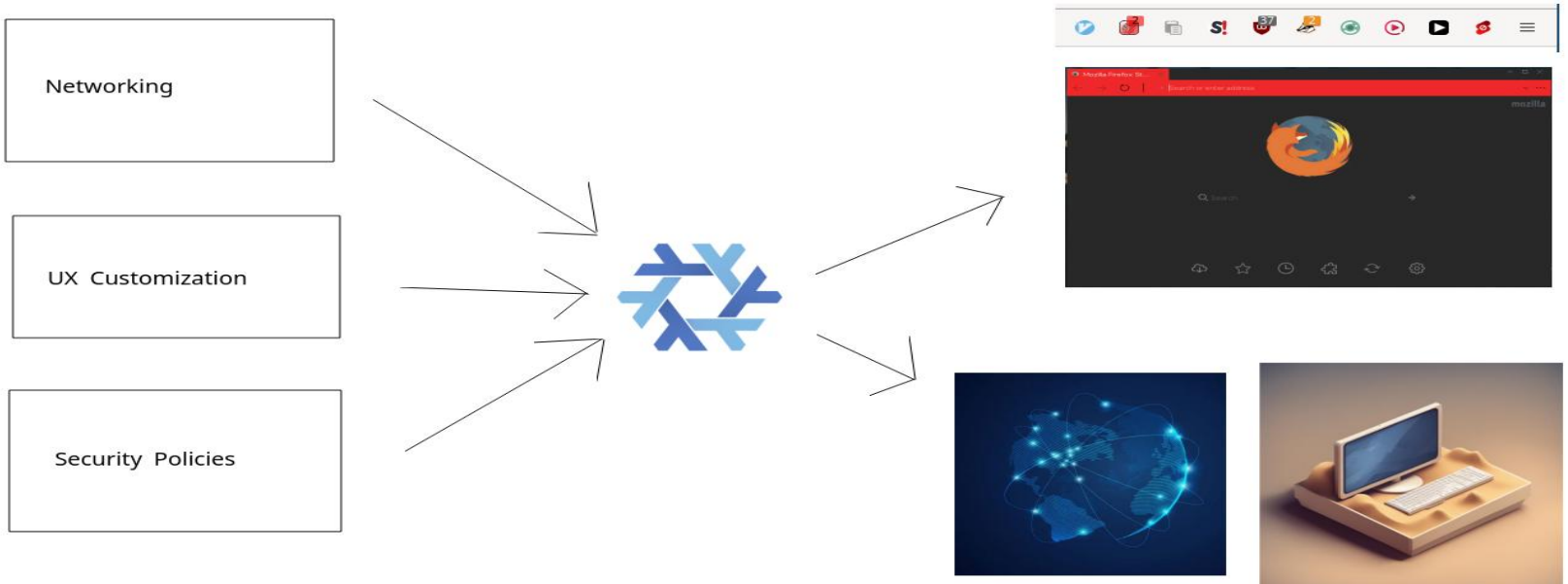
Single Website Firefox VMs with NixOS

Nitin Passa



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NixOS Makes VMs Easy

firefox-vm.nix

```
{pkgs, ... }:
let
  config = (pkgs.lib.nixosSystem {
    system = "x86_64-linux";
    modules = [{
      imports = [
        "${pkgs}/nixos/modules/virtualisation/qemu-vm.nix"
        ./base-system.nix    # hostname + xorg + users
        ./autostart-ff.nix
      ];
      virtualisation.memorySize = 8192;
    }];
  }).config;
in
config.system.build.vm
```

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Standard lib function to eval system config

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Autostart Firefox with XDG

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Standard lib function to eval system config

Autostart Firefox with XDG

A script to run system as VM

Autostart Firefox with XDG

autostart-ff.nix

```
{pkgs, ...}: {
  environment.systemPackages = [
    (pkgs.writeTextFile {
      name = "xdg-autostart-firefox";
      destination = "/etc/xdg/autostart/xdg-autostart-firefox.desktop";
      text = ''
          [Desktop Entry]
          Name=xdg-autostart-firefox
          Type=Application
          Terminal=false
          Exec=${pkgs.firefox}/bin/firefox https://nixos.org
        '';
    })
  ];
}
```

Autostart Firefox with XDG

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        '';
    })
  ];
}
```

Command to run and url to visit

Launch the VM with the Generated Script

config.system.build.vm -> run-firefoxvm-vm

```
#! /nix/store/<sha>-bash-5.2-p15/bin/bash
...
if test -n "$NIX_DISK_IMAGE" && ! test -e "$NIX_DISK_IMAGE"; then
    echo "Disk image do not exist, creating the virtualisation disk
    ↪  image..."
    ...
fi

# Start QEMU.
exec /nix/store/<sha>-qemu-host-cpu-only-8.0.3/bin/qemu-kvm -cpu max \
    -name firefoxvm \
    -m 8192 \
    ...
    $QEMU_OPTS \
    "$@"
```

VM Per Website: Let's Try the Naive Approach

Utility Function to Generate VM

```
mkBrowserVm = name: url:  (pkgs.lib.nixosSystem {
  system = "x86_64-linux";
  modules = [{
    imports = [ ... ];
    networking.hostName = "firefoxvm-${name}";
    _module.args.url = url; # convenience to reduce LOC
  }];
}).config.system.build.vm;
```

VM Per Website: Let's Try the Naive Approach

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Take a name for the VM and URL to visit

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Output the VM start script

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  }];
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```

Take a name for the VM and URL to visit

Pass url as argument to all modules

Output the VM start script

VM Per Website: Templating is Convenient

autostart-ff.nix

```
{pkgs, url, ...}: {
  environment.systemPackages = [
    (pkgs.writeTextFile {
      name = "xdg-autostart-firefox";
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      text = ''
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          Name=xdg-autostart-firefox
          Type=Application
          Terminal=false
          Exec=${pkgs.firefox}/bin/firefox ${url}
        '';
    })
  ];
}
```

VM Per Website: Templating is Convenient

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          Terminal=false
          Exec=${pkgs.firefox}/bin/firefox ${url}
        '';
    })
  ];
}
```

Visit the configured URL

VM Per Website: VM all the Sites!

site-vms.nix

```nix
let
  sites = {
    discourse = "https://discourse.nixos.org";
    nixos = "https://nixos.org";
    github = "https://github.com/nixos/nixpkgs";
  };
  vms = pkgs.lib.mapAttrsToList mkBrowserVm sites;
in
pkgs.symlinkJoin {
  name = "site-vms";
  paths = vms;
}
```

VM Per Website: VM all the Sites!

site-vms.nix

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  sites = {
    discourse = "https://discourse.nixos.org";
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Generate VMs using our utility function.

VM Per Website: VM all the Sites!

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pkgs.symlinkJoin {
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}
```

Generate VMs using our utility function.

Join the VMs into one result

VM Per Website: Naive Approach is Slow

- Build took 30s with 2 VMs. 48s with 4 VMs. Roughly linear.
- With dozens, build was taking minutes, even with no changes to VMs.

Important Observations on Slow Builds

- A NixOS system is built per website
- pkgs.lib.nixosSystem performs full eval

Improvement 1: Use Flakes to Cache VM Build

flake.nix

```
{
  inputs.nixpkgs.url = "nixpkgs/nixos-23.05";
  outputs = { self, ... }@inputs: {
    nixosConfigurations.firefoxvm = inputs.nixpkgs.lib.nixosSystem {
      specialArgs = { inherit inputs; };
      system = "x86_64-linux";
      modules = [./nixos-vm.nix];
    };
  };
}
```

Improvement 1: Use Flakes to Cache VM Build

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    };
  };
}
```

Standard flake output for a NixOS system

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      specialArgs = { inherit inputs; };
      system = "x86_64-linux";
      modules = [./nixos-vm.nix];
    };
  };
}
```

Standard flake output for a NixOS system

System build will now be cached

Improvement 2: QEMU Runtime Variables

QEMU Option:

```
-fw_cfg [name=]<item_name>,string=<string>
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Creates File:

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/sys/firmware/qemu_fw_cfg/by_name/<name>/raw
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Improvement 2: QEMU Runtime Variables

QEMU Option:

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Creates File:

```
/sys/firmware/qemu_fw_cfg/by_name/<name>/raw
```

Setting Option:

```
-fw_cfg name=opt/ffurl,string=https://nixos.org
```

Improvement 2: QEMU Runtime Variables

QEMU Option:

```
-fw_cfg [name=]<item_name>,string=<string>
```

Creates File:

```
/sys/firmware/qemu_fw_cfg/by_name/<name>/raw
```

Setting Option:

```
-fw_cfg name=opt/ffurl,string=https://nixos.org
```

Creates File:

```
> cat /sys/firmware/qemu_fw_cfg/by_name/opt/ffurl/raw
https://nixos.org
```

Improvement 2: Use the Runtime Variable in Launch Script

runvm-pkg.nix

```
{self, pkgs, ...}:

pkgs.writeShellScriptBin "ffvm-visit-url" ''
set -euo pipefail

NAME="$1"
URL="$2"

export QEMU_OPTS="-fw_cfg name=opt/ffurl,string=$URL"
export NIX_DISK_IMAGE="$HOME/vms/ffvm-$NAME.qcow2"

${self.nixosConfigurations.firefoxvm.config.system.build.vm}/bin/run-firefoxvm-
''
```

Improvement 2: Use the Runtime Variable in Launch Script

runvm-pkg.nix

Take name and url as args

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{self, pkgs, ...}:

pkgs.writeShellScriptBin "ffvm-visit-url" ''
set -euo pipefail

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Take name and url as args

Set variables for the VM launch script to use

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''
```

Take name and url as args

Set variables for the VM launch script to use

Start VM, referencing the flake output

Improvement 2: Configure VM to Read Variable

autostart-ff.nix

```
{pkgs, ...}:
let
  ff-visit-url = pkgs.writeShellScriptBin "ff-visit-url" ''
    URL=$(cat /sys/firmware/qemu_fw_cfg/by_name/opt/ffurl/raw)
    ${pkgs.firefox}/bin/firefox "$URL"
  '';
  autostart = pkgs.writeTextFile { ... };
in
{
  environment.systemPackages = [ autostart ];
  systemd.tmpfiles.rules =
    [ "z /sys/firmware/qemu_fw_cfg/by_name/opt/ffurl/raw 0440 root
    ↪  users" ];
}
```

Improvement 2: Configure VM to Read Variable

autostart-ff.nix

Autostart with a custom script which reads variable

```
{pkgs, ...}:
let
  ff-visit-url = pkgs.writeShellScriptBin "ff-visit-url" ''
    URL=$(cat /sys/firmware/qemu_fw_cfg/by_name/opt/ffurl/raw)
    ${pkgs.firefox}/bin/firefox "$URL"
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  systemd.tmpfiles.rules =
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    ↪  users" ];
}
```

Improvement 2: Configure VM to Read Variable

autostart-ff.nix

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    ↪  users" ];
}
```

Autostart with a custom script which reads variable

Ensure variable can be read

We have our single site VM!

```
> ./result/bin/ffvm-visit-url greatsong
↪  "https://www.youtube.com/watch?v=dQw4w9WgXcQ"
```

We have our single site VM!

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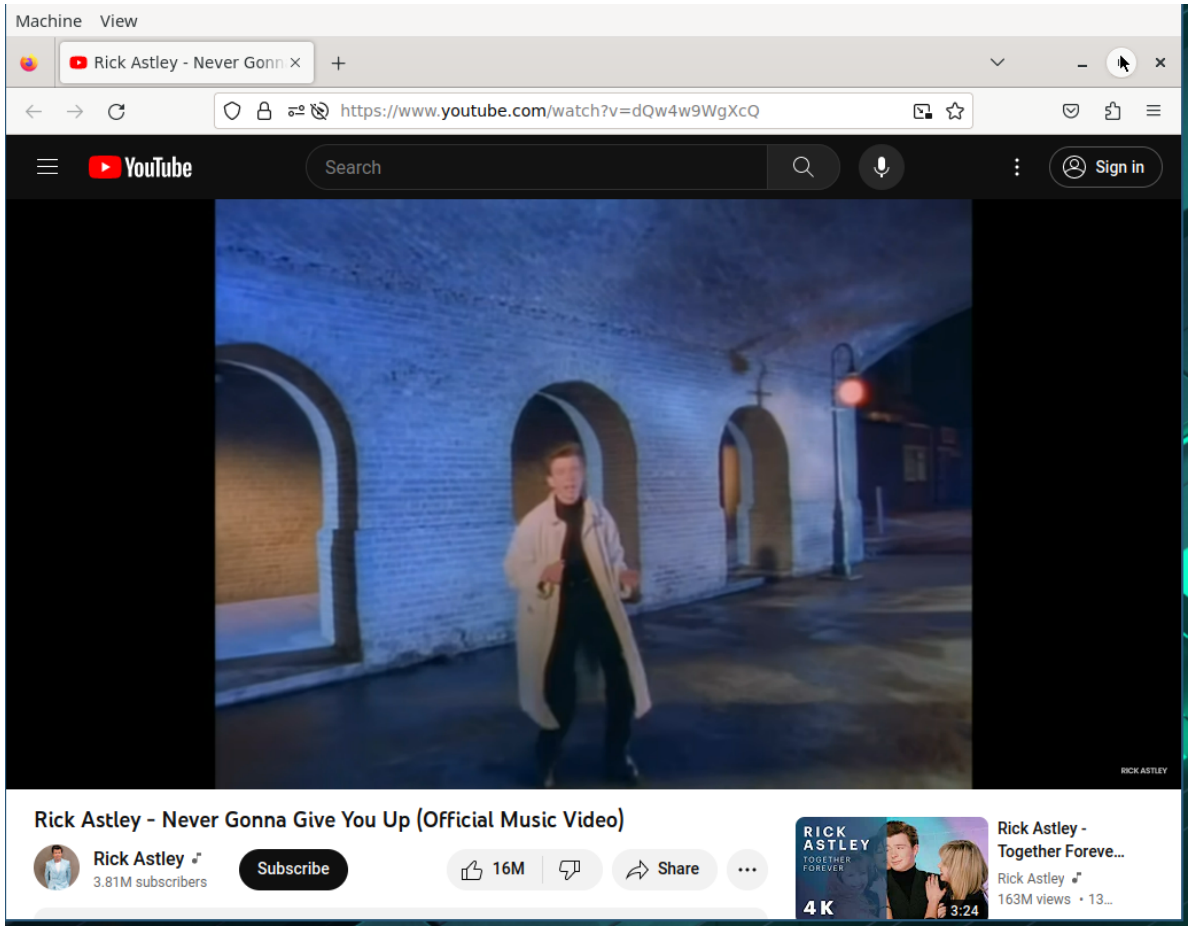
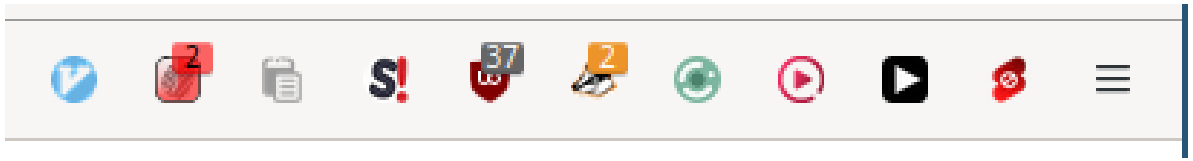


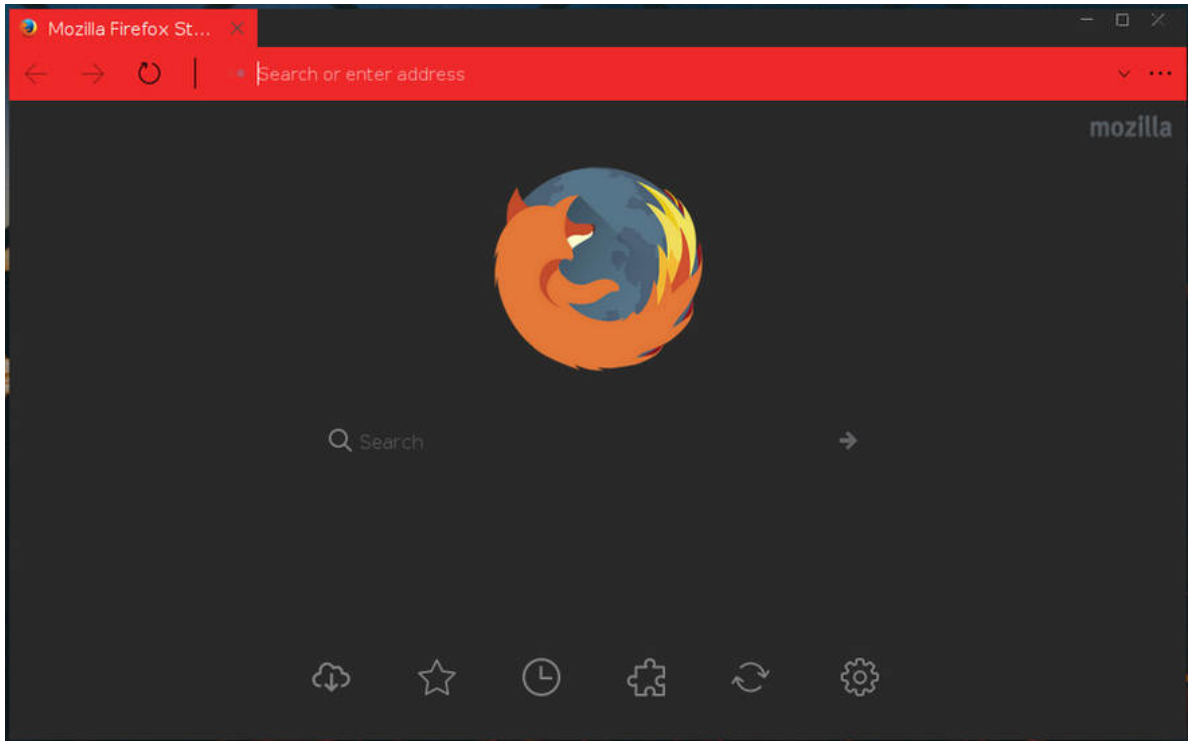
Customize

- Firefox with Addons



Customize

- Firefox with Addons
- User-chrome Styling



Customize

- Firefox with Addons
- User-chrome Styling
- Networking: VPN Configuration

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- Firefox with Addons
- User-chrome Styling
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