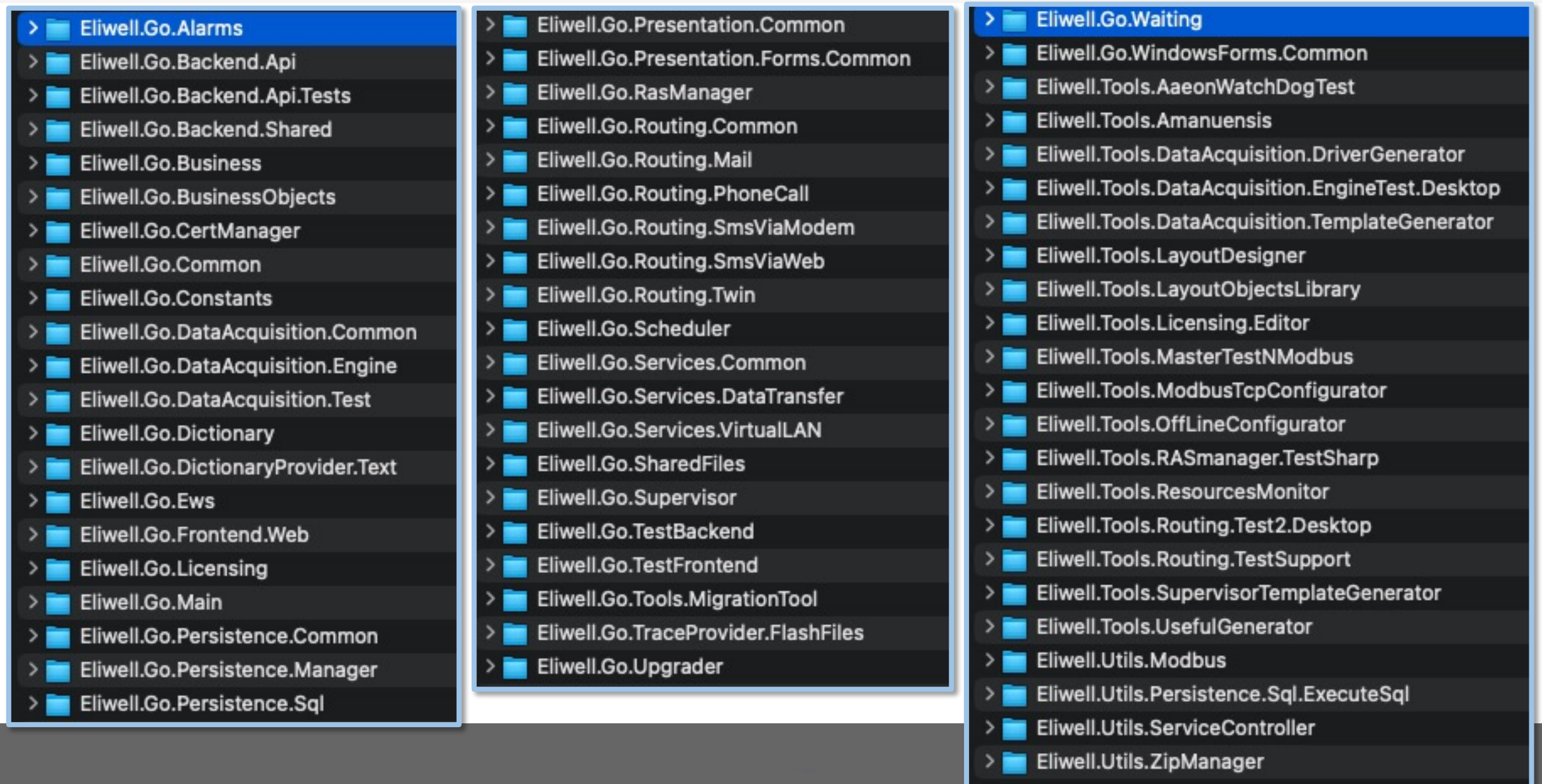
```
root@m172-si:~# dotnet --info

Host:
  Version:      8.0.4
  Architecture: arm
  Commit:       N/A
  RID:          linux-arm

.NET SDKs installed:
  No SDKs were found.

.NET runtimes installed:
  Microsoft.AspNetCore.App 8.0.4 [/home/root/.dotnet/shared/Microsoft.AspNetCore.App]
  Microsoft.NETCore.App 8.0.4 [/home/root/.dotnet/shared/Microsoft.NETCore.App]

Other architectures found:
  None

Environment variables:
  DOTNET_ROOT       [/home/root/.dotnet]
```

It works !

```
root@m172-si:/etc/labs# ./LinuxTest2
05:59:19.053 - Hello, World!
05:59:21.079 - Start task ...
05:59:21.081 - Connection to Modbus ...
05:59:21.129 - Connected to Modbus
05:59:21.130 - Reading from Modbus ...
05:59:21.277 - Read from Modbus ...
05:59:21.414 - Read 4109 - val: 219
05:59:21.415 - Read 4110 - val: 0
05:59:21.420 -
05:59:21.431 - Reading from Modbus ...
05:59:21.504 - Read from Modbus ...
05:59:21.504 - Read 4109 - val: 219
05:59:21.504 - Read 4110 - val: 0
```

```
DumpMessage($"Connection to Modbus ... ");
client.Connect("/dev/ttyS1", ModbusEndianness.BigEndian);
DumpMessage($"Connected to Modbus");

while(true)
{
    DumpMessage($"Reading from Modbus ... ");
    var val1 = client.ReadHoldingRegisters<Int16>(1, 4109, 1)[0];
    var val2 = client.ReadHoldingRegisters<Int16>(1, 4110, 1)[0];
    DumpMessage($"Read from Modbus ... ");

    DumpMessage($"Read 4109 - val: {val1}");
    DumpMessage($"Read 4110 - val: {val2}");
```

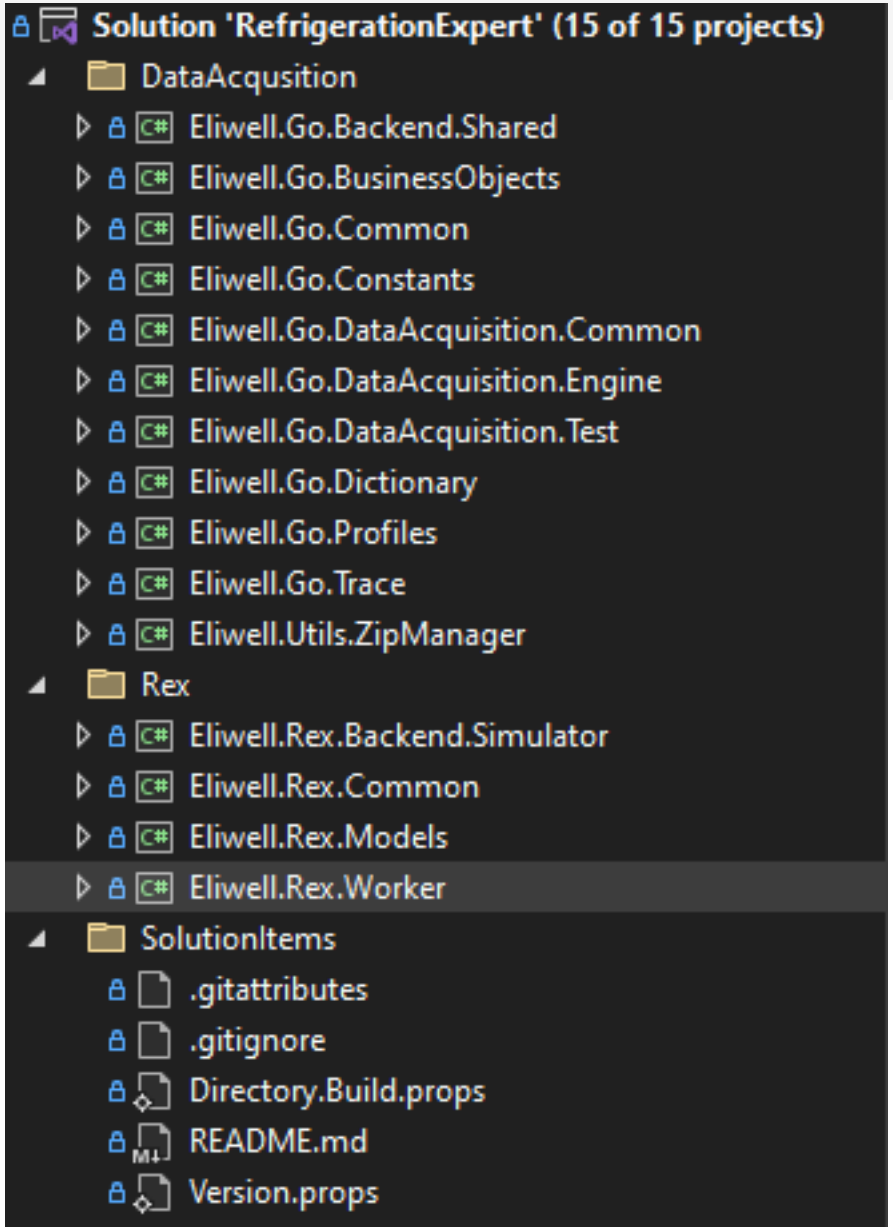
Code Migration



Code Migration

- Disacoppiamento sistemi tramite Nats

- Multipiattaforma Completo
- (Linux ARM32/ Win x86 / Win x64)



Code Migration

```
//Array.Copy(hookFuncBytes, inBuffer, hookFuncBytes.Length);
//Array.Copy(hostPtrBytes, 0, inBuffer, hookFuncBytes.Length, hostPtrBytes.Length);

Buffer.BlockCopy(hookFuncBytes, 0, inBuffer, 0, hookFuncBytes.Length);
Buffer.BlockCopy(hostPtrBytes, 0, inBuffer, hookFuncBytes.Length, hostPtrBytes.Length);
```

```
[MethodImpl(MethodImplOptions.AggressiveInlining)]
1 reference | Mirco Vanini, 359 days ago | 1 author, 1 change
private unsafe Int32[] CopyByteToInt32Array(byte [] source, int[] target, int length)
{
    fixed (Byte* pSource = source)
    {
        fixed (Int32* pTarget = target)
        {
            Byte* pSourceTmp = pSource;
            Int32* pTargetTmp = pTarget;

            //for (int i = 0; i < length; i++)
            while (length-- > 0)
            {
                *pTargetTmp = *pSourceTmp;
                pTargetTmp++;
                pSourceTmp++;
            }
        }
    }

    return target;
}
```

.NET on target

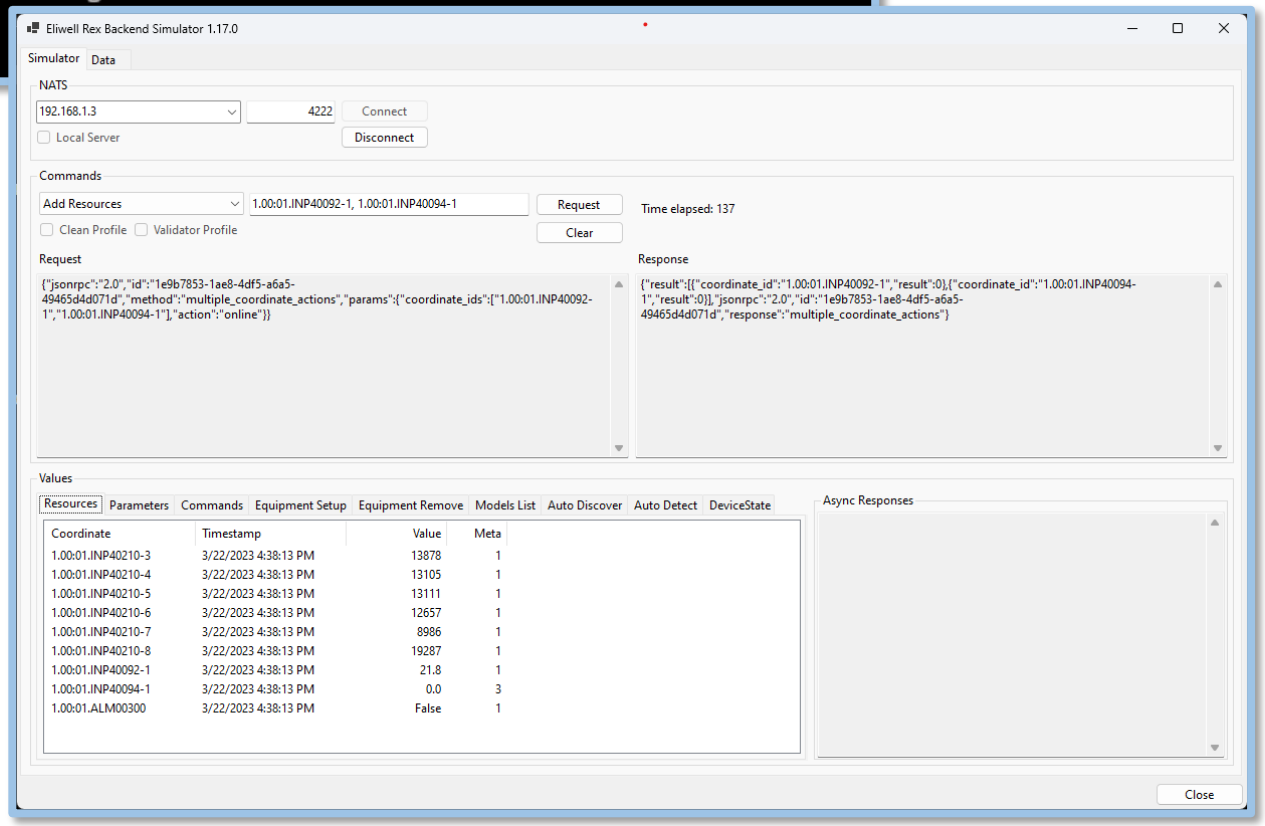
- Globalizzazione .NET e ICU

```
sudo apt install libicu-dev
sudo apt-get update && sudo apt-get install -qqq libicu63
export DOTNET_SYSTEM_GLOBALIZATION_INVARIANT=1
```

.NET Core Globalization Invariant Mode

Stato attuale

```
root@m172-si:/etc/datest# ./Eliwell.Rex.Worker
2023-03-22 17:21:44.614 | INF | Starting up Eliwell.Rex.Worker - 1.17.0 |
2023-03-22 17:21:54.629 | INF | >>> ExecuteAsync | Eliwell.Rex.Worker.Worker
2023-03-22 17:21:55.064 | INF | >>> NatsManager started on 0.0.0.0:4222 | Eliwell.Rex.Worker.NatsManager
2023-03-22 17:22:20.825 | INF | Native (/dev/ttyS1) - MicronetAndModbus - Port settings: [Modbus: 9600 8 E 1], [Micronet: 9600]
2023-03-22 17:22:21.139 | INF | >>> DataAcquisitionManager started! | Eliwell.Rex.Worker.DataAcquisitionManager
2023-03-22 17:22:21.221 | INF | Application started. Press Ctrl+C to shut down. | Microsoft.Hosting.Lifetime
2023-03-22 17:22:21.231 | INF | Hosting environment: Production | Microsoft.Hosting.Lifetime
2023-03-22 17:22:21.240 | INF | Content root path: /etc/datest | Microsoft.Hosting.Lifetime
2023-03-22 17:28:43.611 | INF | Added resources: 6 - commands: 0 @ 1.00:01 |
2023-03-22 17:28:48.506 | INF | Added resources: 6 - commands: 0 @ 1.00:01 |
```

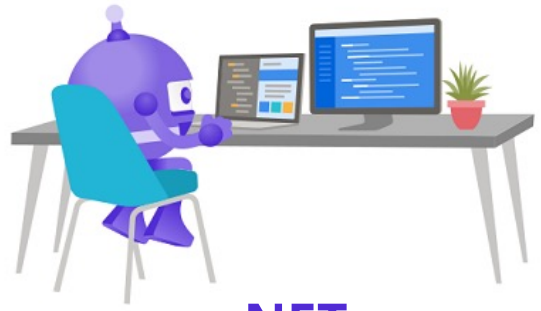


DEMO

Conclusioni

- Porting .NET Core sul target
- Riutilizzo del 100% del codice del Data Acqusition
- Riutilizzo del 100% dei drivers sviluppati per i prodotti precedenti
- Multipiattaforma
  - Linux ARM32
  - Win x86
  - Win x64
- Disaccoppiamento tra i livelli tramite Service Bus
- Piattaforma pronta per le evolutive verso altri HW/SW del gruppo

Grazie !



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