Integrating OS Package Management and the Erlang VM

An Erlang Startup

- Write awesome Erlang code.
- ???
- Profit.

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- Deploy to EC2.
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How do I launch my software

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Erlang/OTP software structure

erlrcdynamic.erl

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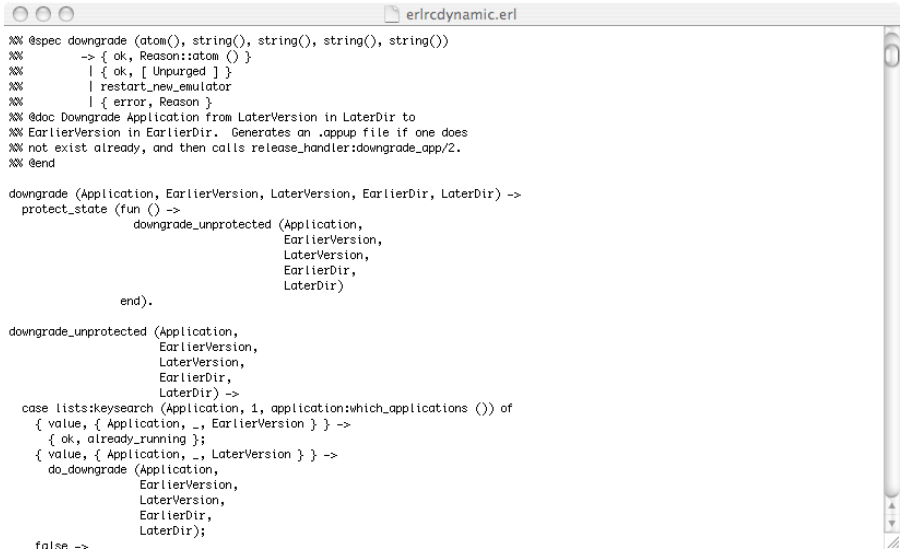

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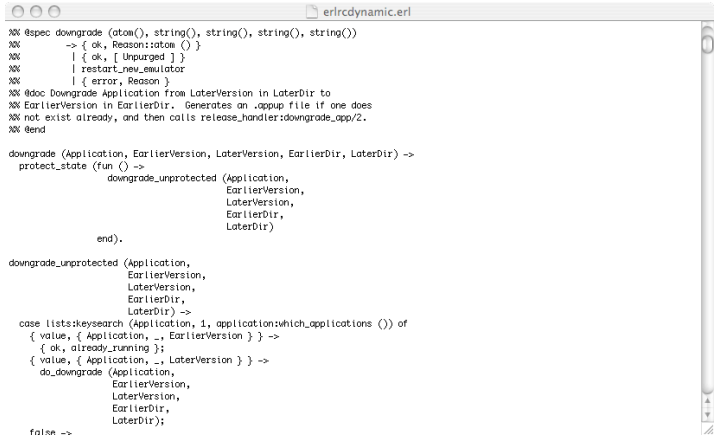

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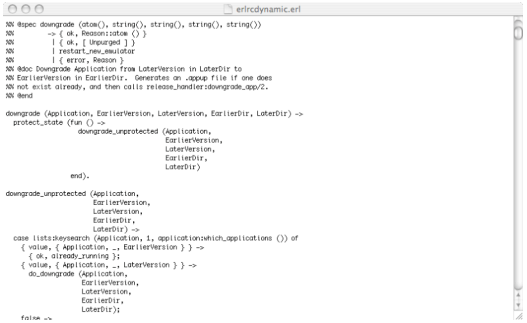

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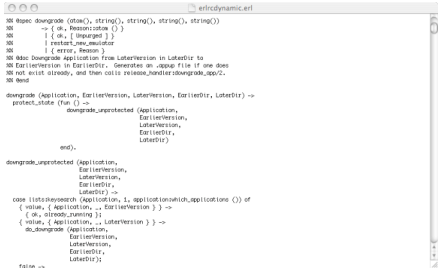

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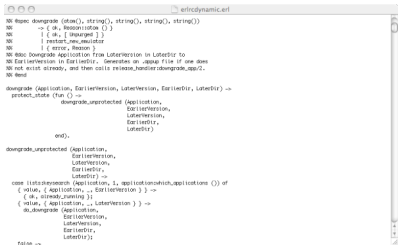

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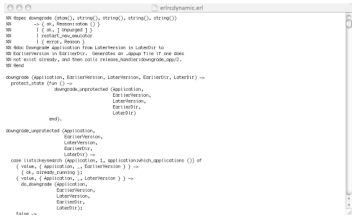

Erlang/OTP software structure

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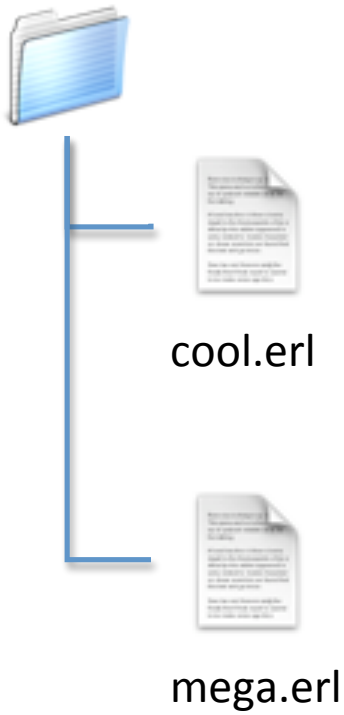

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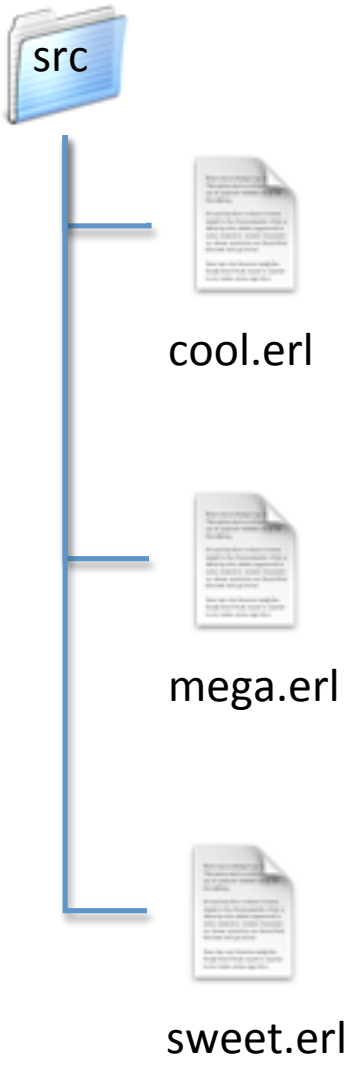

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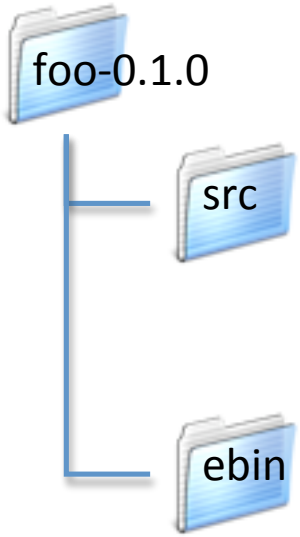

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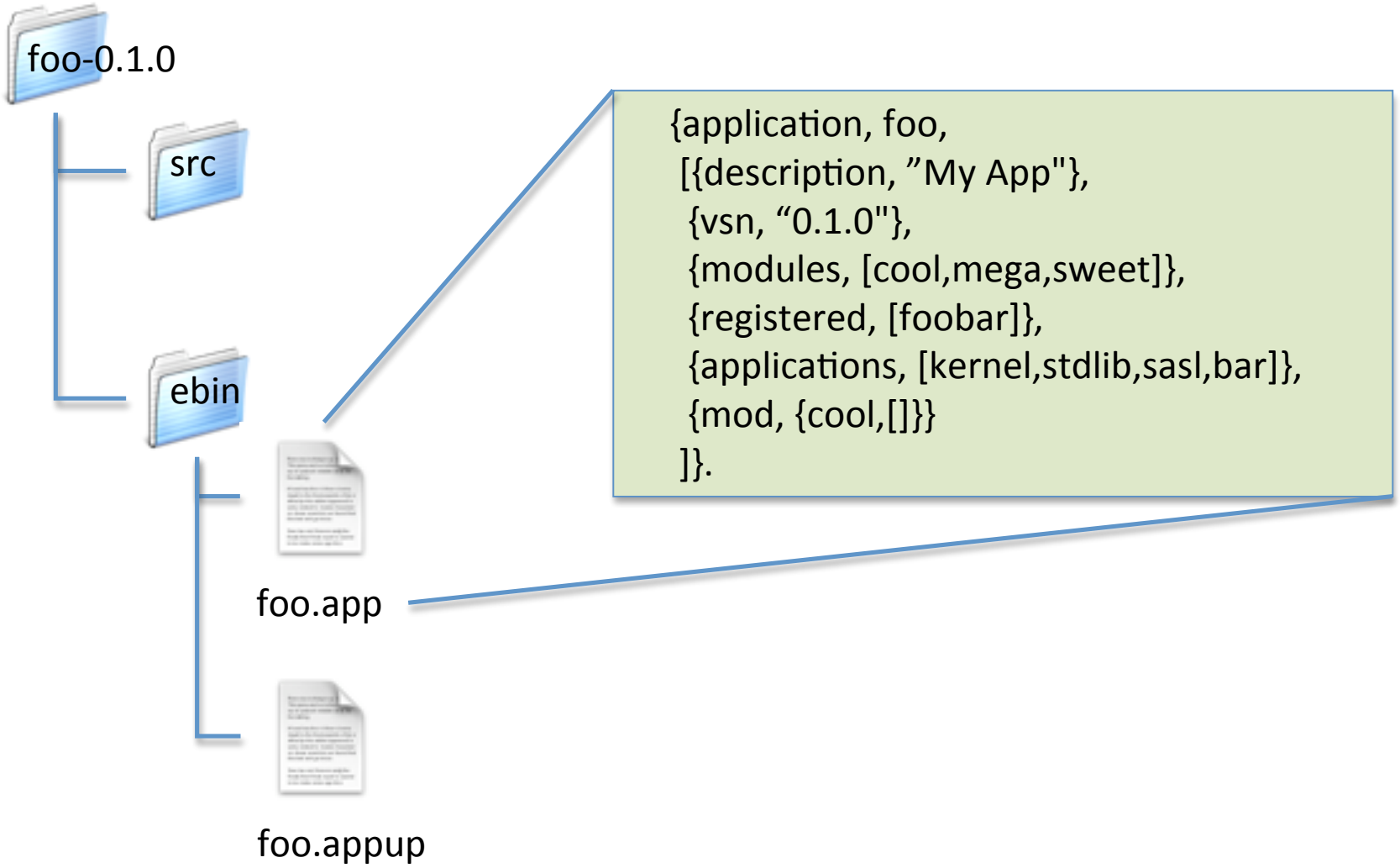

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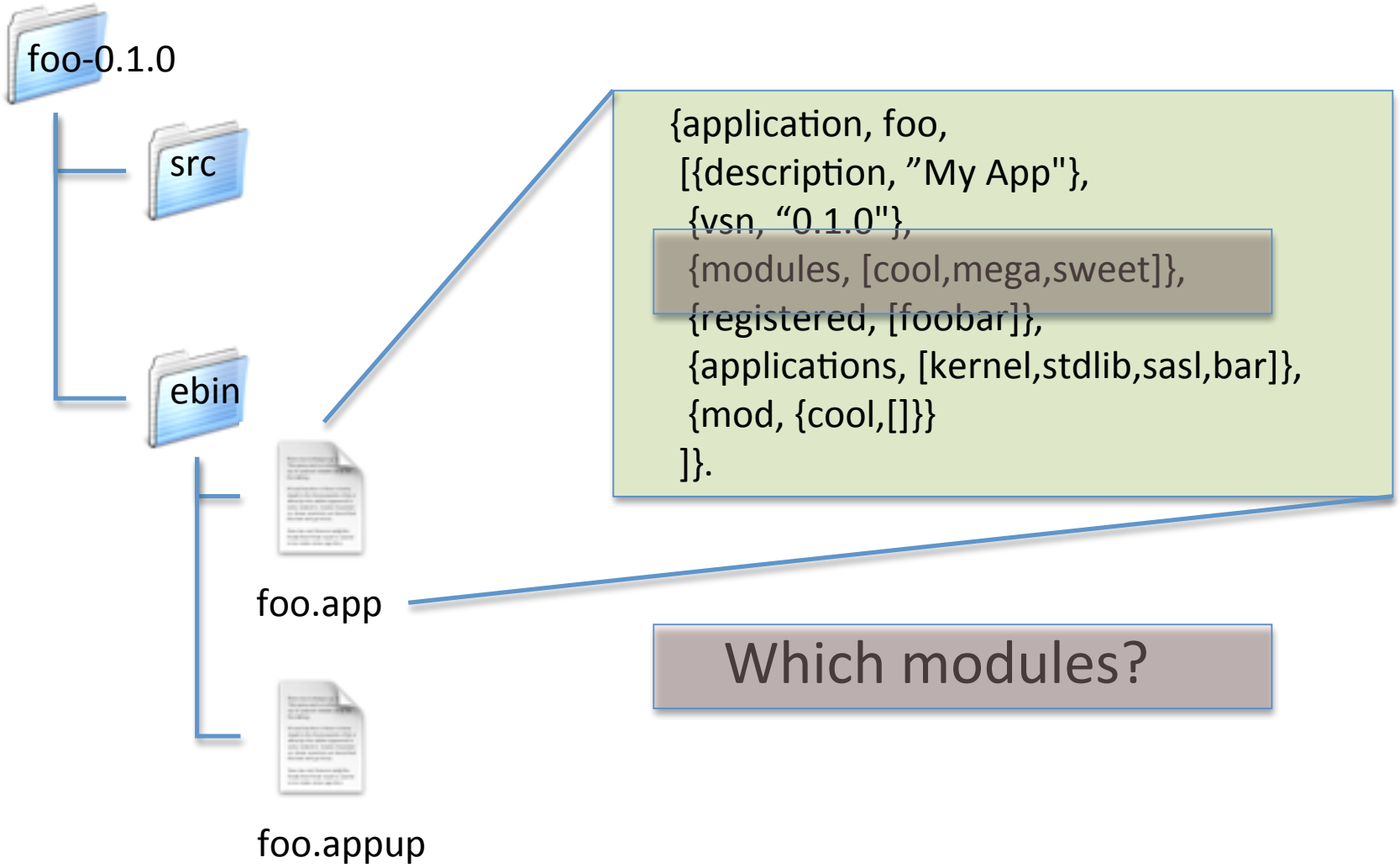

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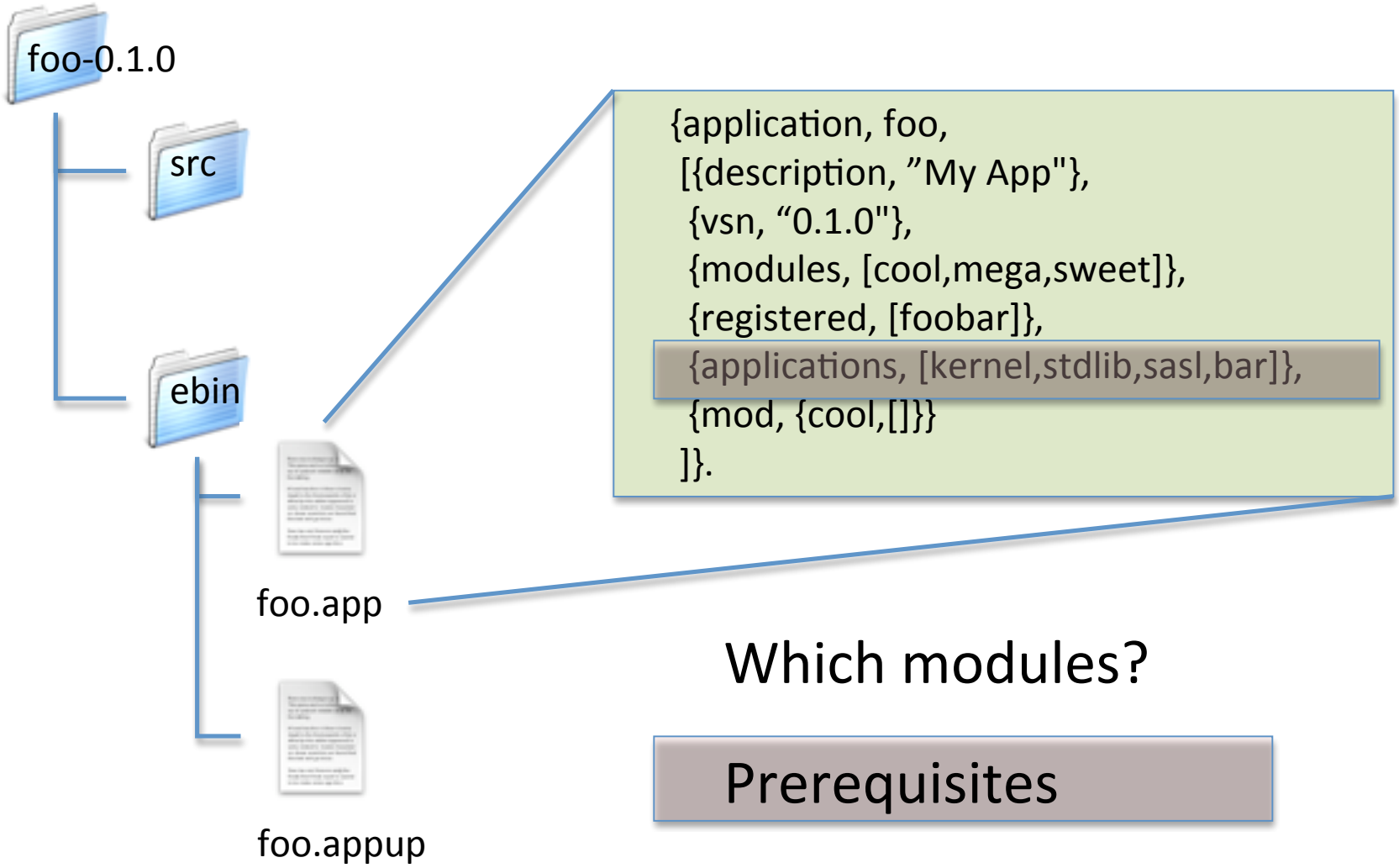

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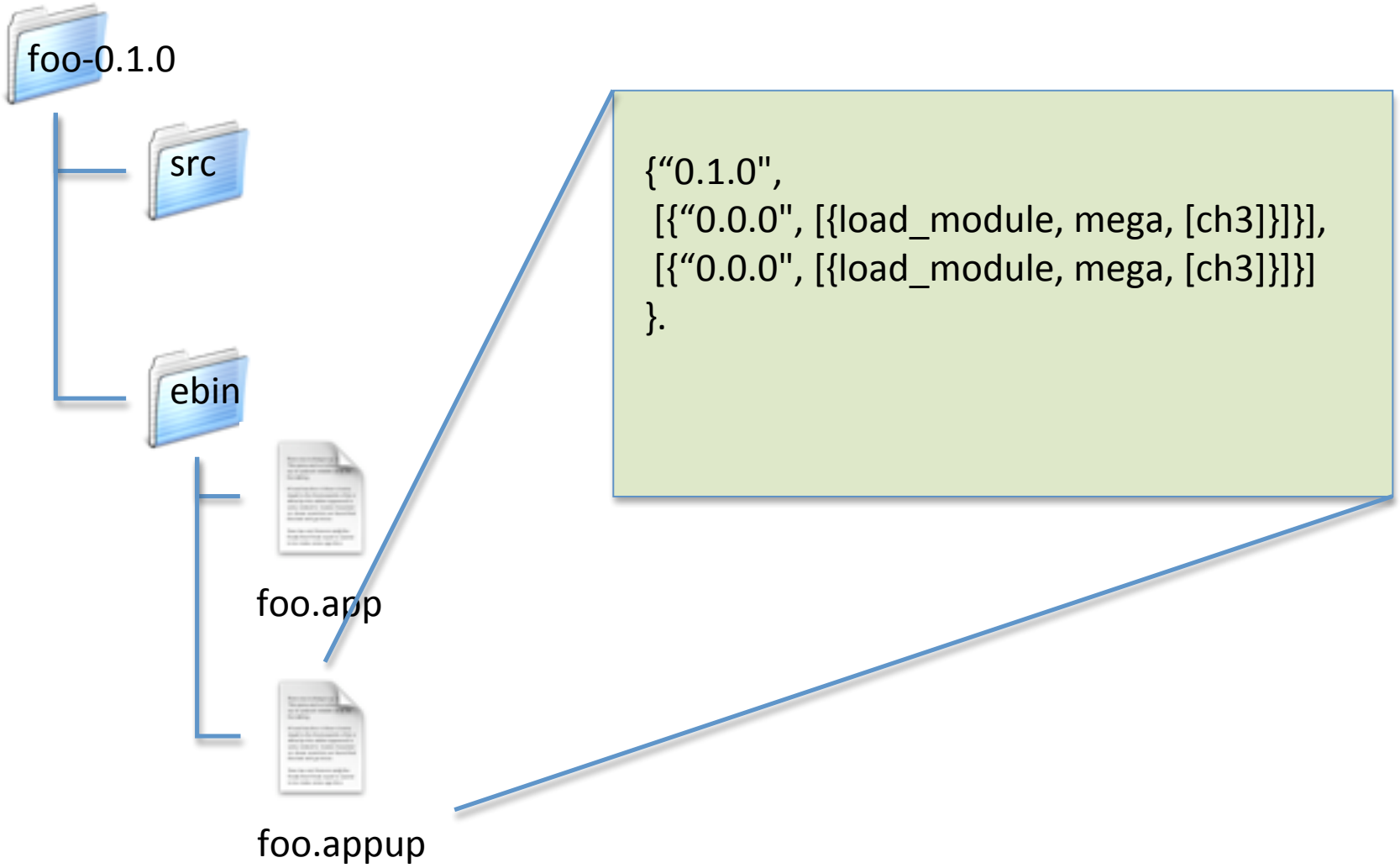

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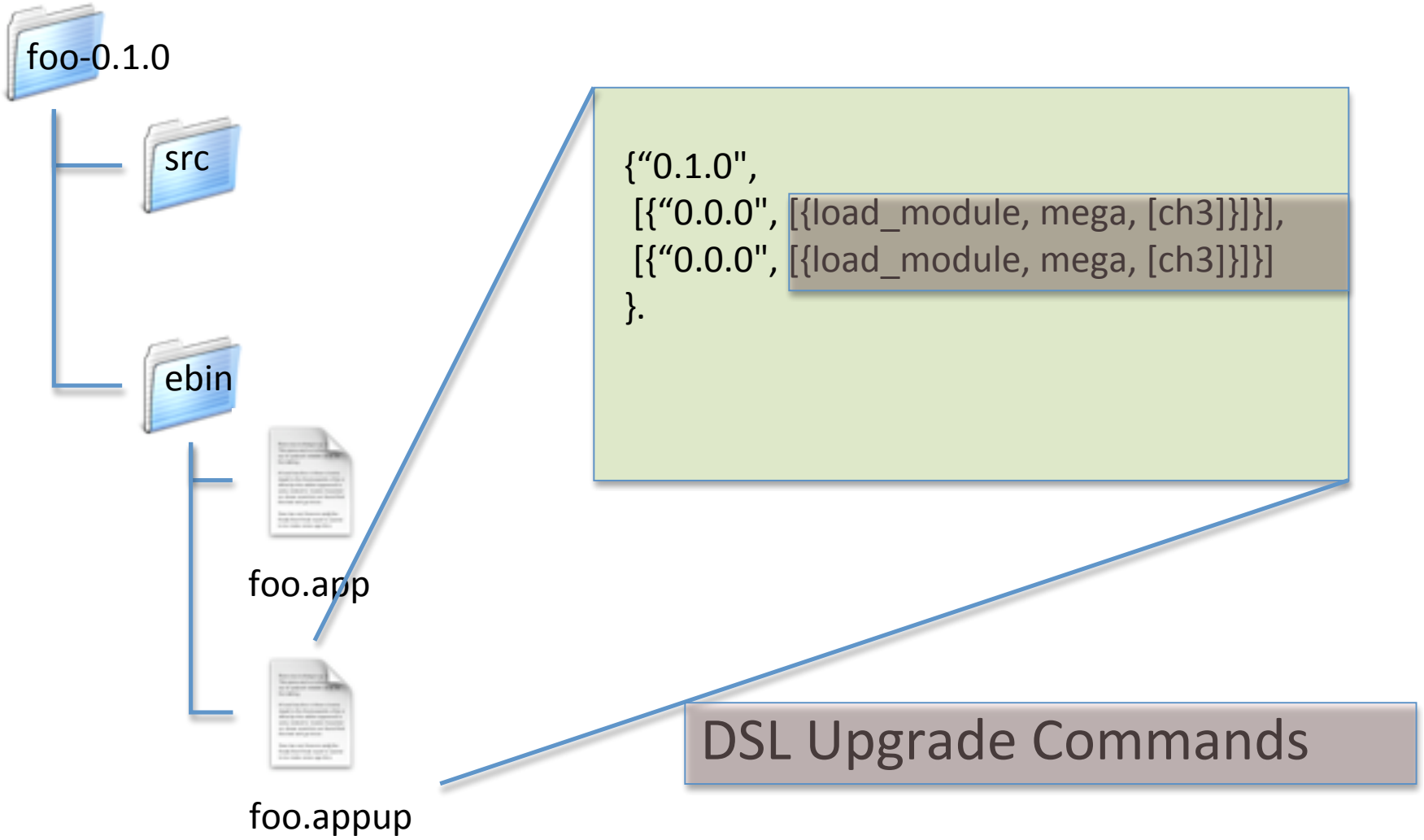

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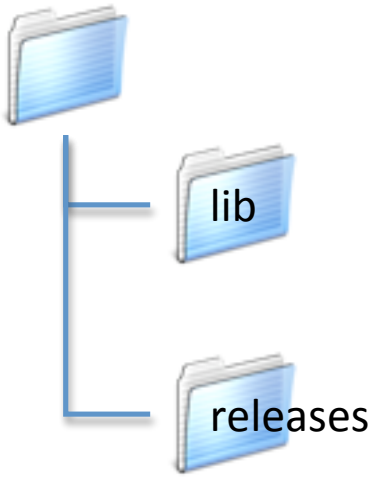

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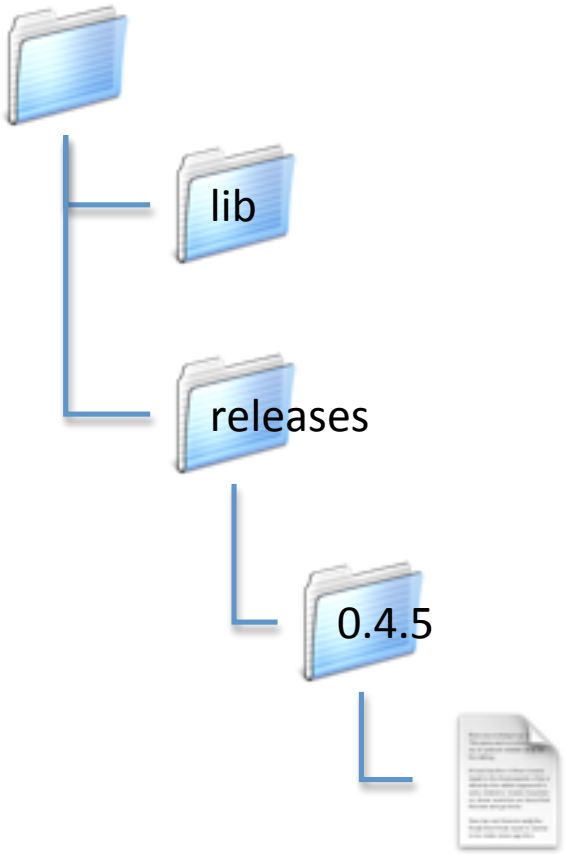

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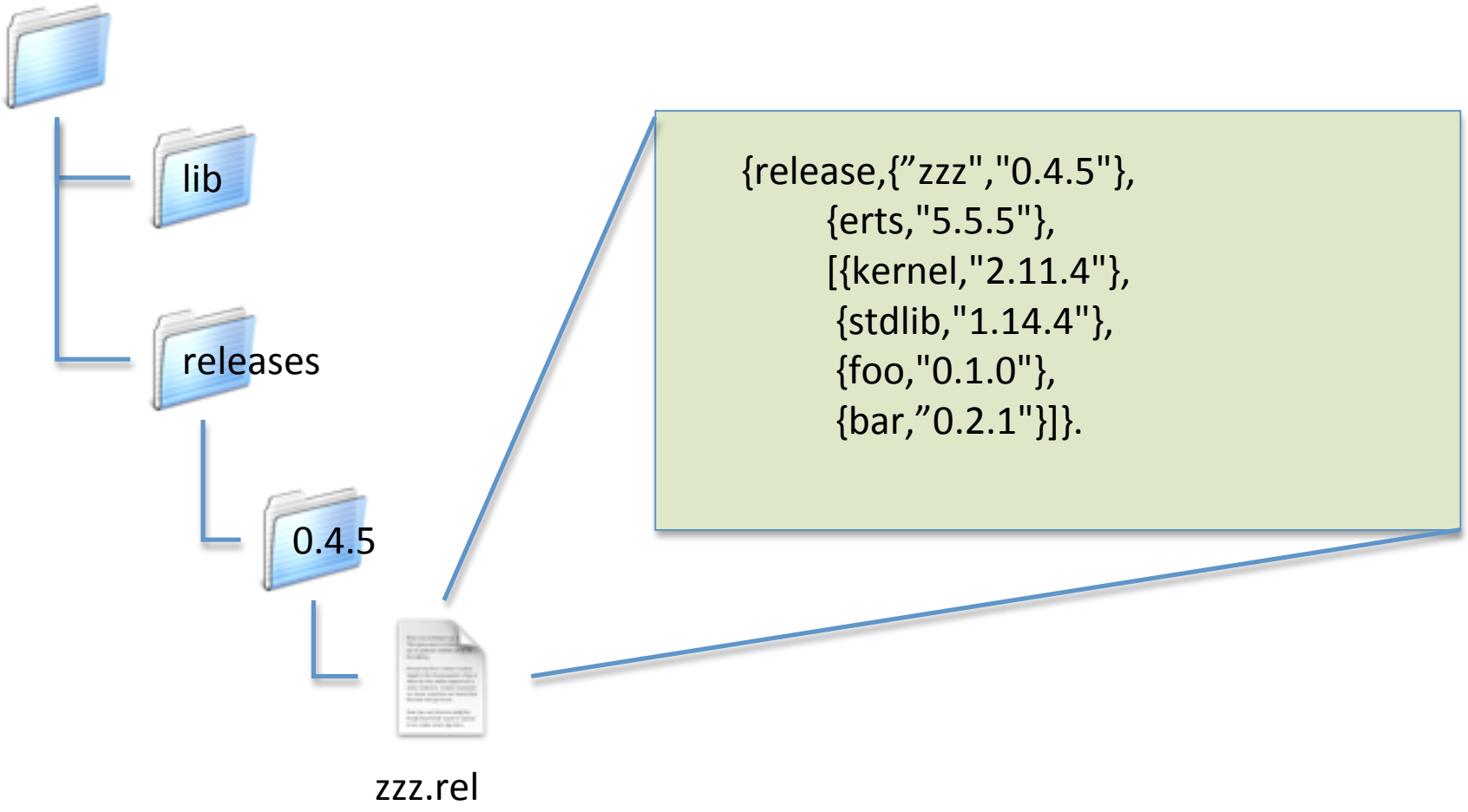

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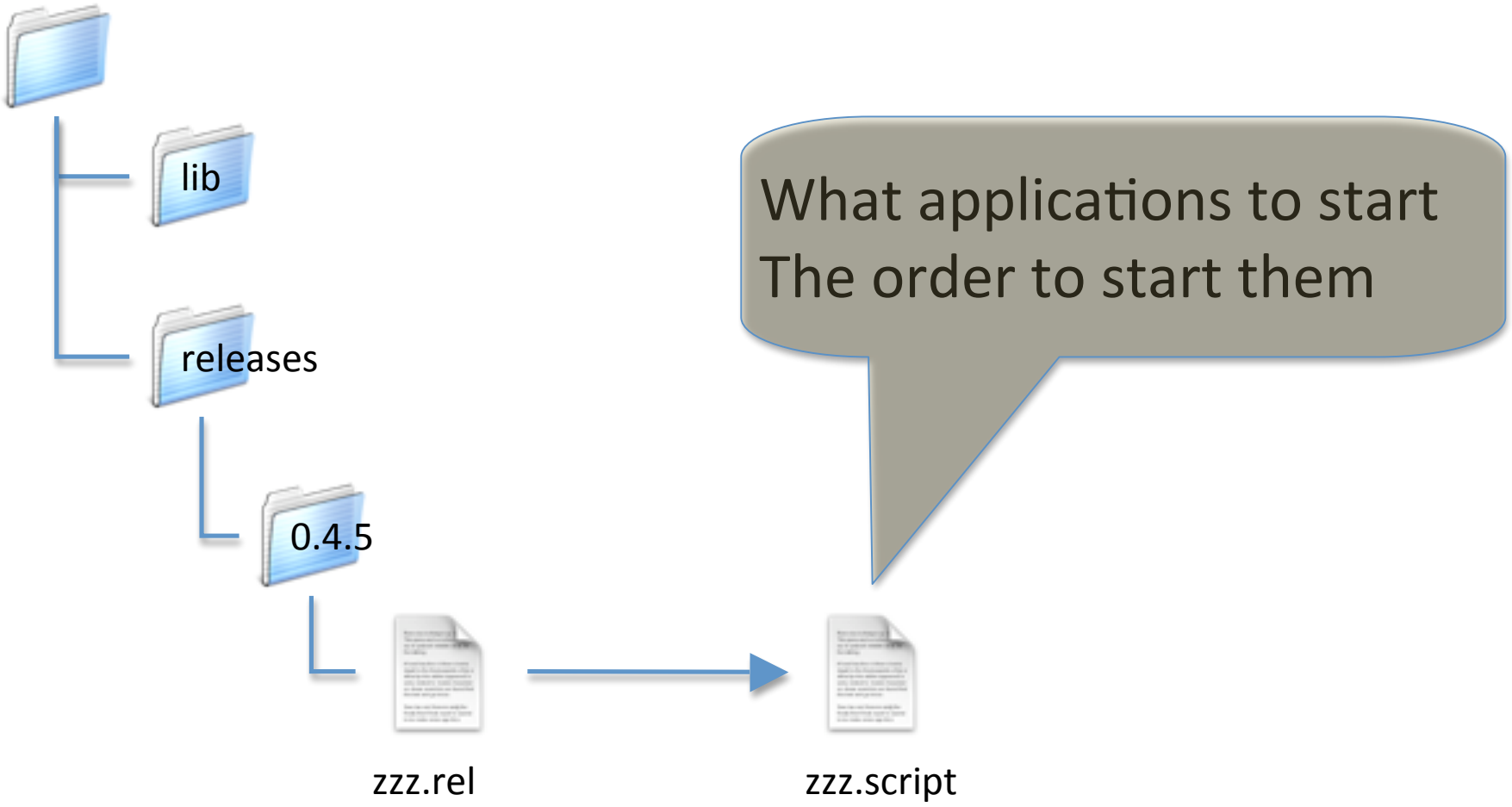

Erlang/OTP Software Structure

- A module is a unit of code.
- An application is a collection of modules.
  - Defines how to start and stop.
  - Defines how to upgrade/downgrade.
- A release is a collection of applications.
  - Defines what constitutes the system.
  - Defines how to start the system.
  - Also can define upgrade/downgrade.

Erlang/OTP Launch Strategy

- Collect versioned applications together.
  - **Defines** the new state of the system.
  - Complete, not incremental.
- Create the release using OTP tools.
- Make the release accessible.
  - The **deployment** problem.
- Upgrade using release handler tools.

Large Companies

- Infrequent complete releases.
- Heavy integrative QA.

~~Large Companies~~

Start Up

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Light Pointwise

Startup

- “Agile” launch processes

Large Companies

- Infrequent complete releases
- Heavy integrative QA

Use the OS Package Manager

- Uniformity.
- Dependency Specification.
  - Between Erlang applications.
  - Between Erlang and non-Erlang components.
- Installation hooks.
  - Hot code management.
- Provisioning.
- Deployment.

1 Xen Instance = 1 Erlang VM

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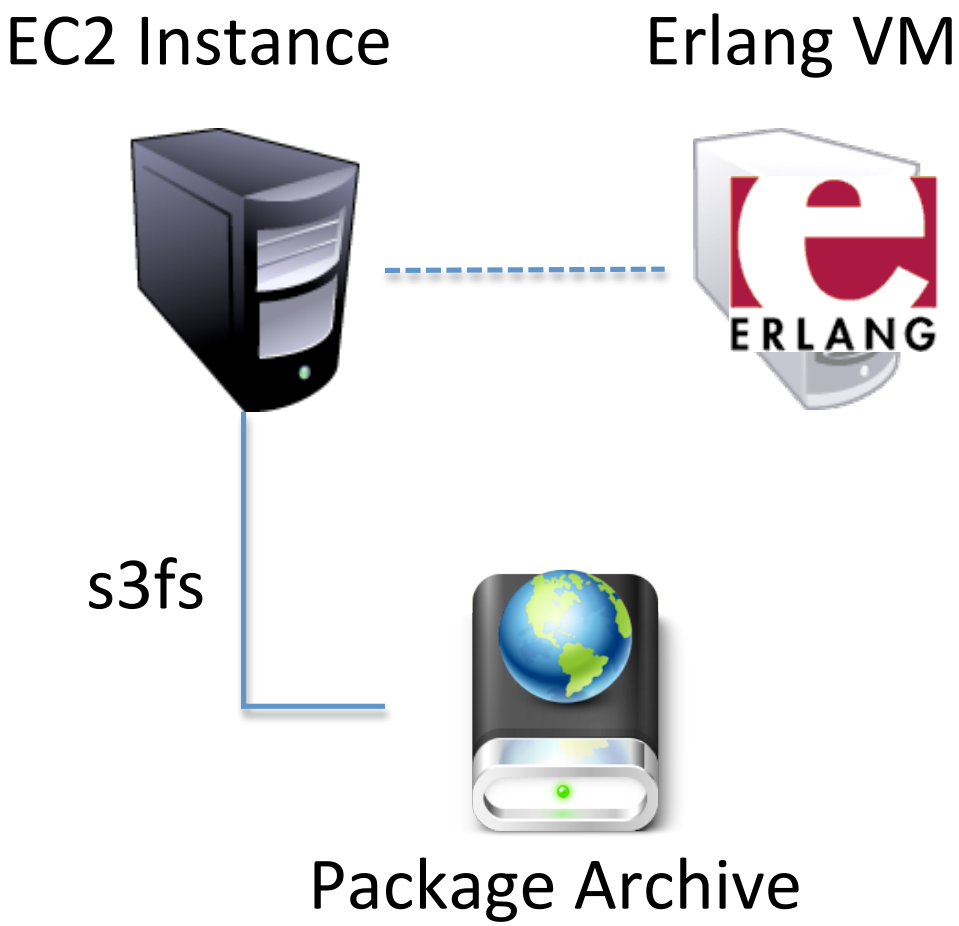

1 Package = 1 Application

- Small enough to launch frequently.
  - No need to assemble all application changes.
  - “Release” = set of packages.
- Large enough to be interesting.
  - Supervision hierarchy.
  - Upgrade semantics.

Our Launch Process

- Create application OS package.
  - Province of the build system.
- Upload to package archive.
  - Standard tools available.
- Install the package on server.
  - Automatically starts, stops, upgrades, downgrades applications as appropriate.

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  - Province of the build system.
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  - Standard tools available.
- Install the package on server.
  - Automatically starts, stops, upgrades, downgrades applications as appropriate.

Erlrc: The Vision …

```
pmineiro@ub32srvvmw-199% sudo apt-get install egerl
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following packages will be upgraded:
  egerl
1 upgraded, 0 newly installed, 0 to remove and 34 not upgraded.
Need to get 0B/113kB of archives.
After unpacking 0B of additional disk space will be used.
WARNING: The following packages cannot be authenticated!  egerl
Install these packages without verification [y/N]? y
(Reading database ... 48221 files and directories currently installed.)
Preparing to replace egerl 4.0.1 (using .../archives/egerl_4.1.0_all.deb) ...
Unpacking replacement egerl ...
erlrc-upgrade: Upgrading 'egerl': (cb8eec1a1b85ec017517d3e51c5aee7b) upgraded
Setting up egerl (4.1.0) ...
erlrc-start: Starting 'egerl': (cb8eec1a1b85ec017517d3e51c5aee7b) already_running
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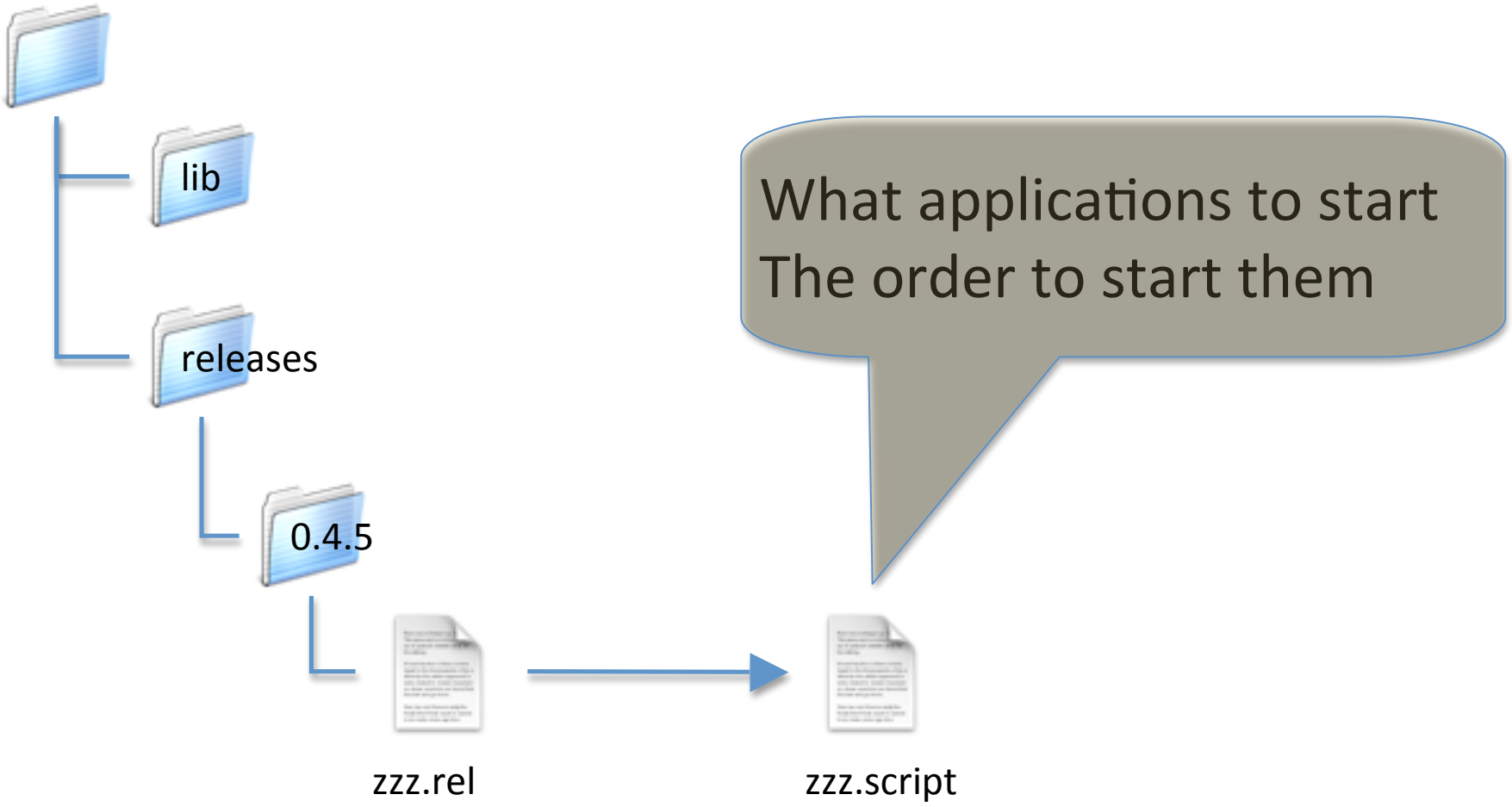
Problems to solve

- Static: booting the VM properly
- Dynamic: hot install/upgrade/remove

Erlang VM Boot



Config File vs. Config Directory

apache.conf

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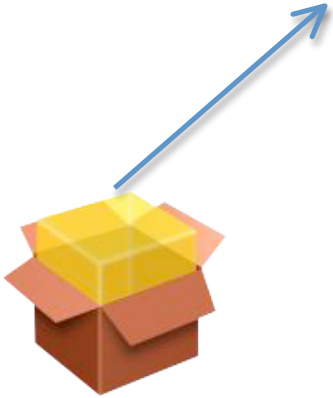
apache.conf



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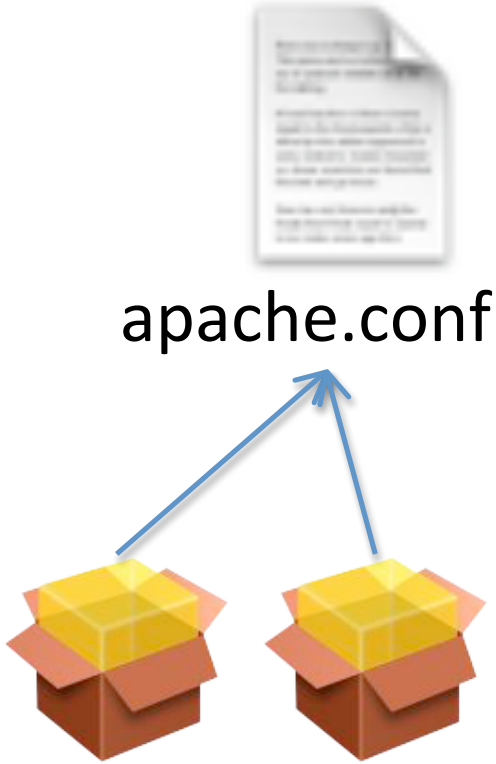

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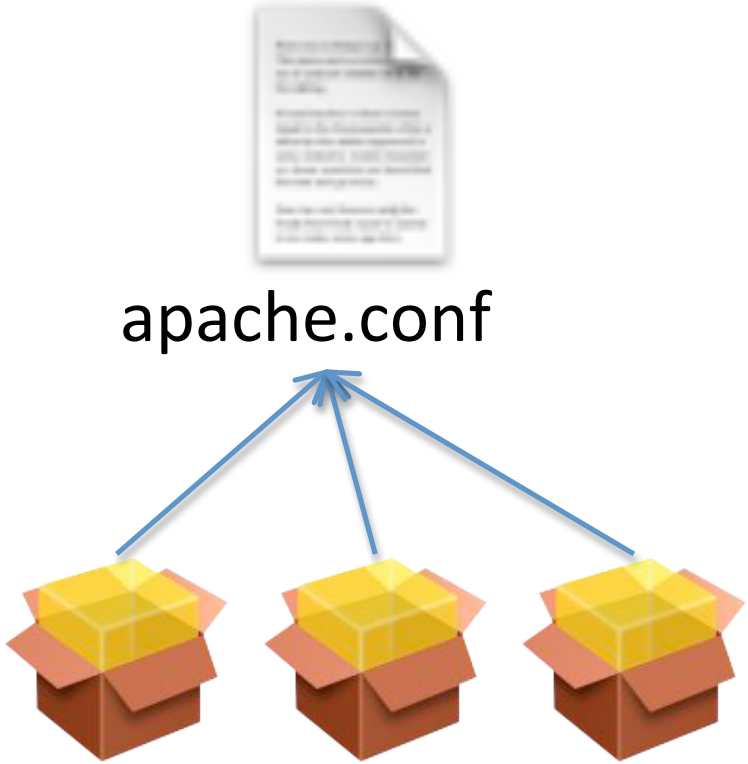

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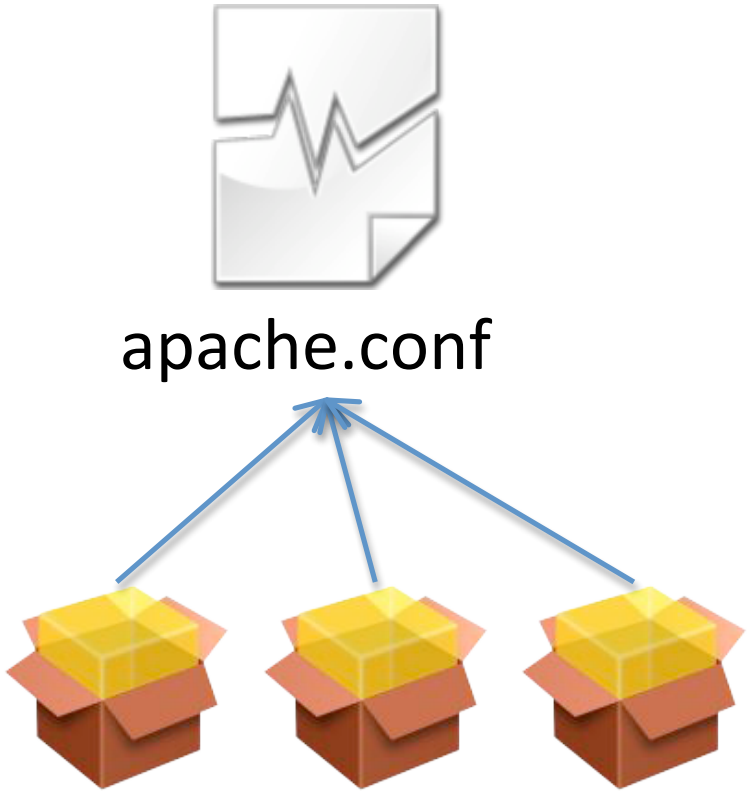

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apache.conf.d

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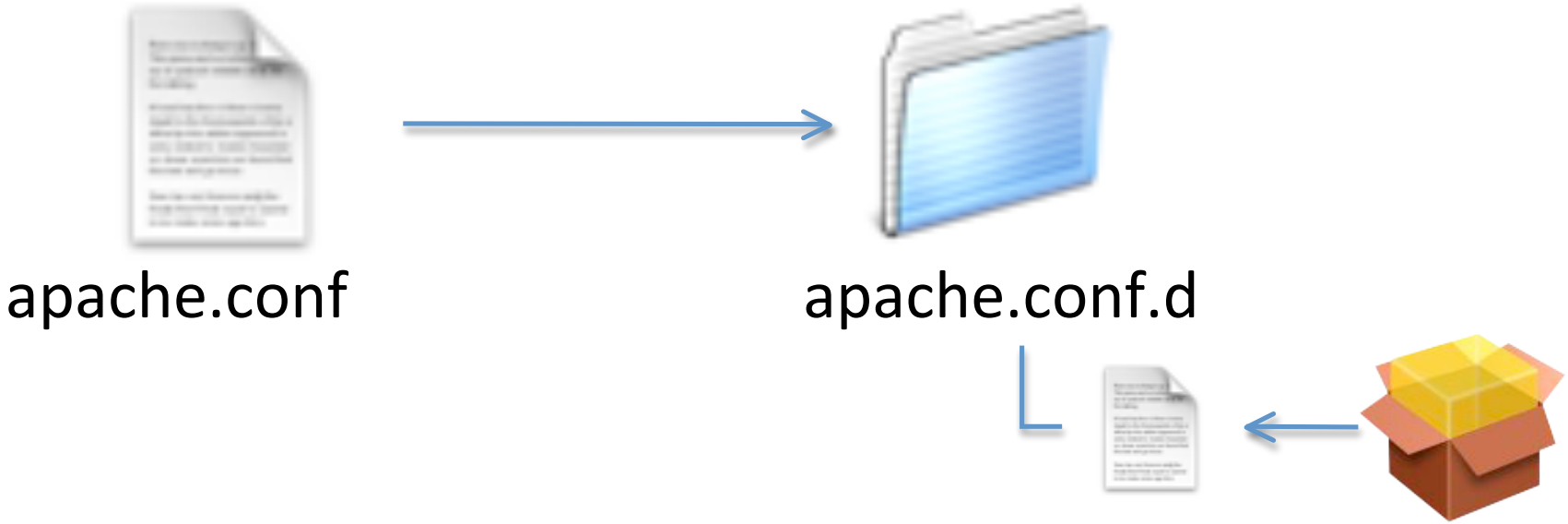

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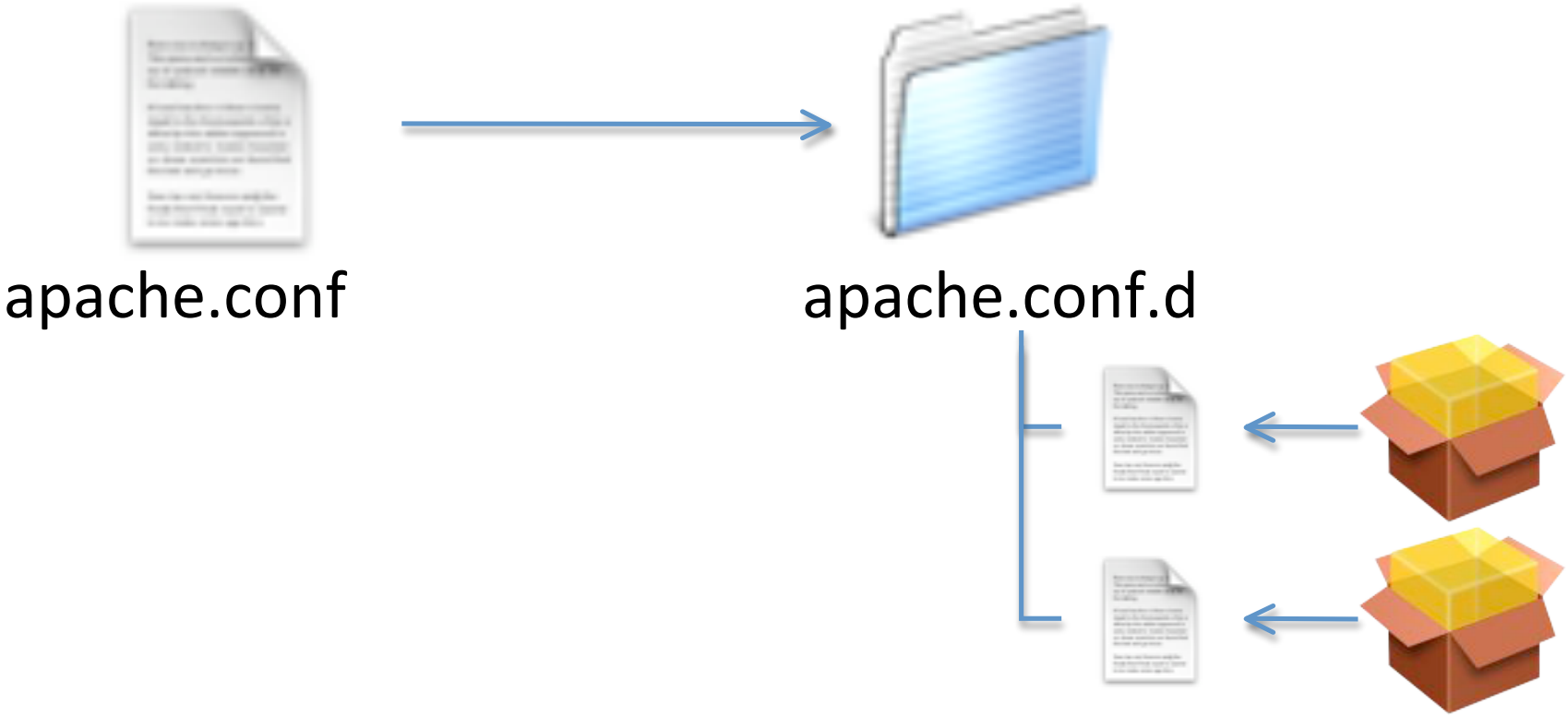

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apache.conf

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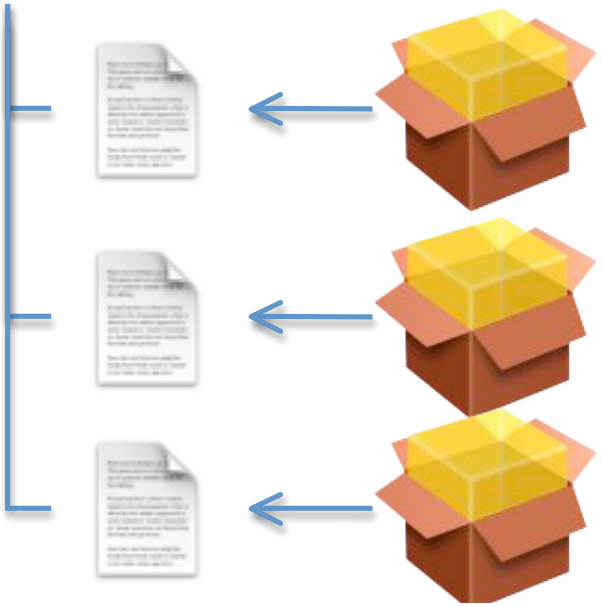
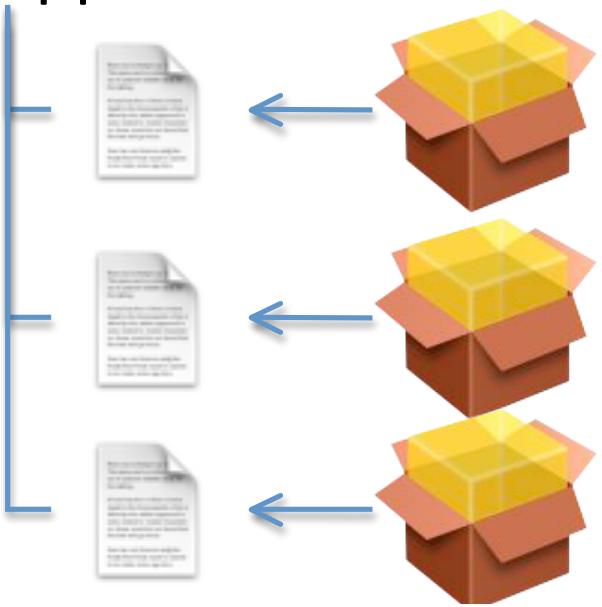


Config File vs. Config Directory

zzz.script

/etc/erlrc.d/applications



Actual Applications Directory

```
% ls /etc/erlrc.d/applications
appinspect       egerl   fragmentron  genherd       nodefinder    zfile
combonodefinder  erlrc   fuserl       loggins       schemafinder
ec2nodefinder    erlsom  gencron      n54etsbugfix  virtuerl
```

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Start Up Order

Actual Applications Directory

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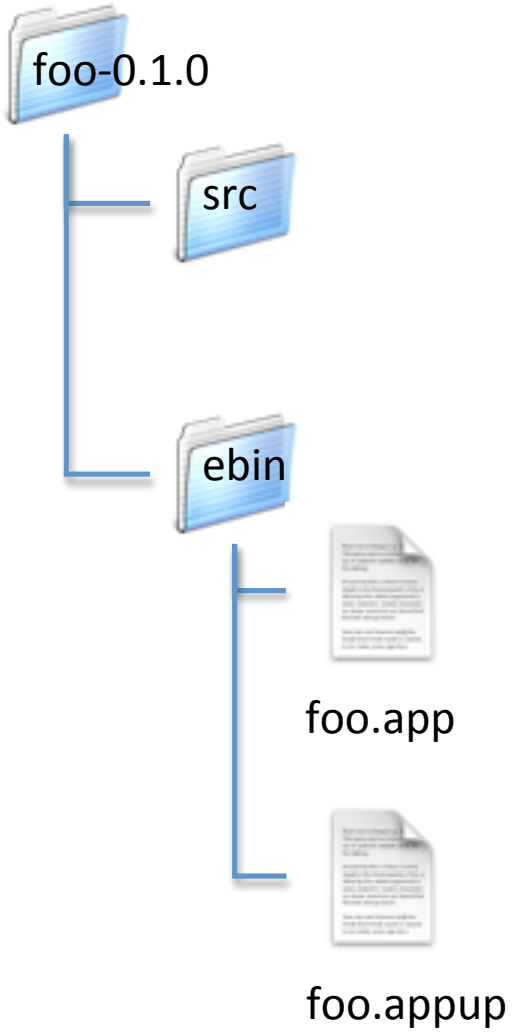
Start Up Order?

Determining the Startup Order



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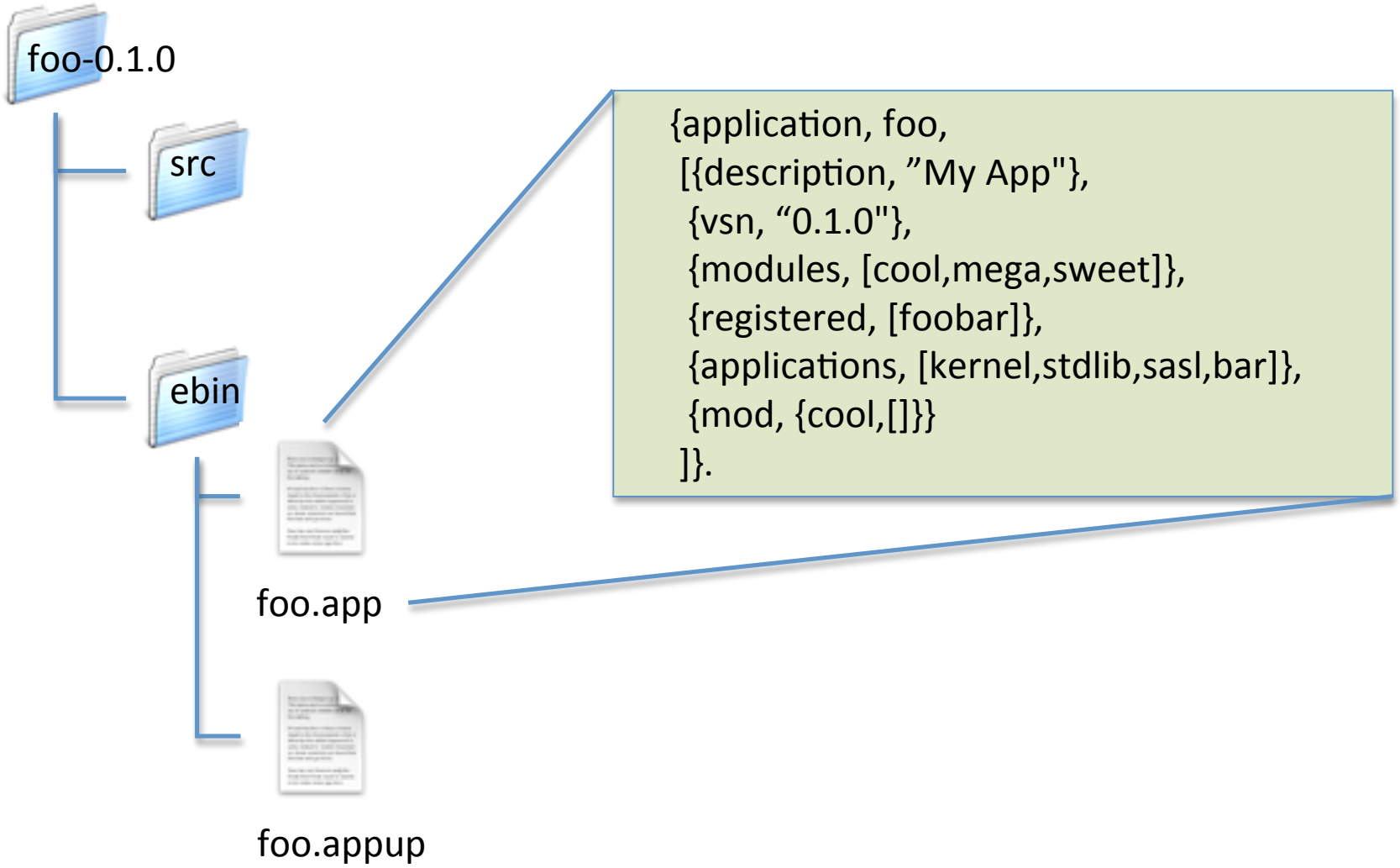

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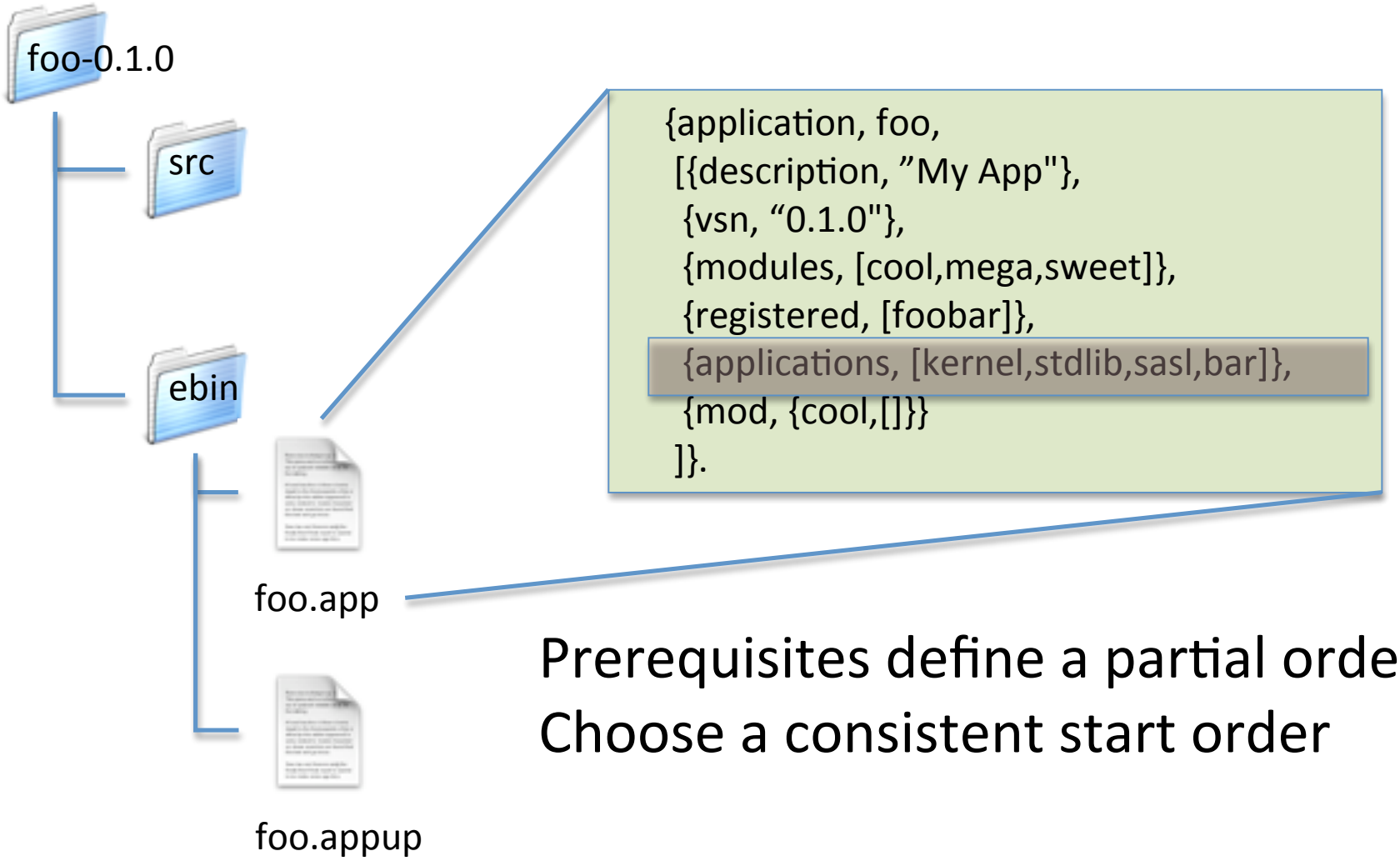


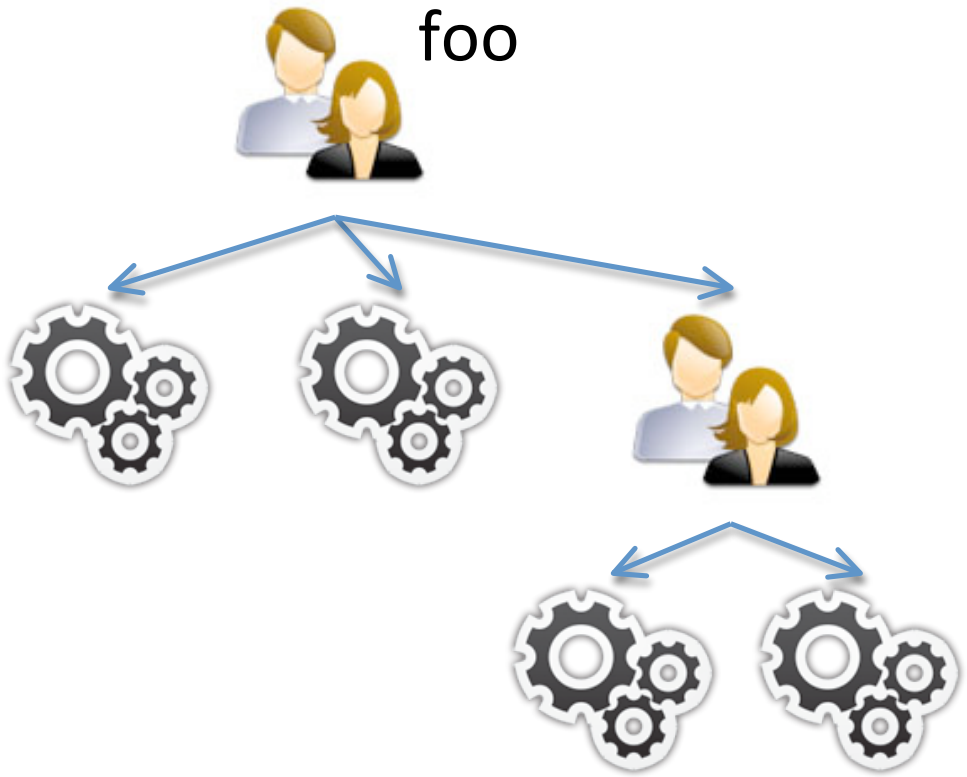
Prerequisites define a partial order

Choose a consistent start order

Regular Application

foo

Regular Application



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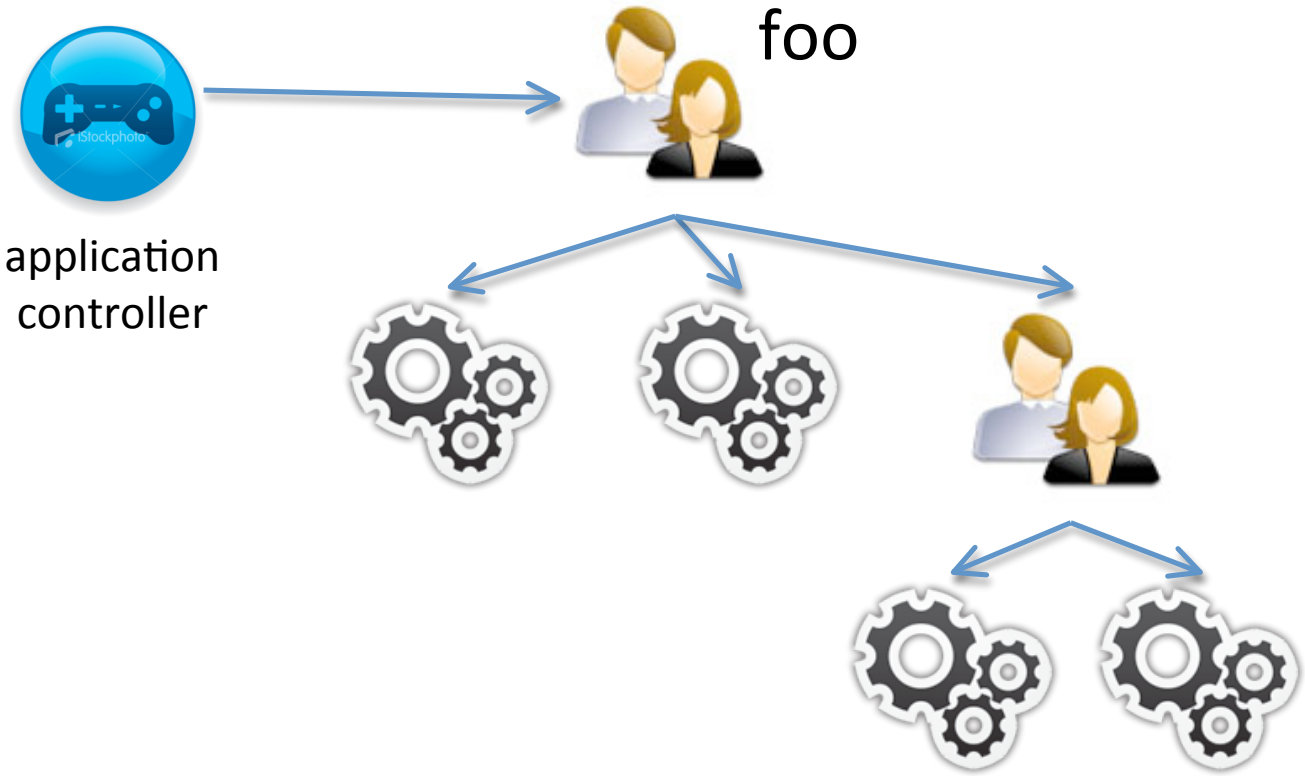
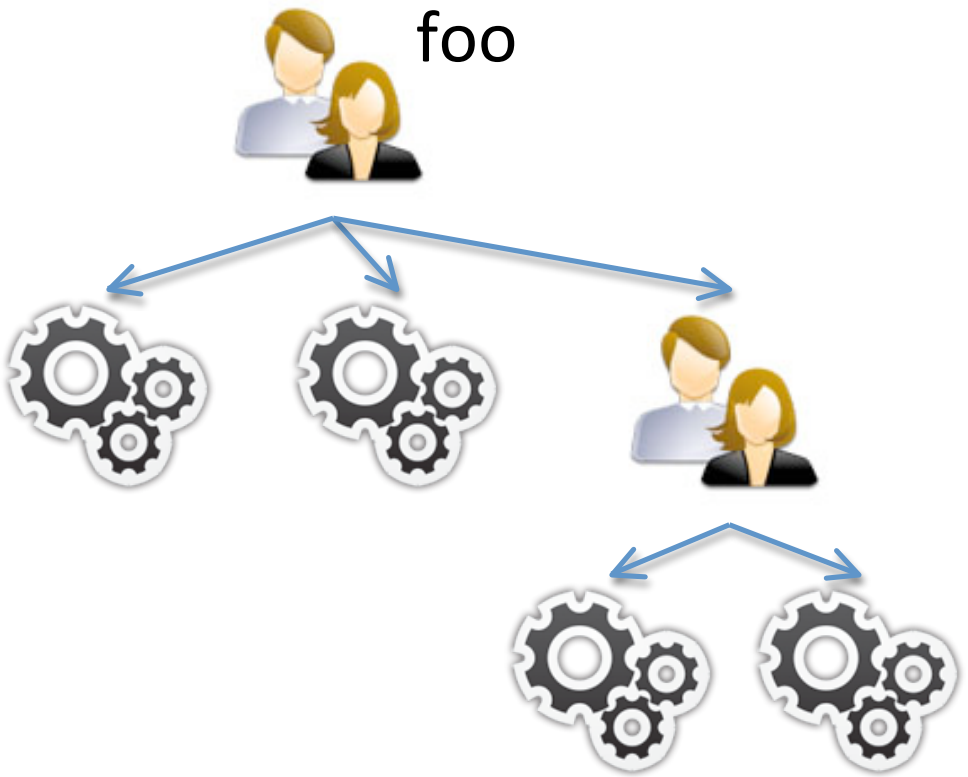


Included Application



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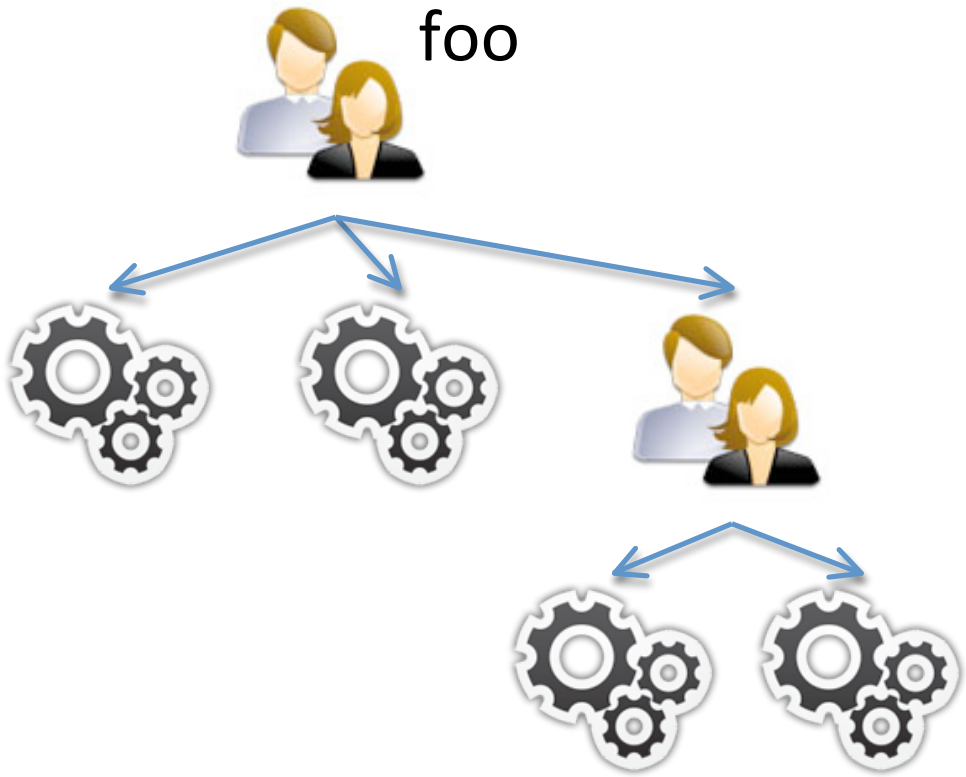

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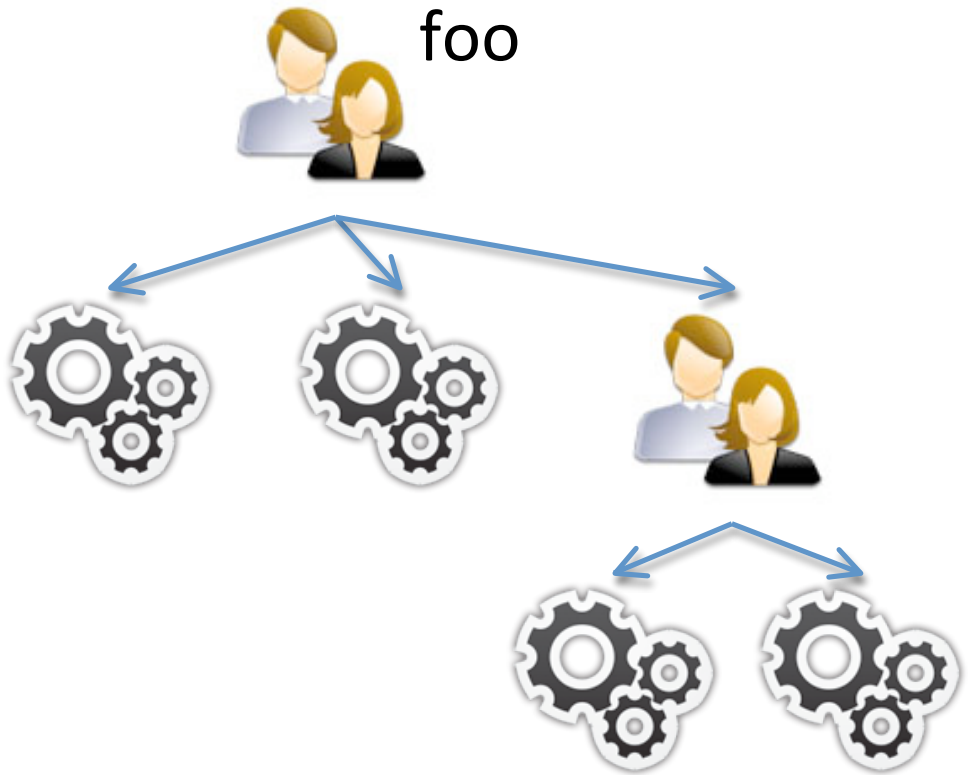

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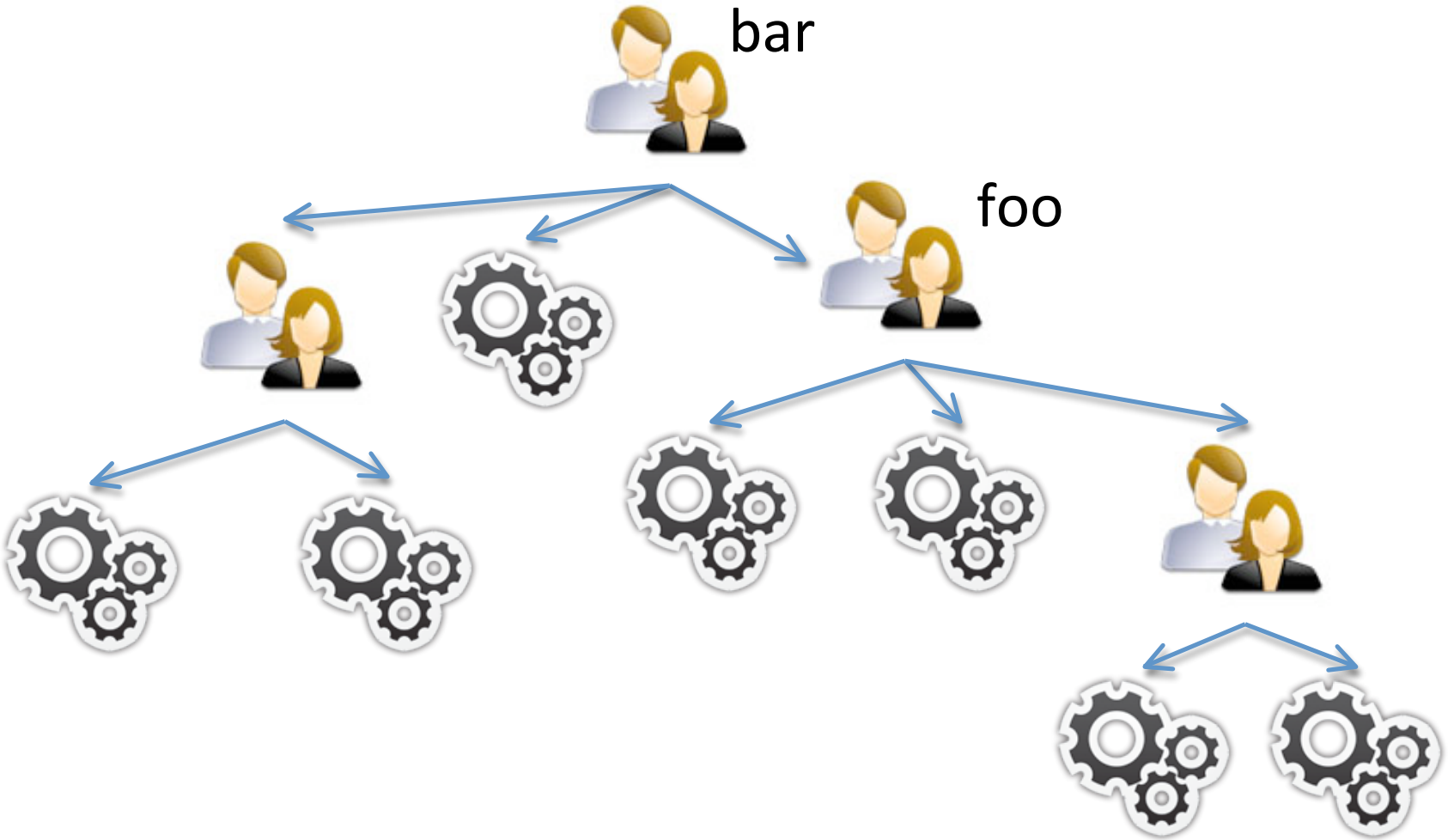

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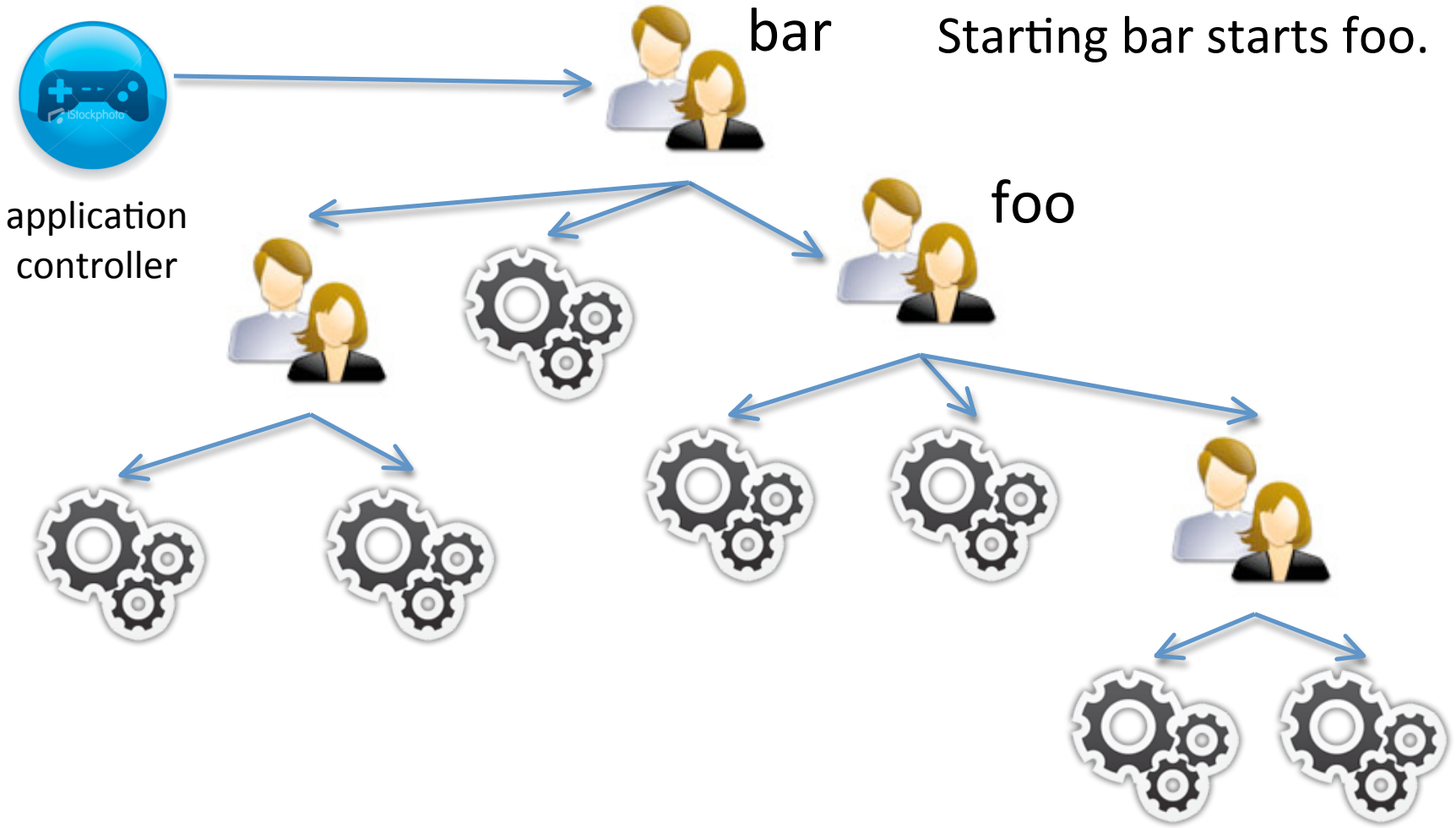

Included Application Logic

- If bar includes foo, and
- both bar and foo are to be started, then
- only start bar.
- If baz depends upon foo, and
- bar is to be started, then
- baz depends upon bar.

Boot Procedure

- Packages contain additional empty file.

  /etc/erlrc/applications/<appname>
- .app prerequisites are correct.
- Start using any boot script, e.g., start_sasl.
- Pass control to `erlrc_boot:boot/0`.

  erl –boot start_sasl –s erlrc_boot boot

Problems to solve

- ✔ Static: booting the VM properly
- Dynamic: hot install/upgrade/remove

Erlrc upgrade components

- `erlrcdynamic` module methods.
  - `erlrcdynamic:downgrade/3`
- shell scripts
  - erlrc-downgrade
- rendezvous at /etc/erlrc.d/nodes

```
% ls /etc/erlrc.d/nodes
cb8eec1a1b85ec017517d3e51c5aee7b
```

Package hook correspondence

Shell script	`erlrcdynamic` method	Description	When (debian)
erlrc-start	`start/2`	Idempotent start	postinst configure ; postinst abort-remove
erlrc-stop	`stop/2`	Idempotent stop	prerm remove
erlrc-upgrade	`upgrade/3`	Upgrade	postinst upgrade
erlrc-downgrade	`downgrade/3`	Downgrade application	postinst abort_upgrade

Example: prerm

```
#! /bin/sh
package_name="example"
package_version="0.0.0”
operation="$1”
case "$operation" in
remove)
  which erlrc-stop >/dev/null 2>/dev/null
  test $? -ne 0 || erlrc-stop "${package_name}" "${package_version}" || exit 1
;;
*)
;;
esac
exit 0
```

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```

Best practices for build system

- Automatically generate erlrc_boot file.
  - `/etc/erlrc.d/applications/<appname>`
- Generate both dependencies from single specification.
  - .app prerequisites
  - OS package dependencies
- Automatically generate package hooks.

Upgrade Logic

- If there is an appup file in the newer application version, use it; otherwise, generate one automatically.
- Ensure all modules listed in the current application specification are loaded.
- Find any added and removed included applications by examining the current and target version OTP app files.
- Stop any added included applications.
- Execute `release_handler:eval_appup_script/4`.
- Start any removed included applications, if they are listed in $ERLRC_ROOT/applications.

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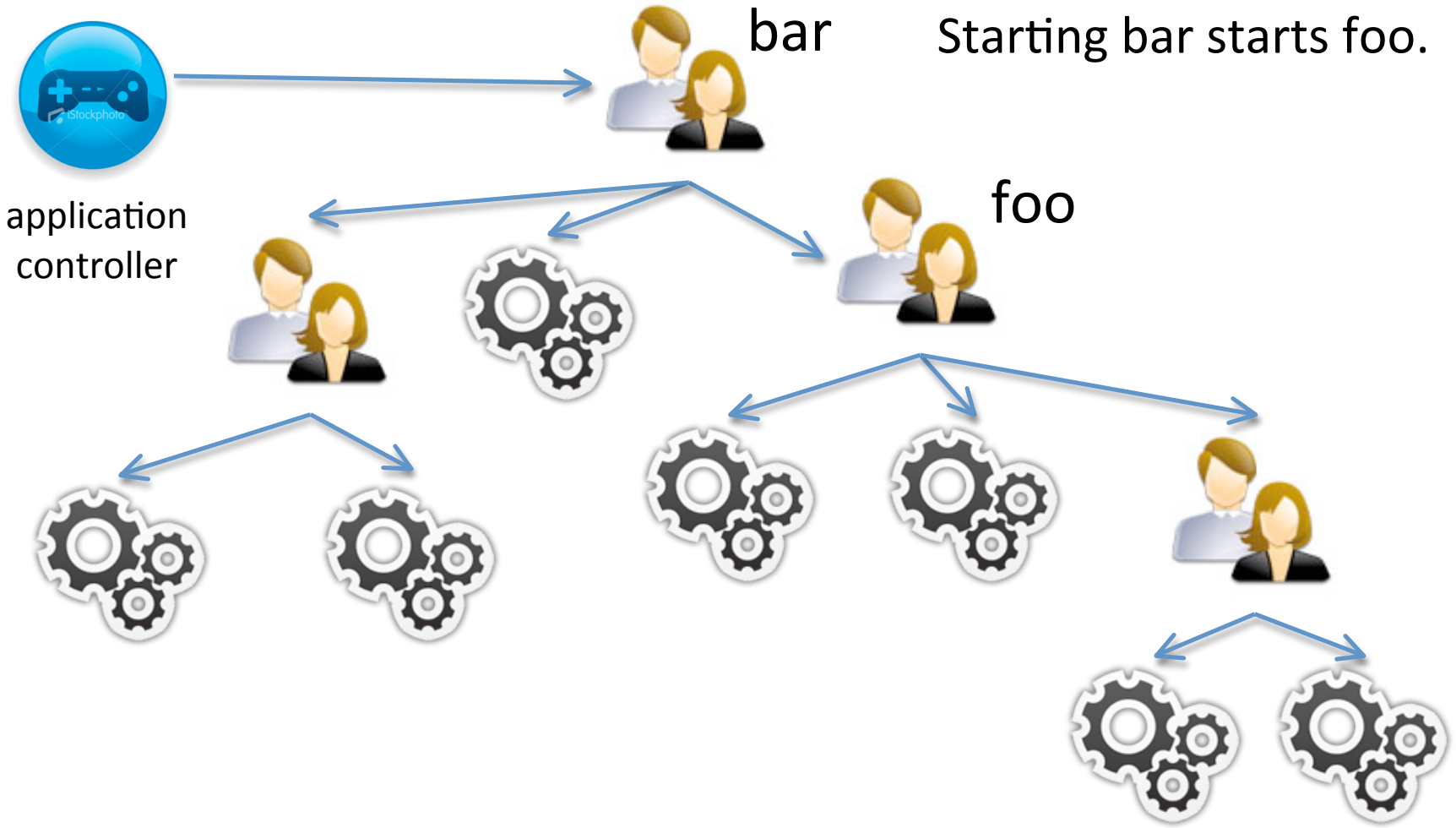

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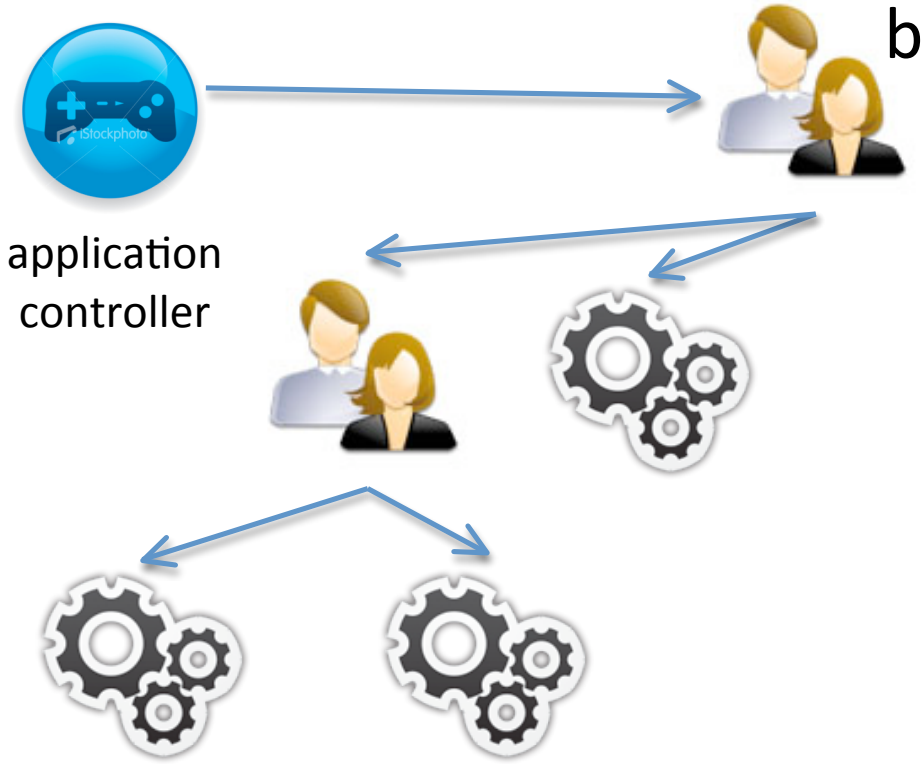

does not start

Starting bar ~~starts~~ foo.

Included Application Invariants

- If an application is listed in the `/etc/erlrc.d/applications` directory, then it should be running.
- When an application is running, all of its included applications are considered running.
- An application cannot both run itself and be included.

Included Application Logic

- If X is included by Y, then before starting Y, X is stopped.
- If X is included by Y, then after stopping Y, X is started.
- If Y is upgraded or downgraded such that X becomes included when it was not previously, before Y is upgraded or downgraded, X is stopped.
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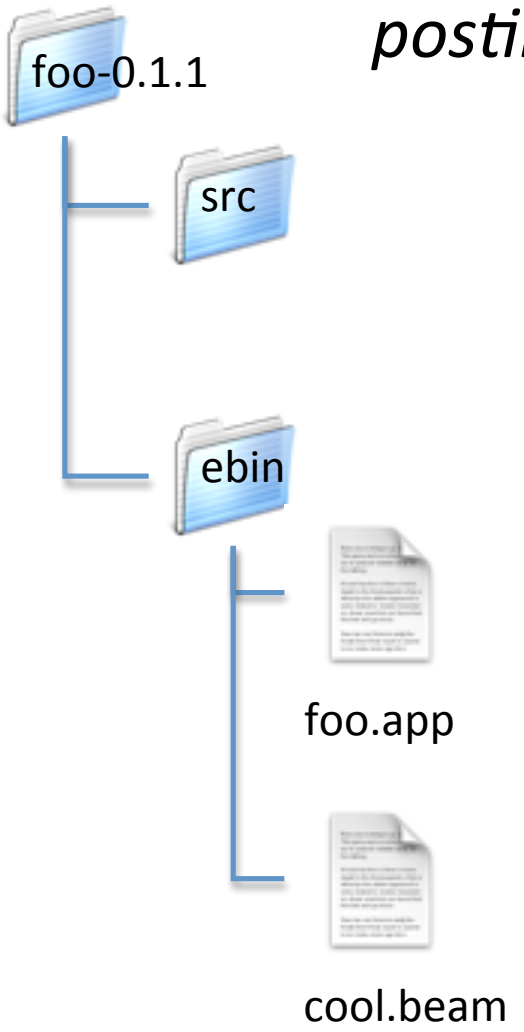
.appup files

- Manual generation: tedious, error-prone.
- Typically can be automatically generated.
- Strategy: automation with override.
  - Use .appup file if provided (rare).
  - Otherwise automatically generate (common).
- Key tool: `beam_lib:chunks/2`.

Automatic .appup generation

Automatic .appup generation

postinst upgrade



Automatic .appup generation

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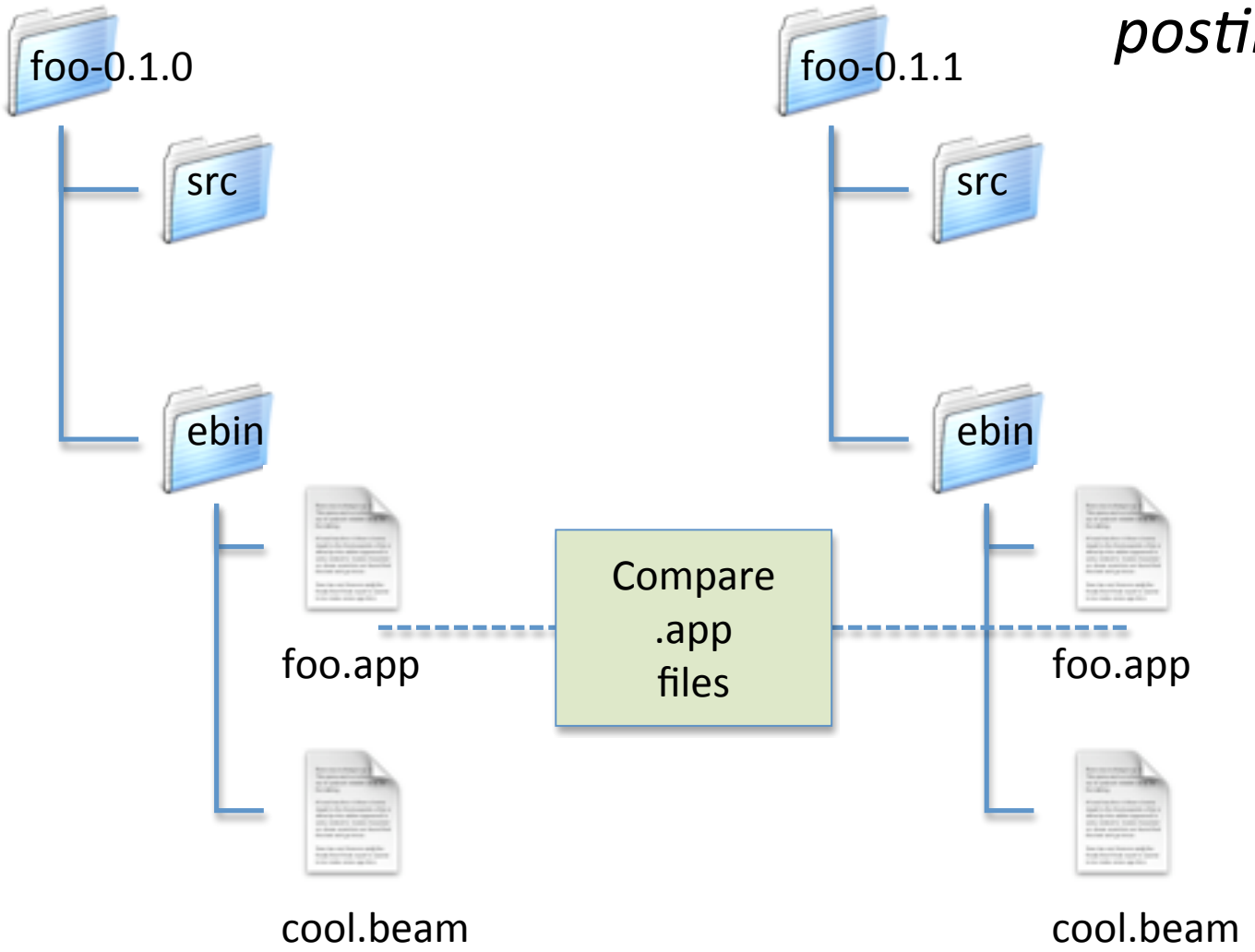

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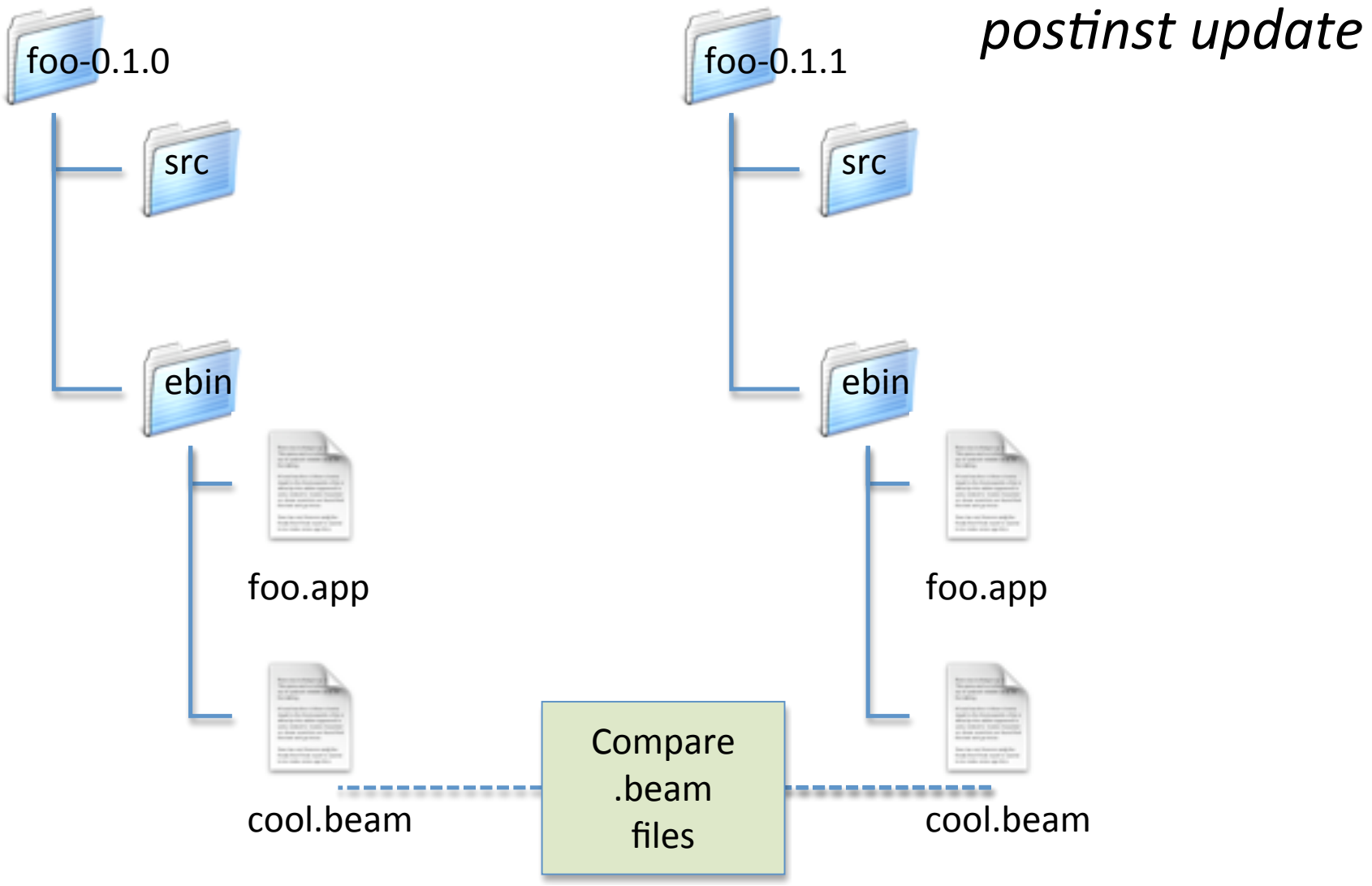

Example: load_module

```
{application, foo,
 [{description, ”My App"},
  {vsn, “0.1.0"},
  {modules, [cool,mega,sweet]},
  {registered, [foobar]},
  {applications, [kernel,stdlib,sasl,bar]},
  {mod, {cool,[]}}
 ]}.
```

```
{application, foo,
 [{description, ”My App"},
  {vsn, “0.1.1"},
  {modules, [cool,mega,sweet,ultra]},
  {registered, [foobar]},
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```

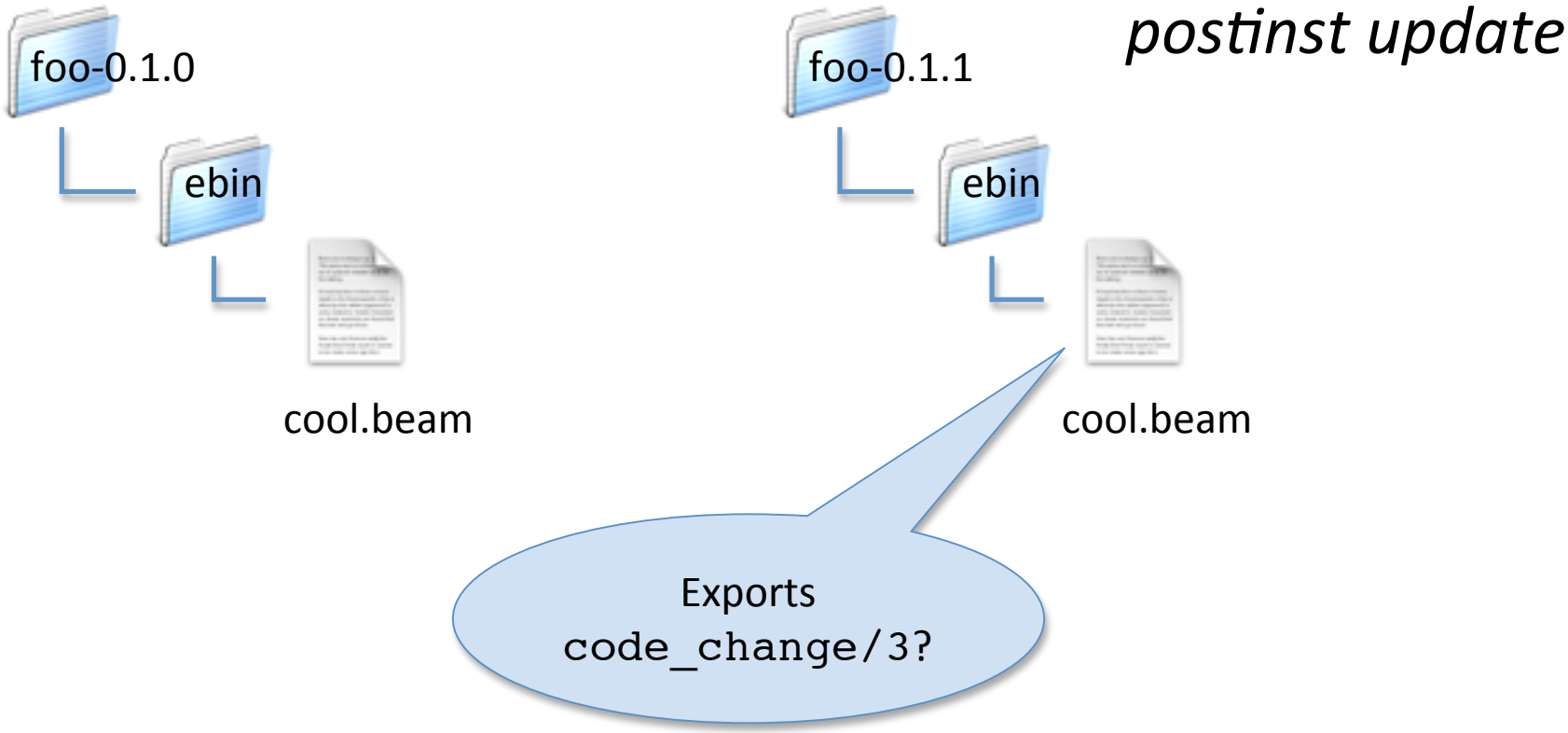
ultra is a new module

emit `load_module` directive

Example: update

- `update` directive is used to upgrade the code and the state of an active process, e.g., gen_server.
- All of the gen_XXX family export `code_change/3` in their behaviour.

Example: update



If yes, issue `update` directive.

.appup file generation

- Compute added and removed modules by looking at the old and new OTP app files.
- Emit a load_module directive for every added module.
- For each module which is in both versions of the application:
  - If the module implements the supervisor behaviour
    - Emit an "upgrade for supervisors" instruction.
    - If the module exports a sup_upgrade_notify/2 function, emit an instruction to call it.
  - Else if the module exports a code_change/3 function, emit a update directive for that module.
  - Otherwise, emit a load_module directive for that module.
- If there is a start module for the application:
  - Determine if the new beam for the start module exports a version_change/2 function. If so, emit a directive to call it.
- Emit a delete_module directive for every removed module.

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Custom .appup hooks

- `<supervisor>:sup_upgrade_notify/2`
  - Used to start or stop newly added or removed children.
- `<application>:version_change/2`
  - Used to notify the application start module that the application version has changed.

Distribution and provisioning

- ec2-do
  - escript for rolling window execution across an ec2 group.

```
% ec2-do -g production -m 3 apt-get install egerl
```

- apt-snapshot
  - provisioning tool based upon .deb packages

```
% apt-snapshot create <snapshot>
% apt-snapshot restore host:<snapshot>
```

An Erlang Startup

- Write awesome Erlang code.
- ???
- Deploy to EC2.
- ???
- Profit.

An Erlang Startup

- Write awesome Erlang code.
- Use erlrc and make OS packages.
- Deploy to EC2.
- ???
- Profit.

More Information

http://dukesoferl.blogspot.com/

Google

http://code.google.com/p/erlrc/

n54
Target.Engage.Convert

http://n54.com/