

MVS on a Raspberry

Or how to have fun, and learn new things, by
Running Old Technology on New Technology.

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Session PI



Abstract

MVS 3.8J was released in 1981 and you may be surprised to learn that not only is it freely available but it runs extremely well on the latest technology available today.

This fun session will show you how easy it is to obtain and run this iconic operating system on a Raspberry Pi, in a Cloud and on Windows. This is all done by exploiting the freely available Hercules mainframe emulator along with the original IBM operating system code. The objective behind the session is to demonstrate using a live demo where to find these great free resources and how to get MVS downloaded and IPLed in minutes.

The deployed MVS environment provides a great way to explore a true heirloom which includes the original MVS and JES2 source code as well as many languages including COBOL, C, PL/1, PASCAL and, of course, our favourite Assembler. It's also an excellent way of getting into the open source world and exploiting new technology as an educational tool.

So, unless you have a spare z14 in your garage along with a licensed copy of z/OS come along to this session and see what you can do for free (well almost) in your spare time.

Disclaimers

The views of the author may not necessarily reflect those of his current, or any previous, employer.

Any products or suppliers mentioned in this presentation are examples of possible solutions and are not recommendations or endorsements.

It is YOUR responsibility to comply with the terms of the license for the operating system and any software you intend to run on the Hercules Emulator.

Mains voltage can kill, take expert advice before attempting any projects involving mains electricity.

Raspberry Pi Foundation

Our mission

To put the power of computing and digital making into the hands of people all over the world.

Our reason

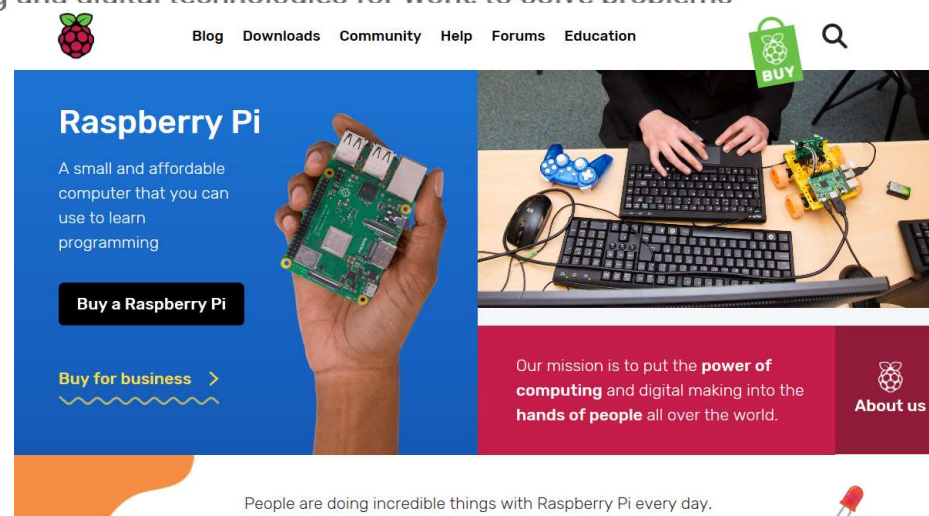
So that more people are able to harness the power of computing and digital technologies for work, to solve problems that matter to them, and to express themselves creatively.

What we stand for

- Learning through making
- Accessible to all

How we work

- Focused on impact
- Community-led
- Open and collaborative



<https://www.raspberrypi.org/>

<https://www.raspberrypi.org/magpi/>

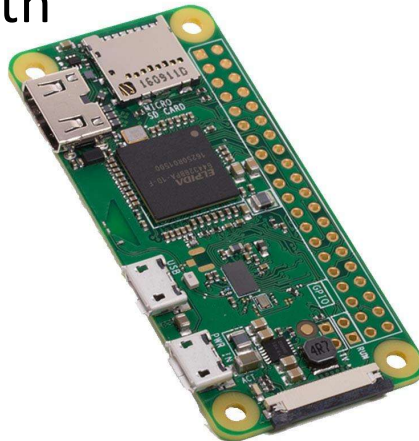
Raspberry Pi



https://en.wikipedia.org/wiki/Raspberry_Pi

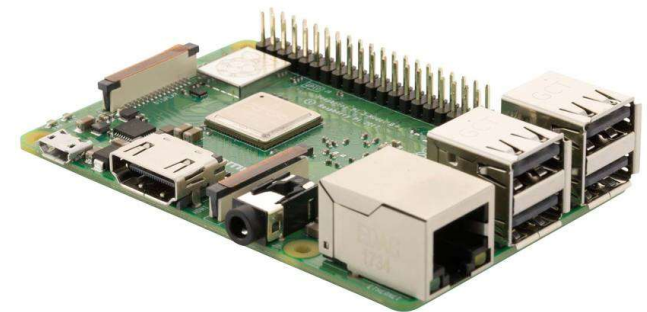
Pi Zero W → £9.30*

- 1Ghz 32bit ARM CPU
- 512 MB Ram
- WiFi / Bluetooth
- Mini USB port
- Mini HDMI
- GPIO holes



Pi 3B+ → £32.00*

- 1.4GHz 64 bit ARM CPU 4 Core
- 1GB RAM
- WiFi / Bluetooth
- 4 x USB ports
- HDMI
- GPIO pins



<https://thepihut.com> * pricing as of Oct 2018

Pi Operating Systems



Raspbian



What can you use a Pi for?

TV / Media streaming



Welcome - Tvheadend - your TV streaming server and video recorder

Welcome to Tvheadend, your TV streaming server and video recorder. This wizard will help you get up and running fast. Let's start by configuring the basic language settings. Please select the default user interface and EPG language(s).

This wizard should only be run on initial setup. Please cancel it if you're not willing to touch the current configuration, as continuing in such cases can lead to misconfiguration and not all changes made thru this wizard will take effect.

Notes :

- If you cannot see your preferred language in the language list and would like to help translate Tvheadend see [here](#).
- If you don't enter a preferred language, US English will be used as a default.
- Not selecting the correct EPG language can result in garbled EPG text; if this happens, don't panic, as you can easily change it later.

The interface will reload in your chosen language (if the translation is available).

Web interface

Language:

EPG Language (priority order)

Language 1:

Language 2:

Language 3:

Apps Add coverage Data / History Social Press About Commercial services

Log in UTC 08:15

© Filippo Grassi

BE763 /BEE2VE
Flybe

3D VIEW

| SOU | | EDI | |
|------------------|-------|------------------|-------|
| SOUTHAMPTON | | EDINBURGH | |
| BST (UTC +01:00) | | BST (UTC +01:00) | |
| DEPARTURE | | ARRIVAL | |
| SCHEDULED | 08:40 | SCHEDULED | 10:10 |
| ACTUAL | 08:53 | ESTIMATED | 10:00 |

First Officer Interviews

GREAT CIRCLE DISTANCE: 572 KM

155 KM 00:22 AGO → 434 KM IN 00:10

BE763 - AVERAGE FLIGHT TIME: 01:09

[More BE763 flights](#)

TYPE (DH8D)
Bombardier Dash 8 Q400

| REGISTRATION | MODE-S CODE |
|---------------------|-------------|
| G-ECOM | 405EF5 |
| SERIAL NUMBER (MSN) | AGE |

Map view (default)

Search King's Lynn

Map showing flight paths and aircraft positions around Birmingham and Northampton.

Remove ads

Backup, DR & Advanced Ransomware Protection. Really

UNITRENDS

[See the live demo](#)

<https://www.flightradar24.com/build-your-own>

Build your own ADS-B receiver – Pi24

To get started, you will need to order a few parts that are available all over the world, but vendors and availability may vary by country.

Your receiver will run Flightradar24's Pi24 client to track flights within 200-400 miles and will automatically share data with Flightradar24. You can track flights directly off your Pi24 device or via Flightradar24.com

Free [Flightradar24 Business Plan](#) subscription (a USD 499.99/year value) for all data sharers.

Build your own

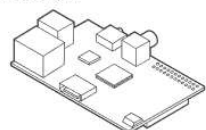
 Share data with us and get a free Business Plan subscription.

[Download Pi24](#)

What to get

REQUIRED

Raspberry Pi

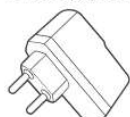


Pi24 is compatible with all Raspberry Pi devices, including Raspberry Pi Zero. Please note that Raspberry Pi Zero has no network port and only one USB port. Get a USB hub with Ethernet adapter and you are good to go!

[Buy here >](#)

OPTIONAL

Power supply for RPi



[Buy here >](#)

4 GB MicroSD card



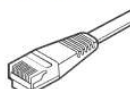
[Buy here >](#)

ADS-B USB dongle



[Buy here >](#)

Ethernet cable



[Buy here >](#)

Installation instructions

Windows



OS X



Setting up your Pi24

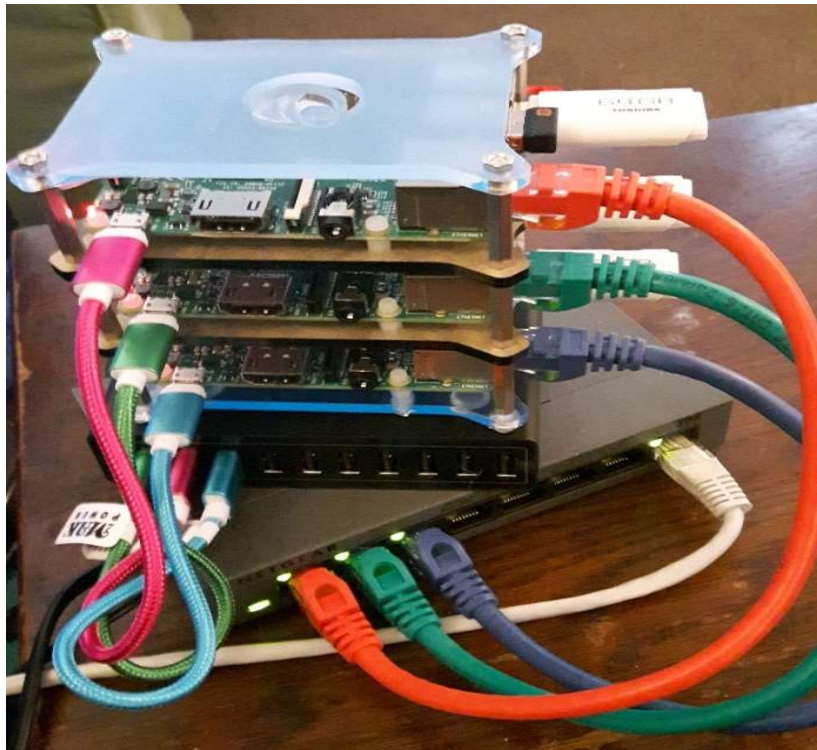


Setting up your Pi24

1. Insert the SD card into the slot at the bottom of your Raspberry Pi.
2. Plug in your ADS-B dongle with the antenna cable.
3. Next, plug in all the other cables (Ethernet, Power) into your Pi24.
4. You should see a solid red LED, a blinking green one and as well as green and yellow Ethernet LEDs.
5. On your computer, or LAN connected smartphone/tablet, click on the [following link](#) and our system will automatically detect your Pi24 and ask you to register it.

That is all you have to do, once your receiver is active you will receive an email from us with instructions on how you can access your free Flightradar24 Business subscription

Hadoop cluster.....



BIG DATA ON LITTLE COMPUTERS

11/2/2019

Introduction

From the outset it should be understood that this is a hobby project. If there is an expected outcome, it is simply to gain a greater familiarity with the Raspberry Pi, Linux, Hadoop, and the way in which these technologies can be brought together to work with SAS Software to provide a "Big Data on Little Computers" implementation.

There is no intention to provide a business solution, or even any new knowledge, developments or discoveries, as this project has been undertaken in parts by others, before me. Although I have not found any examples of the entire project being undertaken end-to-end.

That said, as a training exercise, it has proved to be a very effective means of learning the technologies involved, and may well provide a springboard for further projects in the future.



Figure 1 - MEPRO 6-layer RPi3 stack

Andy Knight |

Heating controller



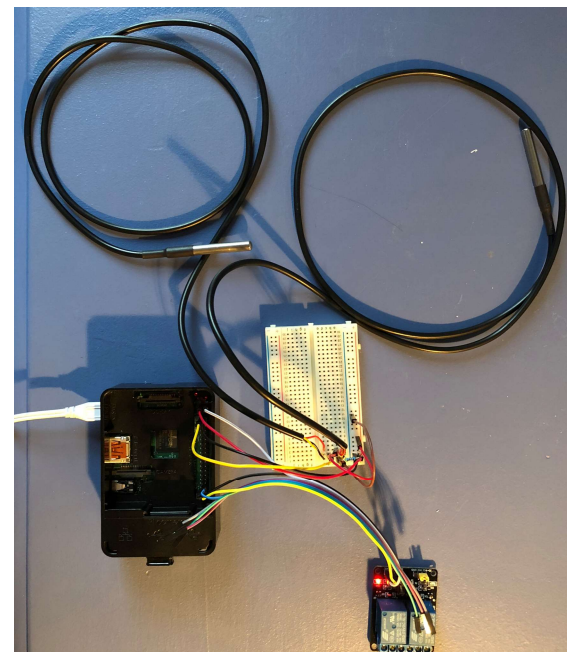
Raspberry Pi B+
B+ J8 GPIO Header

| Pin No. | | |
|---------|----|--------|
| 1 | 2 | 5V |
| 3 | 4 | 5V |
| 5 | 6 | GND |
| 7 | 8 | GPIO14 |
| 9 | 10 | GPIO15 |
| 11 | 12 | GPIO18 |
| 13 | 14 | GND |
| 15 | 16 | GPIO23 |
| 17 | 18 | GPIO24 |
| 19 | 20 | GND |
| 21 | 22 | GPIO25 |
| 23 | 24 | GPIO8 |
| 25 | 26 | GPIO7 |
| 27 | 28 | DNC |
| 29 | 30 | GND |
| 31 | 32 | GPIO12 |
| 33 | 34 | GND |
| 35 | 36 | GPIO16 |
| 37 | 38 | GPIO20 |
| 39 | 40 | GPIO21 |

<https://pinout.xyz/#>

Relay Control

Single Wire Thermostats e.g. DS18B20



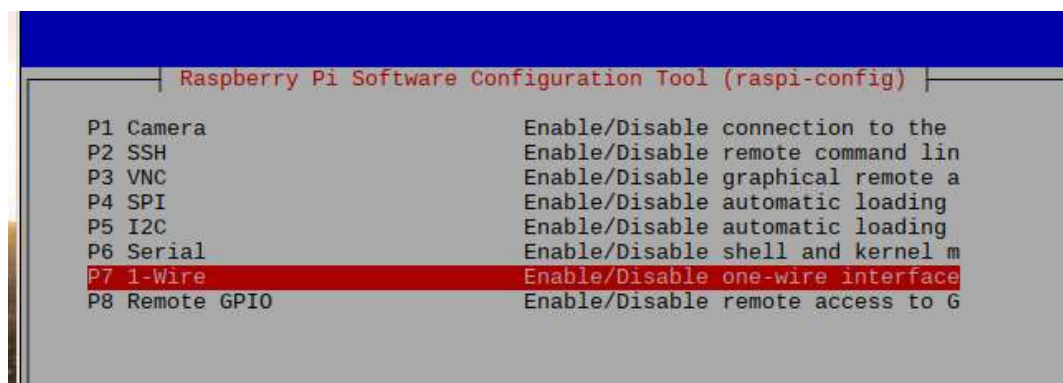
Single wire devices...

Thermostats e.g. DS18B20

Enable single wire devices

Connect to GPIO pin 4

Read the temperature....



```
pi@mvs1:~/temp $ ls /sys/bus/w1/devices/
28-031688bd02ff 28-031688e3e9ff w1_bus_master1
pi@mvs1:~/temp $ cat /sys/bus/w1/devices/28-031688bd02ff/w1_slave
09 02 4b 46 7f ff 0c 10 db : crc=db YES
09 02 4b 46 7f ff 0c 10 db t=32562
pi@mvs1:~/temp $ cat /sys/bus/w1/devices/28-031688e3e9ff/w1_slave
40 01 4b 46 7f ff 0c 10 bc : crc=bc YES
40 01 4b 46 7f ff 0c 10 bc t=20000
pi@mvs1:~/temp $
```

```
pi@mvs1:~/temp $ python temp.py
(19.937, 67.8866)
(19.937, 67.8866)
(20.0, 68.0)
(19.937, 67.8866)
(20.0, 68.0)
(20.0, 68.0)
```

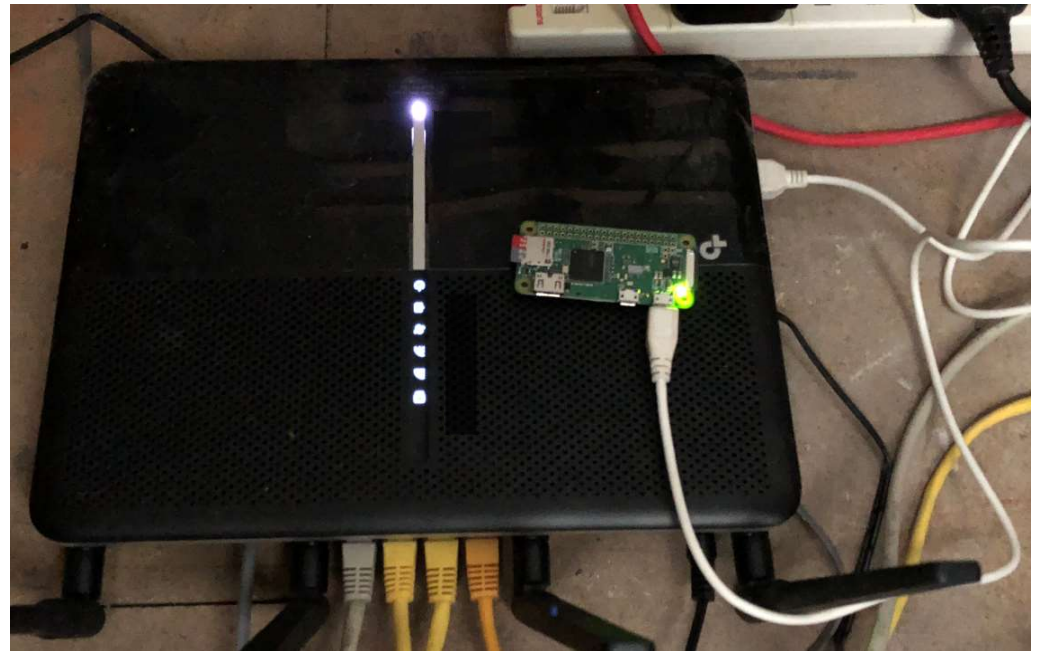

Shrinking the data centre...

1978



© Google

2018



Building your own mainframe

IBM Software in the public domain

IBM Public Domain Software Collection

This site contains copies of distribution tapes, other source and object code libraries, and pregenerated, runnable distributions of IBM public domain software written for the System/360 and System/370 mainframe computers.

All of the software on this site is in the public domain. IBM, by corporate policy, does not assert copyright ownership of any software which it distributed without copyright notices. US copyright law, until 1978, placed such materials in the public domain.

<http://www.ibiblio.org/jmaynard/>

OS/360
MVT with ASP and HASP – turnkey
DOS/360 and TOS/360
VM/370 – 4 pack
MVS 3.8J turnkey v3
TSS/370 - fragile

MV3.8J

Final public domain version of IBM's OS/370 MVS operating system:

Released in the late 1970s and early 1980s.

24-bit addressability => 16MBytes

3 hexadecimal digit I/O addresses.

Lot in common with z/OS systems.

Assembler based

JES2

TSO

Can still perform useful work

Hercules

Open source interpreter of S/360 through 64bit z/Architecture

<http://www.hercules-390.org/>

Latest version Hercules 4.0 (Hyperion)

<https://hercules-390.github.io/html/>

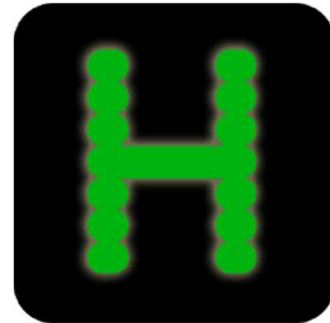
C source code

Builds for LINUX, Windows, UN*X and Mac

Binaries for LINUX, Windows

Configuration file for mainframe ~ IOCDS

<https://hercules-390.github.io/html/hercconf.html>



MVS + Hercules → Tur(n)key

TK3 <http://www.bsp-gmbh.com/turnkey/index.html>

- Volker Bandke
- Ready to run download for Windows and LINUX
- Full SYSGEN instructions provided
- Some compilers included



• TK4- <http://wotho.ethz.ch/tk4-/>

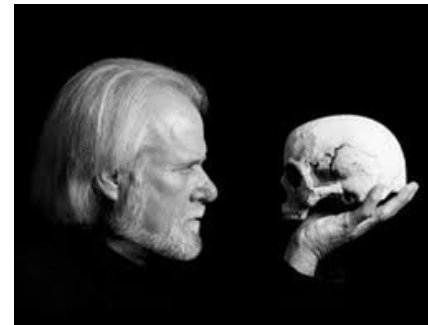
- Jürgen Winkelmann
- Quick start download (LINUX, Windows, Pi)
- Many compilers:
COBOL, PL/1, Algol, Pascal, C, RPG, Simula, ...



Breathing life into a Pi

Hamlet and Apollo 13

- To Be or Not To Be [headless]



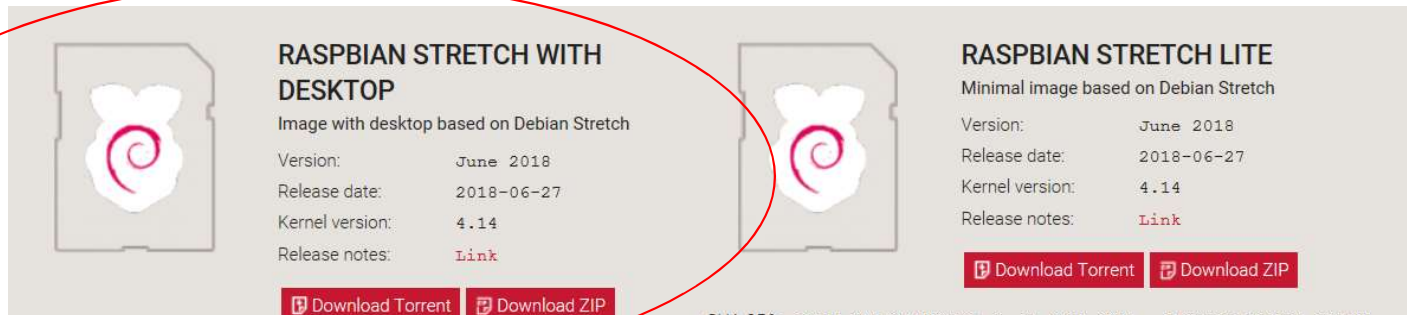
- Power is everything



Get an image

Headless or full fat?

<https://www.raspberrypi.org/downloads/raspbian/>



Download image to PC with SD slot/device

Burn image to SD =>

<https://www.raspberrypi.org/documentation/installation/installing-images/README.md>

On Windows use tool such as <https://etcher.io/>

Headless Extra Steps

If headless => **enable ssh** and **configure wireless (if required)**

1. Create empty file in [boot] filesystem => ssh

2. Edit [boot] wpa_supplicant.conf

```
ctrl_interface=DIR=/var/run/wpa_supplicant
GROUP=netdev update_config=1
country=GB
network={ ssid="«your_SSID»"
          psk="«your_PSK»"
          key_mgmt=WPA-PSK
        }
```

3. Reboot enables ssh and loads wireless settings



Boot and Update

- Apply power.....
- If headless
 - Find it on the network..... E.g. fping or router
 - putty / ssh and login as **pi** password **raspberrypi**
- Update the linux config using menu or command window

```
sudo raspi-config
```

← useful to tailor pi

```
sudo apt-get update
sudo apt-get upgrade
sudo init 6
```

← reboot

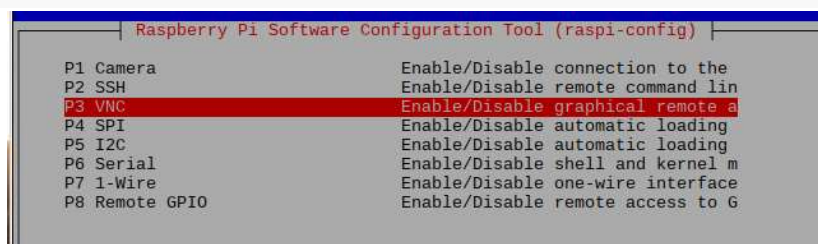
Remote Desktop from anywhere

If ssh / putty doesn't hack it for you.

<https://www.realvnc.com/en/raspberrypi/>

Enable VNCserver on pi

`sudo raspi-config`, navigate to **Interfacing Options > VNC** and select **Yes**.

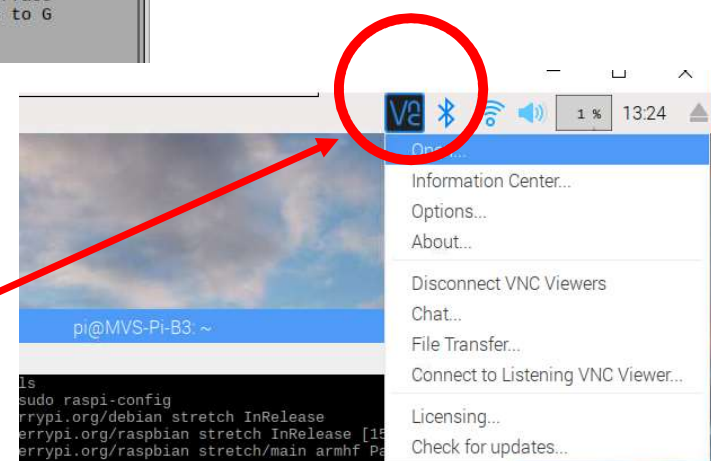


Set screen resolution to 1024 x 768 using raspi-config

Advanced Options => Resolution

Use VNCviewer to access

For cloud access → **MUST** sign in at both ends

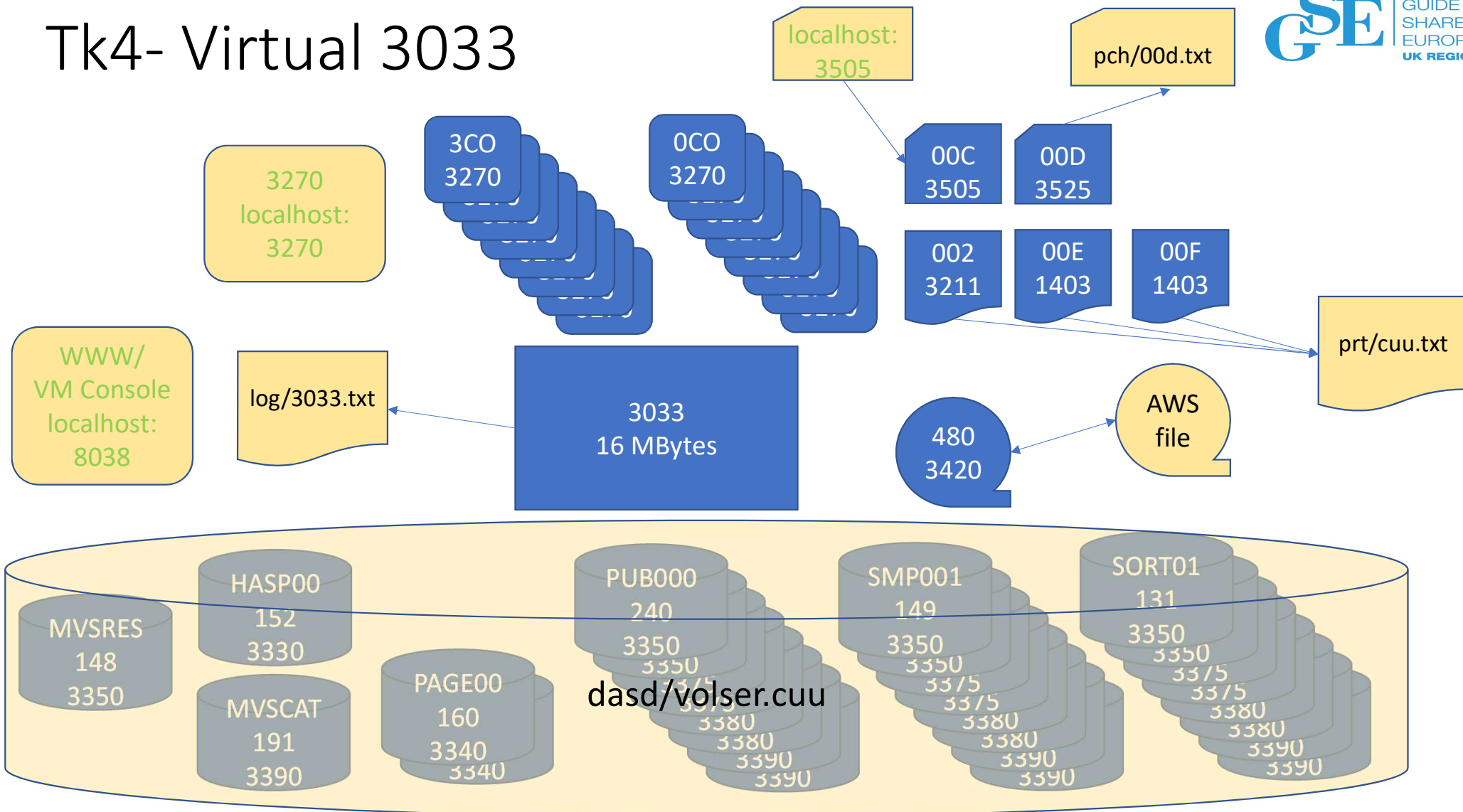


Tk4-



© Copyright IBM Corporation

Tk4- Virtual 3033



Download Hercules / MVS and IPL

Follow TK4- User Guide

<http://wotho.ethz.ch/tk4-/MVS TK4- v1.00 Users Manual.pdf>

Quick Start

```
mkdir tk4
cd tk4
curl http://wotho.ethz.ch/tk4-/tk4-_v1.00_current.zip -o tk4.zip
unzip tk4.zip
./mvs          ← Starts Hercules and IPLs mvs
```

Accounts

Accounts

HERC01 / CUL8TR fully authorised including RAKF user and password
HERC02 / CUL8TR fully authorised no RAKF authority
HERC03 / PASS4U regular user
HERC04 / PASS4u regular user
IBMUSER / IBMPASS recovery account fully authorised no RAKF

Adding Users

Follow pages 18/19 in TK4- User Guide

SYS1.SECURE.CNTL(USERS)

NOTE: must be in ascending order of username

3270

Windows

Vista 3270 - <https://www.tombrennansoftware.com/>
[free trial, \$30]

LINUX

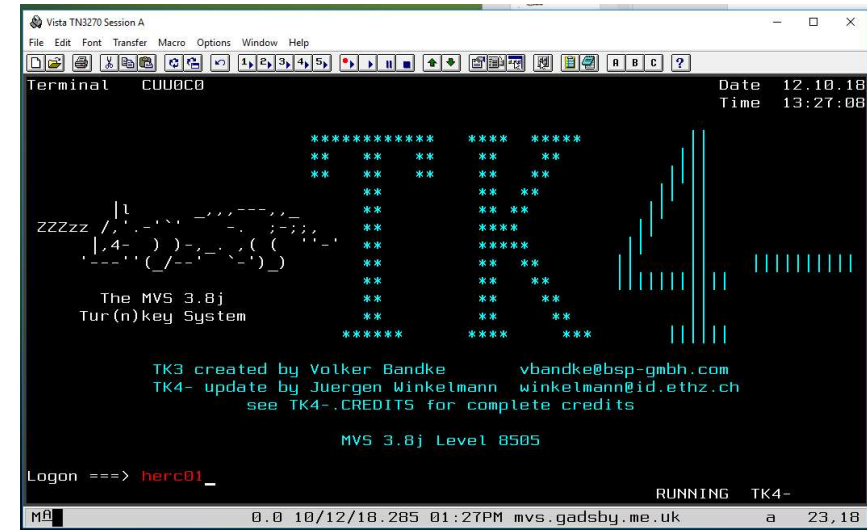
x3270 – free

Pi Native (with special thanks to Dougie Lawson of RSM)
<https://github.com/DougieLawson/x3270-4-RaspberryPi>

Connect to port 3270 otherwise it will fail.

localhost:3270

hostname:3270



Clean Shutdown / Recovery

- Run SHUTDOWN job from authorised TSO user
- Or submit this job via the card reader

```
//SHUT      JOB  USER=HERC01,PASSWORD=CUL8TR
//SHUTDOWN  EXEC  SHUTDOWN
//
```



- To recover MVS to pre first IPL state

Shutdown MVS

```
unzip tk4.zip dasd/\*
```

IPL MVS



How fast is it

Sample job timings for rebuilding JES2 from source (asmhasp2)

| Environment | Clock Time | MIPS * | Peak IOPs * |
|-----------------|----------------|--------|-------------|
| Pi-zero | 14 min 21 secs | 4.7 | 824 |
| Pi-B+ | 2 min 51 secs | 20.7 | 1,269 |
| Cloud (1vCPU) | 0 min 46 secs | 57.4 | 3,575 |
| Laptop (i7@2.8) | 0 min 28 secs | 79.4 | 5,300 |
| Laptop (i5@2.6) | 0 min 37 secs | 76.3 | 4,365 |

```

JJJJJJJJJJ EEEEEEEEEEE SSSSSSSSSS 2222222222 JJJJJJJJJJ 000000000000 BBBBBBBBBB
JJJJJJJJJJ EEEEEEEEEEE SSSSSSSSSS 2222222222 JJJJJJJJJJ 000000000000 BBBBBBBBBB
JJ JJ EE SS SS 22 22 JJ OO OO BB BB
JJ JJ EE SS 22 22 JJ OO OO BB BB
JJ JJ EE SSS 22 22 JJ OO OO BB BB
JJ JJ EEEEEEE SSSSSSSS 22 JJ OO OO BBBBBBBBBB
JJ JJ EE SSS 22 22 JJ JJ OO OO BB BB
JJ JJ EE SS 22 22 JJ JJ OO OO BB BB
JJ JJ EE SS 22 22 JJ JJ OO OO BB BB
JJ JJ EE SS 22 22 JJ JJ OO OO BB BB
JJ JJ EE SS 22 22 JJ JJ OO OO BB BB
JJJJJJJJ EEEEEEEEEEE SSSSSSSSSS 2222222222 JJJJJJJJ 000000000000 BBBBBBBBBB
JJJJJJJJ EEEEEEEEEEE SSSSSSSSSS 2222222222 JJJJJJJJ 000000000000 BBBBBBBBBB

JJJJJJJJJJ 11 0000000000 AAAAAAAAAA
JJJJJJJJJJ 111 0000000000 AAAAAAAAAA
JJ 1111 00 0000 AA AA
JJ 11 00 00 00 AA AA
JJ 11 00 00 00 AA AA
JJ 11 00 00 00 AAAAAAAAAA
JJ 11 00 00 00 AA AA
JJ 11 0000 00 AA AA
JJ JJ 11 000 00 AA AA
JJJJJJJJ 1111111111 0000000000 AA AA
JJJJJJJ 1111111111 0000000000 AA AA

***** START JOB 10 JES2JOB GENERATE OS/VS2 HASP ROOM 10.16.02 AM 19 OCT 18 PRINTER1 SYS TK4- JOB 10 START A****
***** START JOB 10 JES2JOB GENERATE OS/VS2 HASP ROOM 10.16.02 AM 19 OCT 18 PRINTER1 SYS TK4- JOB 10 START A****
***** START JOB 10 JES2JOB GENERATE OS/VS2 HASP ROOM 10.16.02 AM 19 OCT 18 PRINTER1 SYS TK4- JOB 10 START A****

```

Generates 4,045 pages of output

* MIPS and IOPs reported from Hercules **maxrates** command

WWW MVS Operations

MVS Reader: Inxmvs

[Help](#)

[Console](#)
[Output Control](#)
[Tape Management](#)

Code Templates

[Local JCL](#)

[ASM](#) [Algol](#) [C](#)
[COBOL](#) [FORTRAN](#)
[PASCAL](#) [PL1](#)
[RPG](#) [SIMULA](#)
[asmhasp2](#)
[iebgener](#) [Internal](#)
[shutdown](#) [tape](#)

Enter Job Below

[Submit Job](#) [Clear cards](#) %user%=herc03 %pass%=*****

```
//
//      USER=%user%,
//      PASSWORD=%pass%
//*****
///* NAME: SYS2.JCLLIB(TSTFORT)
///*
///* DESC: TEST FORTRAN Installation (Fortran G & H)
///*
//*****
//FORTG EXEC FORTGCLG,REGION.FORT=1024K
//FORT.SYSLIN DD UNIT=SYSDA
//FORT.SYSABEND DD SYSOUT=A
//FORT.SYSIN DD *
C HELLO WORLD, WE HOPE
  WRITE(6,10)
  10 FORMAT(12H HELLO WORLD)
  STOP
  END
//
```

MVS Tape Library: Inxmvs

[Help](#)

[Console](#)
[Card Reader](#)
[Output Control](#)

Mount of TAPE01.aws requested on 480

Load Tape Into Library

Select Tape to upload: [Browse...](#) [Upload Tape](#)

Currently Available Tapes

| Name | Size | Mount to Unit |
|-----------------|--------|---|
| ISPF.V2R0M0.aws | 531296 | Mount 480 Map Download Delete |
| TAPE01.aws | 57386 | Mount 480 Map Download Delete |
| TAPE03.aws | 97738 | Mount 480 Map Download Delete |

MVS Output: Inxmvs

[Help](#)

[Console](#)
[Card Reader](#)
[Tape Management](#)

Output

A
JOB
STC
Z
JOB
STC
TSU

| | | | | |
|--------|-----------------------|--|---|------------------------------|
| Search | Newer than 0 mins. | Display Style <input type="radio"/> List <input checked="" type="radio"/> Icon | Sort Order <input type="radio"/> Oldest <input checked="" type="radio"/> Newest | Refresh Jobs |
|--------|-----------------------|--|---|------------------------------|

Showing output for Class A of Type JOB

| | | | | | |
|---------------------------|--------------------------|---------------------------|--------------------------|--------------------------|--------------------------|
| <i>PRTJES</i> J123 A | <i>PRTJES</i> J122 A | <i>PRTJES</i> J121 A | <i>PRTJES</i> J120 A | <i>PRTJES</i> J119 A | <i>PRTJES</i> J118 A |
| <i>TESTSIMU</i> J115 A | <i>JES2JOB</i> J114 A | <i>TESTNATF</i> J113 A | <i>ISPLDAD</i> J111 A | <i>JES2JOB</i> J110 A | <i>JES2JOB</i> J109 A |
| <i>ISPLDAD</i> J106 A | <i>ISPLDAD</i> J102 A | <i>ISPLDAD</i> J101 A | <i>ISPLDAD</i> J100 A | <i>ISPLDAD</i> J99 A | <i>ISPLDAD</i> J98 A |
| <i>ISPLDAD</i> J95 A | <i>AHELLO</i> J94 A | <i>ISPLDAD</i> J91 A | <i>PRTJES</i> J90 A | <i>PRTJES</i> J89 A | <i>PRTJES</i> J88 A |

MVS Console: Inxmvs

[Help](#)

[Card Reader](#)
[Output Control](#)
[Tape Management](#)

[Pause](#)

[Current](#)

Update Interval
5 seconds

[PRINT](#)
[CONSOLE](#)
[LOG](#)

```
11.31.27 SHASP000 OK
HHC016031 devinit 480 /mnt/mvs/tape/TAPE01.aws
HHC002211 0:0480 Tape file /mnt/mvs/tape/TAPE01.aws, type aws: format type AWS Format tape file
HHC022451 0:0480 device initialized
HHC010401 0:0000 COMM: client localhost, ip 127.0.0.1 connected to device 3505
HHC012061 0:0000 Card: client localhost, ip 127.0.0.1 disconnected from device 3505
11.38.57 JOB 123 SHASP100 PRTJES ON READER1
11.38.57 JOB 123 SHASP373 PRTJES - STARTED - INIT 1 - CLASS A - SYS TR4-
11.38.57 JOB 123 IEP403I PRTJES - STARTED - TIME=11.38.57
HHC002011 0:0480 Tape file /mnt/mvs/tape/TAPE01.aws, type aws: tape closed
11.38.57 JOB 123 IEP234E R 480, TAPE01, PVT, PRTJES, STEP1
11.38.57 JOB 123 IEP404I PRTJES - ENDED - TIME=11.38.57
11.38.57 JOB 123 SHASP395 PRTJES ENDED
11.38.57 SHASP309 INIT 1 INACTIVE ***** C=A
11.38.57 JOB 123 SHASP150 PRTJES ON PRINTER1 715 LINES
11.38.57 SHASP160 PRINTER1 INACTIVE - CLASS=A
11.38.57 JOB 123 SHASP250 PRTJES IS PURGED
HHC000081 /d u,tape
11.44.36 IEE450I 11.44.36 UNIT STATUS 878
UNIT TYPE STATUS VOLSER VOLSTATE UNIT TYPE STATUS VOLSER VOLSTATE
480 3400 O-NRD /REMOV 481 3400 OFFLINE
482 3400 OFFLINE 483 3400 OFFLINE
484 3400 OFFLINE 485 3400 OFFLINE
486 3400 OFFLINE 487 3400 OFFLINE
```

d u,tape

[Enter](#) [Clear](#) Status: OK d u,tape

Optional MVS Source and CBT

Download and install into tk4 directory

```
curl http://wotho.ethz.ch/tk4-/tk4-source.zip -o tk4-source.zip
unzip tk4-source.zip
curl http://wotho.ethz.ch/tk4-/tk4-cbt.zip -o tk4-cbt.zip
unzip tk4-cbt.zip
```

Re-ipl MVS to pick up added dasd

Define CBT → submit job **SYS1.SETUP.CNTL(MVS0170)**

- Connects the SYS1.UCAT.CBT user catalog
- Defines the **CBT**, **CBTCOV**, **CBT072**, **CBT129**, **CBT249** and **CBT429** HLQ aliases.

Define Source → submit job **SYS1.SETUP.CNTL(MVS0200)**

- Connects the SYS1.UCAT.SRC user catalog
- Defines the **MVSSRC** HLQ alias.

Useful Resources

Various cheat sheets etc.

<http://www.jaymoseley.com/hercules/index.html>

<http://timpinkawa.net/hercules/>

<http://www.bsp-gmbh.com/hercules/index.shtml>

<http://hansen-family.com/mvs/MVS%20Commands.htm>



Groups

<https://groups.yahoo.com/neo/groups/hercules-390/info>

<https://groups.yahoo.com/neo/groups/H390-MVS/info>

Demonstration

- Pi, Windows
- MVS Ops
- TSO
- DSLIST
- Source – HLQ MVSSRC

Public Cloud Instance

mvs.gadsby.me.uk

- 3270 GSE01 – GSE09 / GSE
- MVS Ops gse/gse

Request personal account

mvs@gadsby.me.uk

We want your feedback!

- Please submit your feedback online at
 - <http://conferences.gse.org.uk/2018/feedback/PI>
- Paper feedback forms are also available from the Chair person

- This session is PI



Optional:

Quick Start Building a WAMP / LAMP server

LAMP

```
sudo apt-get install apache2 php libapache2-mod-php
sudo apt-get install php7.0-gd
sudo apt-get install mysql-server php-mysql phpmyadmin
sudo ln -s /etc/phpmyadmin/apache.conf 010-phpmyadmin.conf
mysql_secure_installation
sudo service apache2 restart
Web sites under /var/www/html
```

WAMP

<http://www.wampserver.com/en/>
<http://strawberryperl.com/>

Optional Pi MySQL database

On the Pi I have observed that sometimes it's impossible to login from an application, such as phpMyAdmin due to security issues. If this happens run the following command from the LINUX prompt:

```
mysql -u root -p  
use mysql;  
UPDATE user SET plugin='mysql_native_password' WHERE User='root';  
FLUSH PRIVILEGES;
```