

Nix(OS) - Revolutionizing packaging and configuration management!



NixOS

The Purely Functional Linux Distribution

Before we begin (FYI)

- Ask questions at any time
- Please ask lots of questions :)
- The slides contain some redundancy
- There are a few optional slides at the end
- Please give me feedback
 - Louder
 - Faster/slower
 - More/less details
 - Etc.

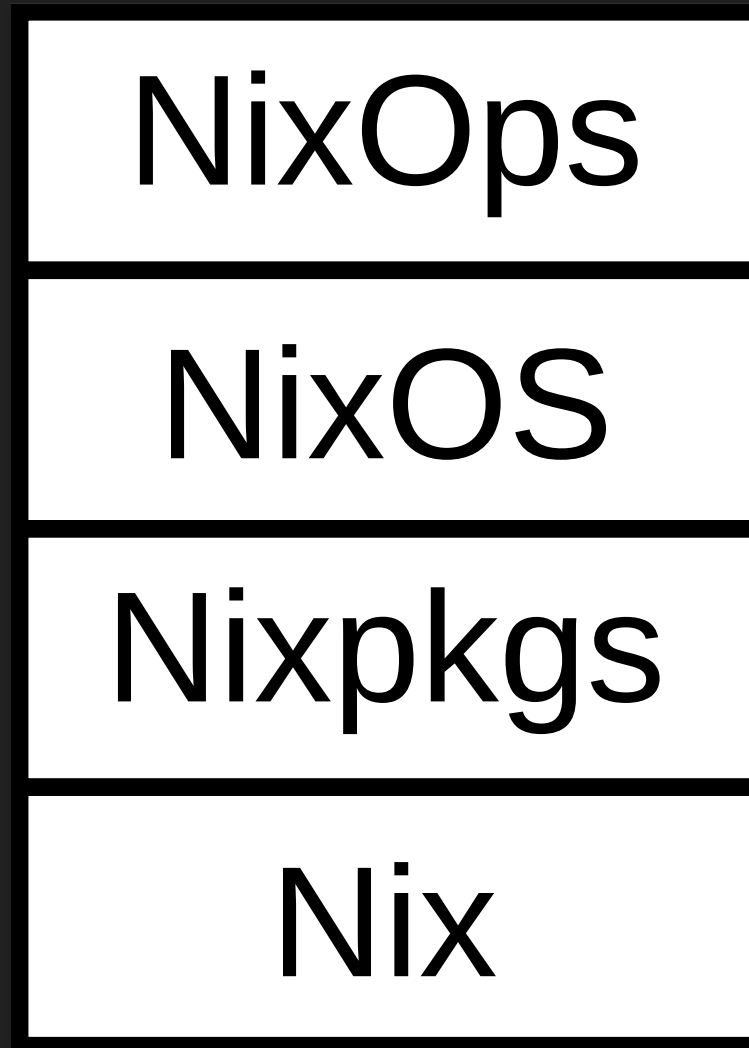
About me

- Michael Weiss aka. primeos
- Computer science student at the University of Tübingen
- I love free software, etc.
- First `nixpkgs` commit: 2016-10-05
- I maintain ~41 packages and ~3 modules (2018-06-08)
- I also love privacy (i.e. no more details :P)
- Email: dev.primeos@gmail.com (#privacy)

Main components

- Nix (package manager)
- Nixpkgs (Nix packages collection)
- NixOS (operating system)
- NixOps (DevOps / cloud deployment tool)

Nix* ISO/OSI model



Other tools

- Hydra (Nix based continuous build system)
- Disnix (distributed services deployment)
- PatchELF (change dynamic linker and RPATH)
- {cabal,go,node,pip,python,pypi,composer,hex,bower,vim,...}2

History

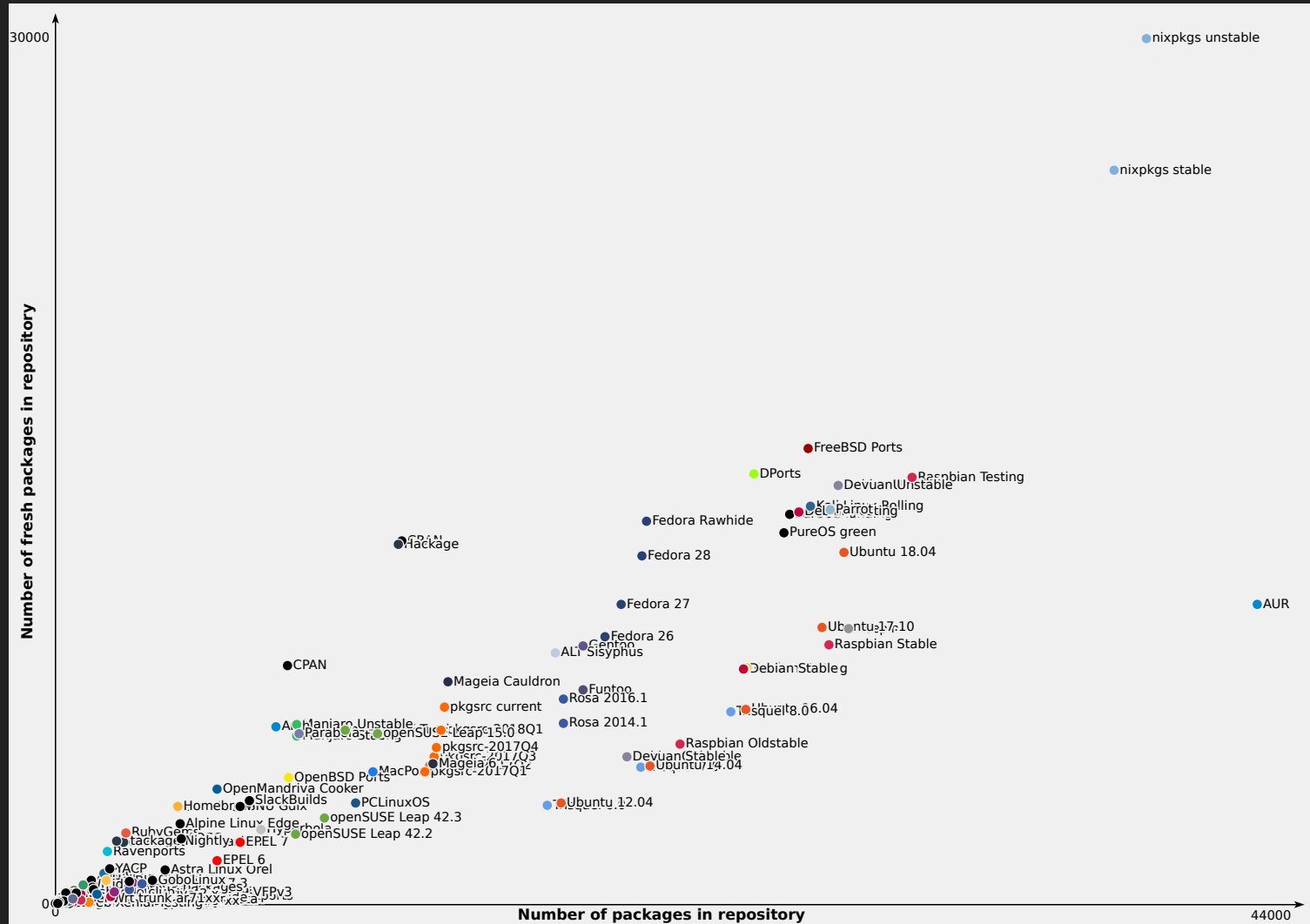
- Started as a **research project** (with funding)
- First paper in 2004 (many will follow)
- Nix package manager developed by **Eelco Dolstra** as part of his PhD research (~2003)
- First NixOS prototype developed by Armijn Hemel as his master's thesis project
- Hydra developed as part of the LaQuSo Buildfarm project

Timeline



- 2003: init (research begins)
- 2007: NixOS becomes usable + x86_64 support
- 2008: Website moved to nixos.org
- 2009: Nix logo + Nix(OS) build on Hydra
- 2011: Migration from Subversion to Git(Hub)
- 2013: Switch from Upstart to systemd + NixOps 1.0 release
- 2015: NixOS Foundation + First NixCon (Berlin)
- 2017: Second NixCon (Munich)
- 2018: Third NixCon (London)

Repology (2018-06-08)



Problems of classical package managers

- Upgrades/configuration changes destructively update the system state (overwriting files in sequence -> temporary inconsistency)
- State -> nondeterministic builds -> not reproducible
- Different versions of a binary
- Package conflicts
- No rollbacks
- No configuration management

Nix(OS)

- Atomic upgrades/rollbacks (software & configuration)
- Multiple versions of a package (side-by-side, e.g. testing a new Apache version)
- Deterministic & Reproducible builds
- Reliable upgrades (and rollbacks - configuration bound to correct software version + service reloads/restarts)
- Reliable channel upgrades/rollbacks (e.g. 17.03 -> 17.09)
- Unprivileged users can securely install software

Being functional

- Classically: Imperative configuration
 - Stateful changes (-> dependency hell, inconsistent states, etc.)
- NixOS: Declarative configuration
 - Packages/Configuration = immutable values
 - (Complete) rebuilds instead of destructive updates
 - Referential transparency (~an expression always evaluates to the same result)

Problems

- Lacking manpower/workforce (e.g. for better testing/security/documentation)
- Not all packages are reproducible (2016: 12.8%)
- Running pre-compiled binaries
- Scripts with hard-coded paths don't work
- No GUI for package/configuration management
- No LTS releases or super stable (i.e. old :P) branches
- Not all use-cases or configuration options supported
 - Some tricks available + PRs welcome ;)

Nix

- A purely functional package manager (transparent source/binary deployment)
- Secure multi-user support
- Stores packages in the Nix store (`/nix/store` by default)
- Each package has its own unique identifier/directory
 - E.g. `qn96dbgqdryaw38zw6v08da34q5v4qz3-git-repo-1.12.37` (cryptographic hash, name, version)
 - Enables multiple versions & binary substitutes
 - "Forces" complete dependencies

Nix expressions / Nix expression language

- A DSL (not a GPL!)
 - Describes graphs of build actions ("derivations")
 - Packages, compositions of packages, configurations, ...
- Dynamically typed ("Nix won't be complete until it has static typing." @edolstra) - <https://typing-nix.regnat.ovh/>
- Lazy (a very important feature!)
- Purely functional (no side-effects, immutable store)
- Turing complete (e.g. Dhall is not -> [dhall-nix](#))

nix-repl

- Demo

Nixpkgs (the Nix packages collection)

- Main GitHub repository (permissive MIT/X11 license)
- Contains definitions of packages (Nix) and modules (NixOS)
- Also contains tests, library functions, etc.
- Different branches (rolling: master, stable: release-YY.MM)
- Build and tested by Hydra (+ uploaded to binary cache)
- Distributed through (nixpkgs-)channels (nixpkgs-unstable, nixos-unstable(-small), nixos-YY.MM(-small))

An example Nix package (pgpdump)

```
pgpdump = callPackage ../tools/security/pgpdump { };
```

```
{ stdenv, fetchFromGitHub  
, supportCompressedPackages ? true, zlib, bzip2  
}:
```

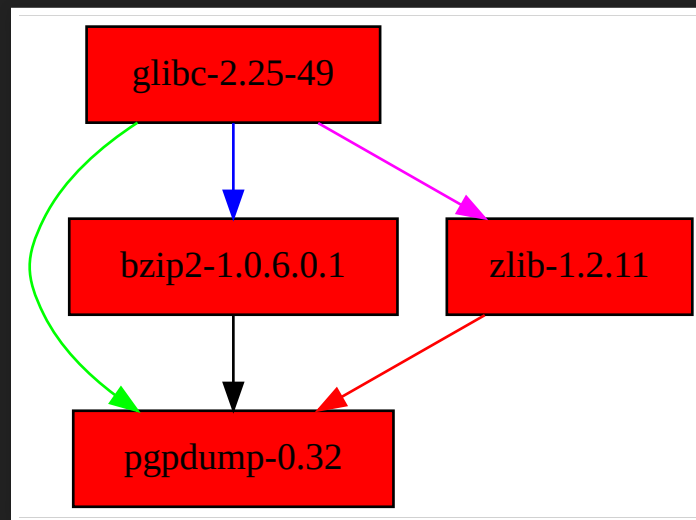
```
stdenv.mkDerivation rec {  
  name = "pgpdump-${version}";  
  version = "0.32";
```

```
  src = fetchFromGitHub {  
    owner = "kazu-yamamoto";  
    repo = "pgpdump";  
    rev = "v${version}";  
    sha256 = "1ip7q5sgh3nwdqbrzpp6s11k1s5kma98kns53yspw1830xi1n8xc";  
  };
```

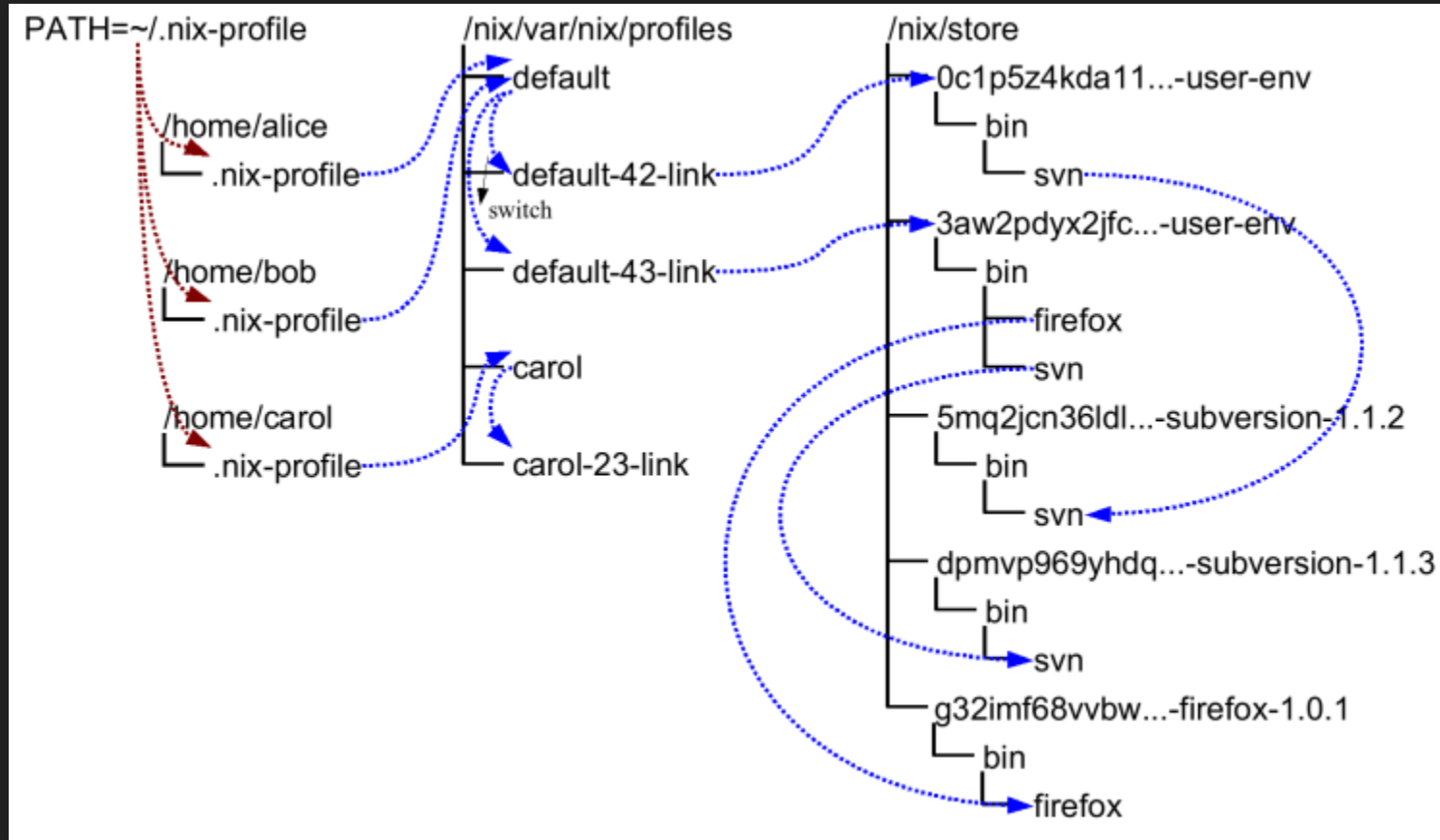
Dependency graphs

pgpdump's runtime dependencies:

```
nix-store -q --graph $(nix-store --realise $(nix-instantiate -A pgpdump
```



nix-env (manipulate or query Nix user environments)



<https://nixos.org/nix/manual/figures/user-environments.png>

nix-shell

- Demo

NixOS

- Implements a declarative and purely functional system configuration model
- Based on Nix (package + configuration management)
- NixOS modules (separation of concerns)
- Form the full "system configuration"

```
{ config, pkgs, ... }: {  
  options = { nested attribute set of option declarations using mkOp  
  config = { nested attribute set of option definitions };  
}
```

An example NixOS module

```
{ config, lib, pkgs, ... }:  
  
with lib;  
  
let  
  cfg = config.programs.vim;  
in {  
  options.programs.vim = {  
    defaultEditor = mkOption {  
      type = types.bool;  
      default = false;  
      description = ''  
        When enabled, installs vim and configures vim to be the default  
        using the EDITOR environment variable.  
      '';  
    }  
  }  
}
```

Another example NixOS module

```
{ config, lib, pkgs, ... }:  
  
with lib;  
  
let  
  cfg = config.services.monetdb;  
  
in {  
  meta.maintainers = with maintainers; [ StillerHarpo primeos ];  
  
  ##### interface  
  options = {  
    services.monetdb = {  
  
      enable = mkEnableOption "the MonetDB database server";
```


An example NixOS configuration

```
{ config, pkgs, ... }:  
  
{  
  system.nixos.stateVersion = "18.03";  
  
  nix.useSandbox = true;  
  
  boot.kernelPackages = pkgs.linuxPackages_latest;  
  
  i18n = {  
    consoleFont = "Lat2-Terminus16";  
    consoleKeyMap = "de";  
    defaultLocale = "en_US.UTF-8";  
  };  
};
```

Nixpkgs overlays

```
self: super:
# self: Final package set / fixed-point result (use as dependencies)
# super: Previous evaluation result
{
  nix = super.nix.override {
    storeDir = "${<nix-dir>}/store";
    stateDir = "${<nix-dir>}/var";
  };
  boost = super.boost.override {
    python = self.python3;
  };
  rr = super.callPackage ./pkgs/rr {
    stdenv = self.stdenv_32bit;
  };
}
```

NixUP & co.

- Nix User Profile
- Manage \$HOME

Community

- A great & kind community ([overview](#))
- [nix-devel mailing list](#)
- Discourse (Forum): discourse.nixos.org
- Bugs and PRs via GitHub ([Nixpkgs](#))
- [#nixos](#) on irc.freenode.net
- Blogs ([NixOS planet](#))
- Local meetups (e.g. in [Stuttgart](#))
- NixCon
- Commercial support via consulting companies

Learning

- Learn X in Y minutes, where X=nix
- A tour of Nix
 - By Joachim Schiele & Paul Seitz from Tübingen ;)
- Unofficial user's wiki
- Manuals (Nix, Nixpkgs, NixOS, and NixOps)

Nix Pills

- A ported version of the Nix Pills (a series of blog posts)
- A tutorial introduction into the Nix package manager and Nixpkgs package collection
- In the form of short chapters called 'pills'
- <https://nixos.org/nixos/nix-pills/>

Trying out Nix*

- Use Nix side-by-side with your regular package manager:

```
curl https://nixos.org/nix/install | sh
```

- Experiment with nix-env, nix-shell, nix-repl, etc.
- Try out NixOS (e.g. VirtualBox demo appliance)
- Install NixOS

Thank you :)



- Questions?
- Feedback
- Discussion

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 - MIT (see <https://github.com/hakimel/reveal.js>)