Building a right-sized, do-anything runtime using OSGi technologies

a case study
(sort of)

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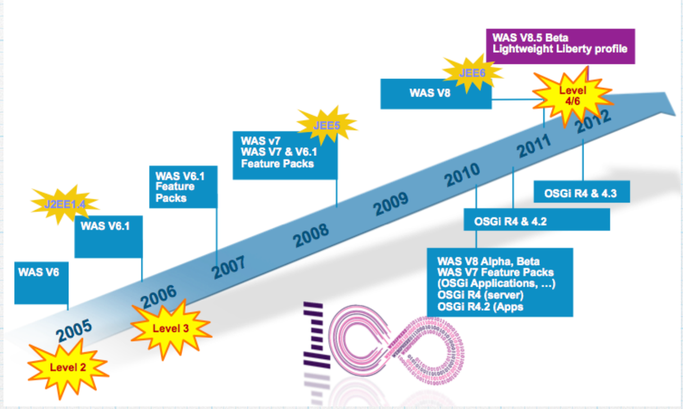
<background>

Some notes on motivation

* The full profile of WebSphere application server is awesome in its capabilities
* It is also well-known that the full profile is not well-suited for development
* We did and do listen... and were presented with a challenge: "Create a light-weight profile of WebSphere that starts in under 2 seconds... [but] Don't break any eggs" — Ian Robinson

History

* WebSphere Application Server (the full profile) has been around forever.
  * Big codebase
  * Big customer base
  * Big workloads
  * ... Big inhibitors to massive change



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This is not a complaint.
This is a problem we are happy to have.

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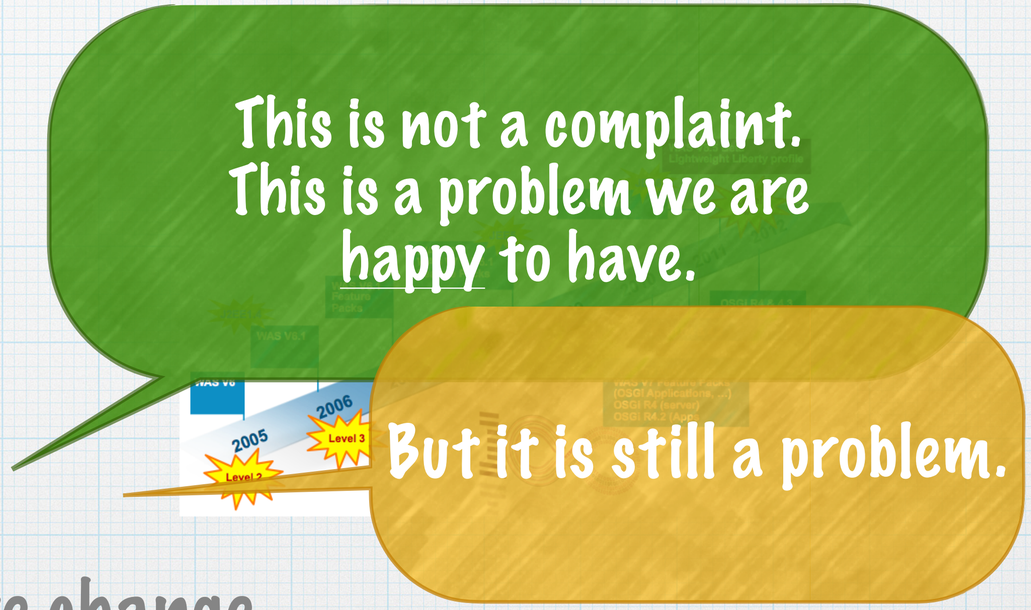

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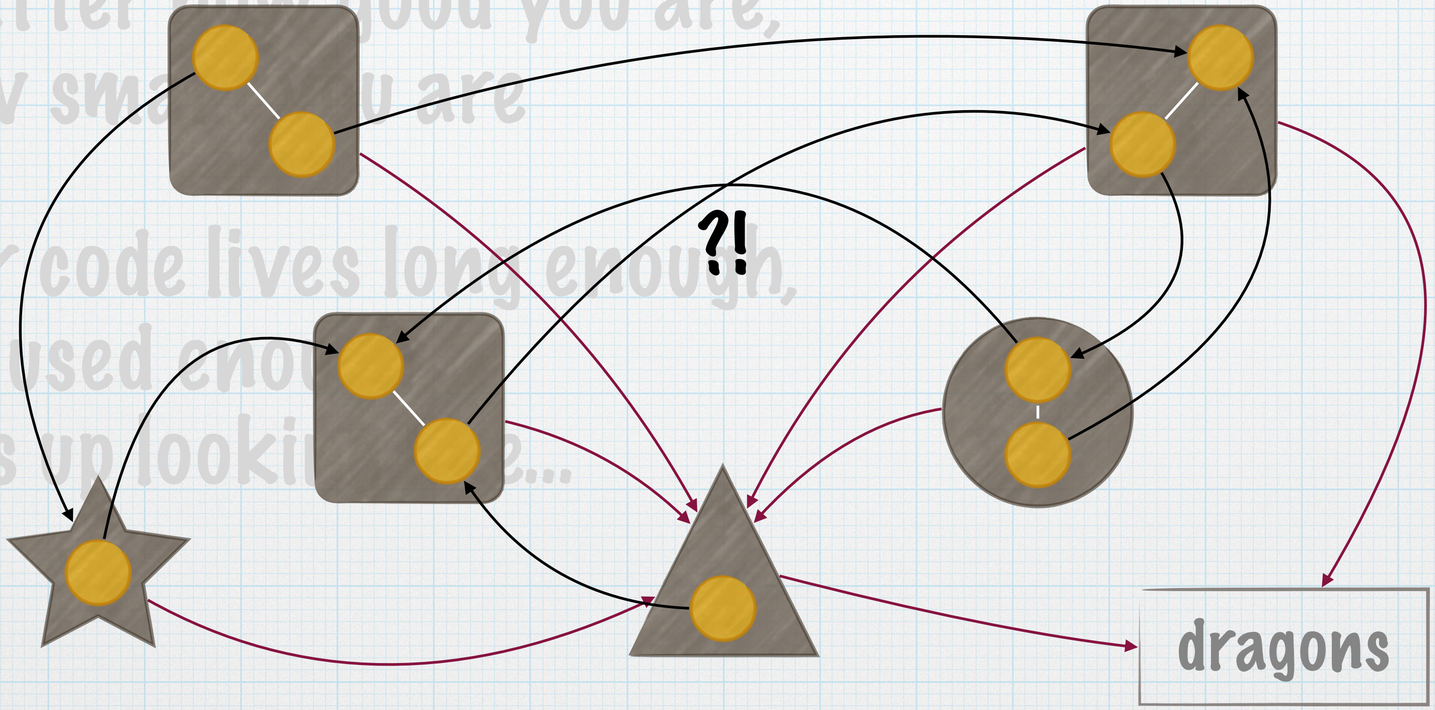

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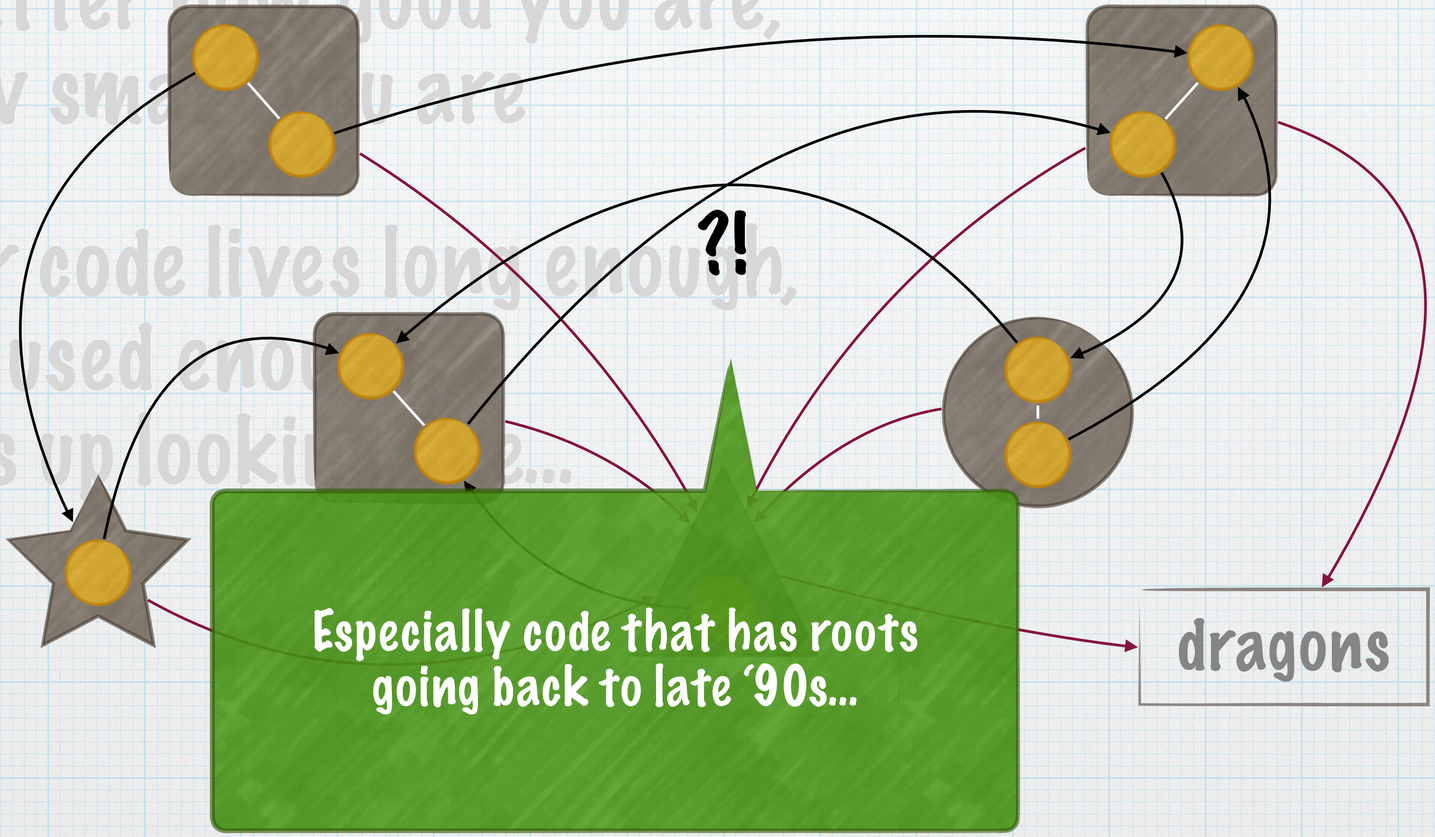

OSGi and WAS: The first pass...

* OSGi was included in WAS v6.1, in 2006
* Went from lots of arbitrary jars to a few bundles
  * Achieved some modularity enforced by OSGi
* We did not use or expose OSGi services
  * Compatibility constraints: WAS is the bottom of the stack
  * Assumptions about resource initialization and availability
  * Entrenched dependencies between some core elements

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This is the version of the story you won't have heard before...

What if...

If we could start over, what would we want?

* Developer-friendly
  * Simple
  * Dynamic
  * Light-weight
  * Composable / Flexible
  * Extensible

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human usable configuration

selectable content

clear API/SPI
runtime/app isolation

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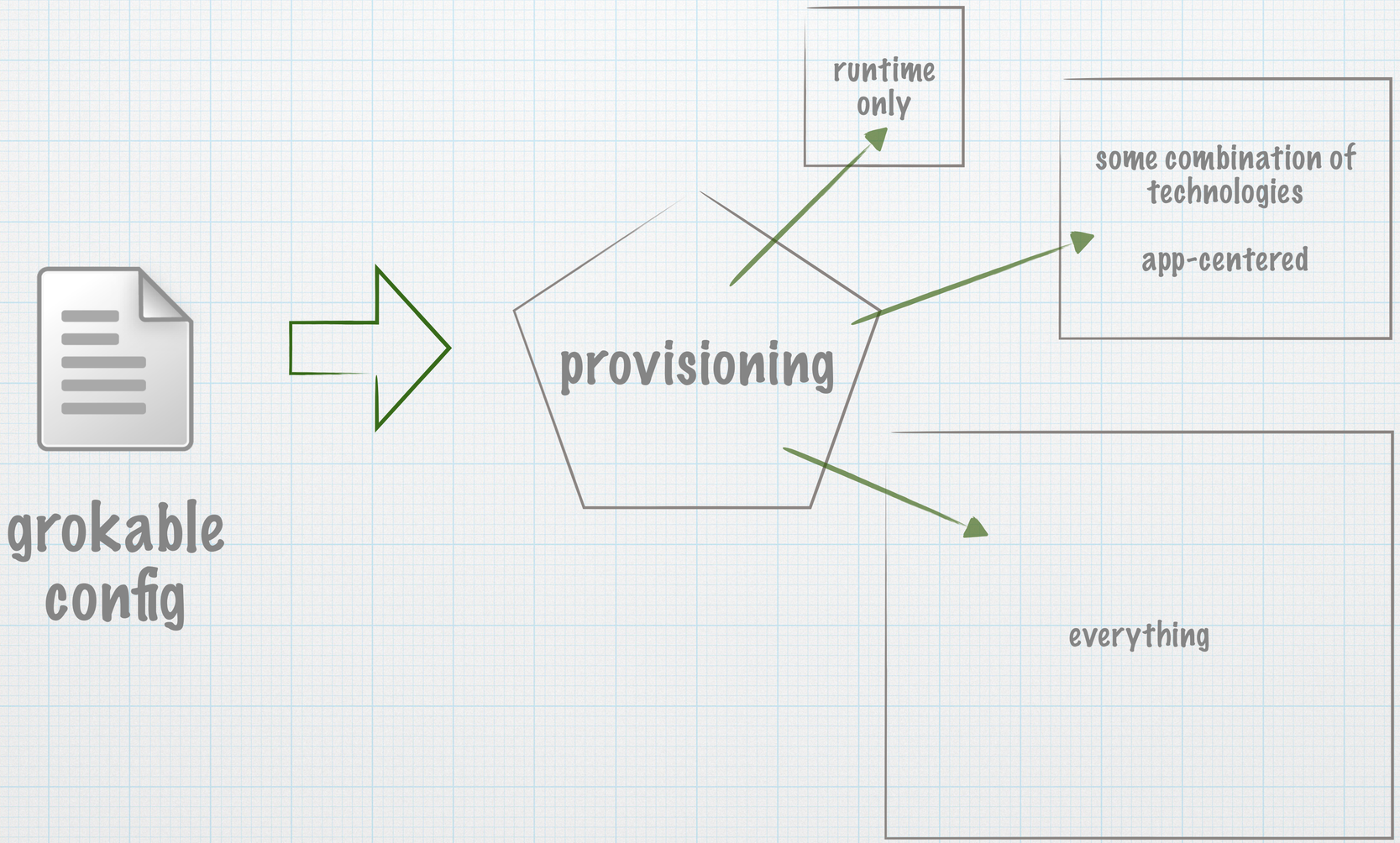

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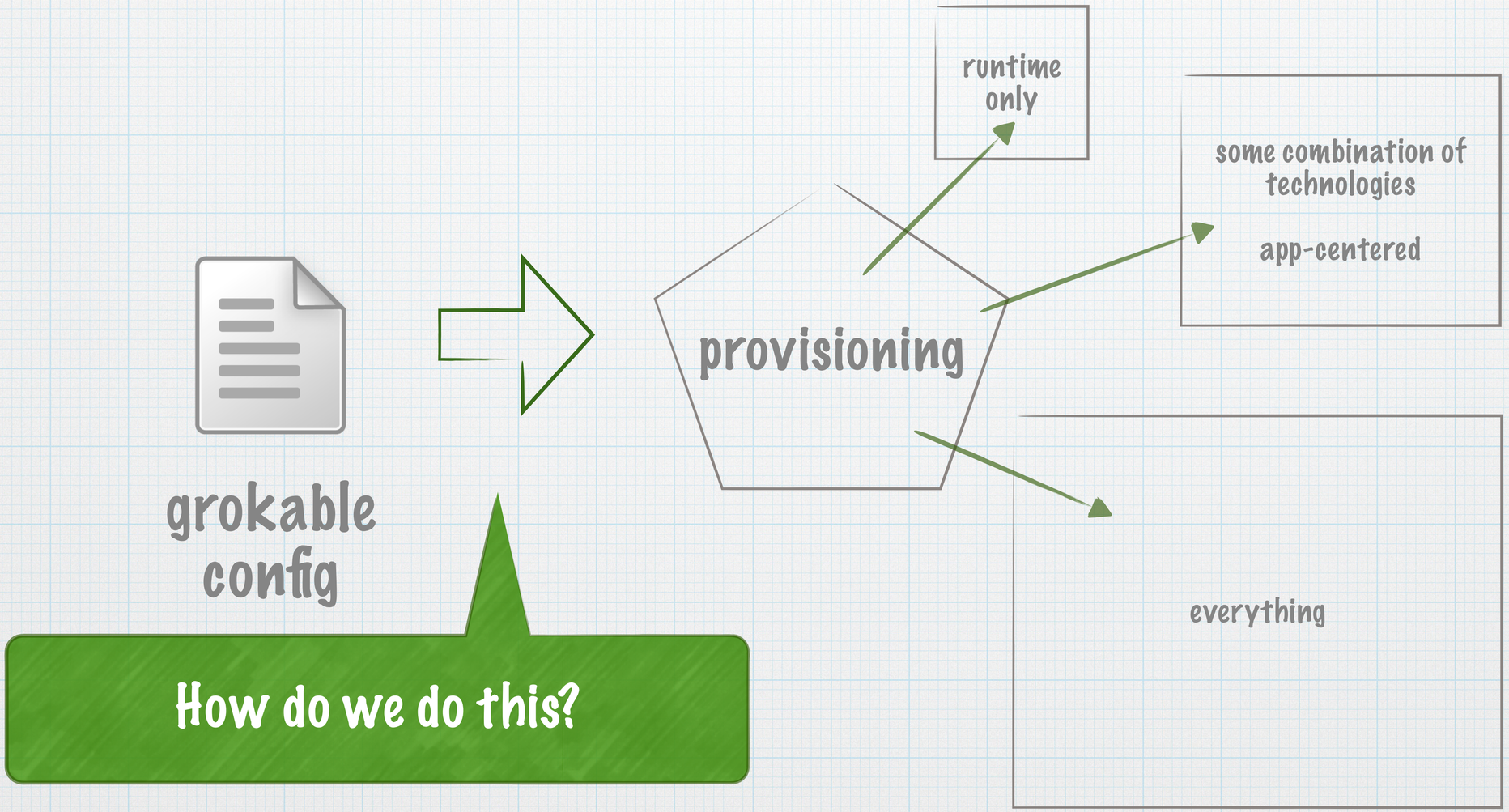

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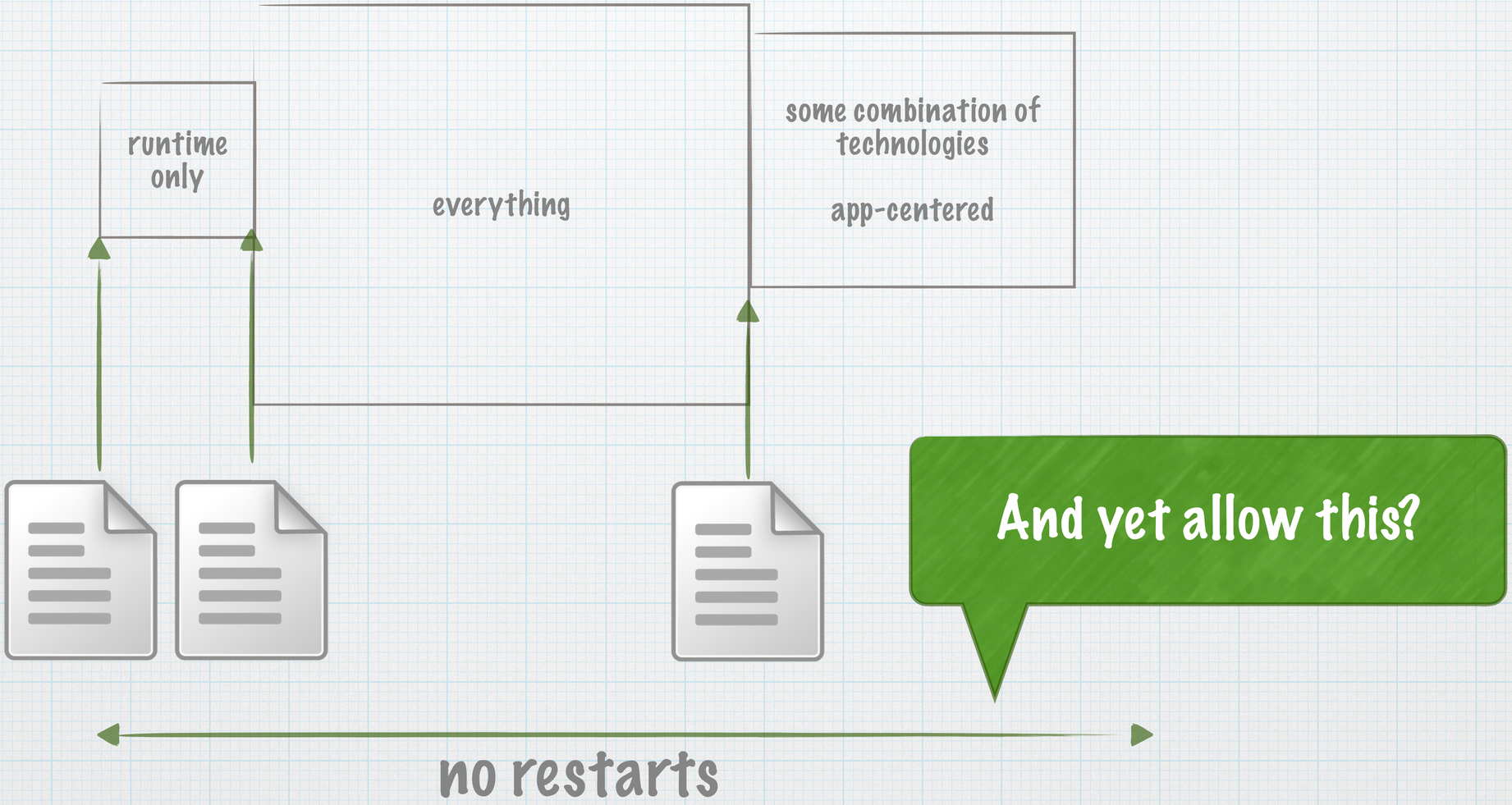

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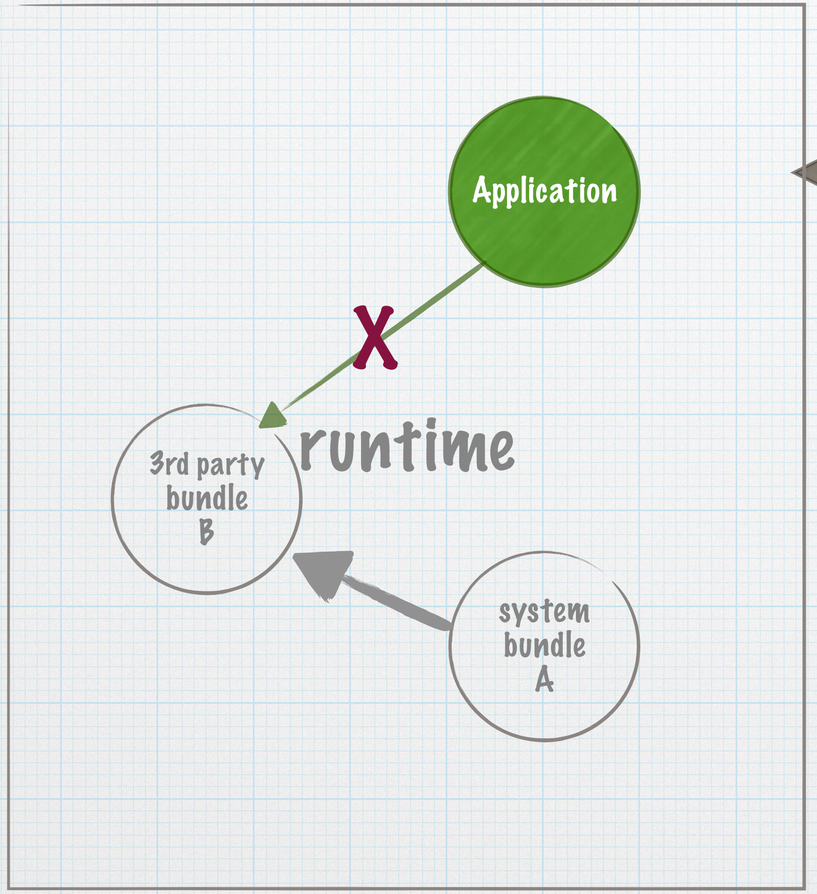

And for crying out loud, can we prevent THIS?!

Building a kernel from scratch

* OSGi-based for all the reasons
* First-class use of OSGi services
  * Must react to configuration changes
  * Runtime composition on-the-fly

Configuration

* Settled on XML for configuration format
  * Ubiquitous
  * Expressive
* BUT, for simplicity:
  * single file
  * usable defaults

```
<server description="simple">
  <featureManager>
    <feature>jsp-2.2</feature>
  </featureManager>

  <httpEndpoint id="defaultHttpEndpoint"
        httpPort="9080" httpsPort="9443" />
</server>
```

Configuration

* Composable system requires composable configuration:
  * Individual components own their config
  * No centralized repository
  * No externally defined global config model

Configuration

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  * Individual components own their config

Configuration Admin and Metatype #FTW!

Configuration Admin

We rolled our own (sorry)

* Parse and merge user configuration and bundle-provided defaults
* Resolve variables
* Provide configuration to consumers as required by the spec (mostly)

Metatype

Equinox impl + extensions

* Uniform validation of user input
* Define configuration and constraints in one place, it gets used everywhere else.
  * We favor metatype.xml for this reason
* Custom namespace for additional types and validators
  * ibm:type — duration, location, password
  * pid/reference
  * unique, final, variable, etc.

http://www-01.ibm.com/support/knowledgecenter/was_beta_liberty/com.ibm.websphere.wlp.nd.multiplatform.doc/ae/rwlp_extensions_osgi_metatype.html

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human readable:
1h30m converted to unit of choice

used by developer tools to help prompt for the right kind of path: file vs. url

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type="String"
ibm:type="password"

The value is a "SerializedProtectedString", which is not a String.

Developer tools display encoding options: xor or aes, etc.

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This is some crazy stuff.

ibm:type="pid"
ibm:reference="specific.service.pid"

Allows nested configuration elements
to define service relationships

#awesome

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Provisioning

- Two phases of provisioning:
  - Bootstrap the kernel to get configuration
  - Add or remove features based on configuration update
    - Features as in Subsystem features
      (*.esa files, metadata, etc.)
    - Adding or removing features
      installs or uninstalls bundles, which
      adds or removes configurations, which
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Dynamically respond to configuration changes at any time without requiring a restart.

#really

Using OSGi Services...

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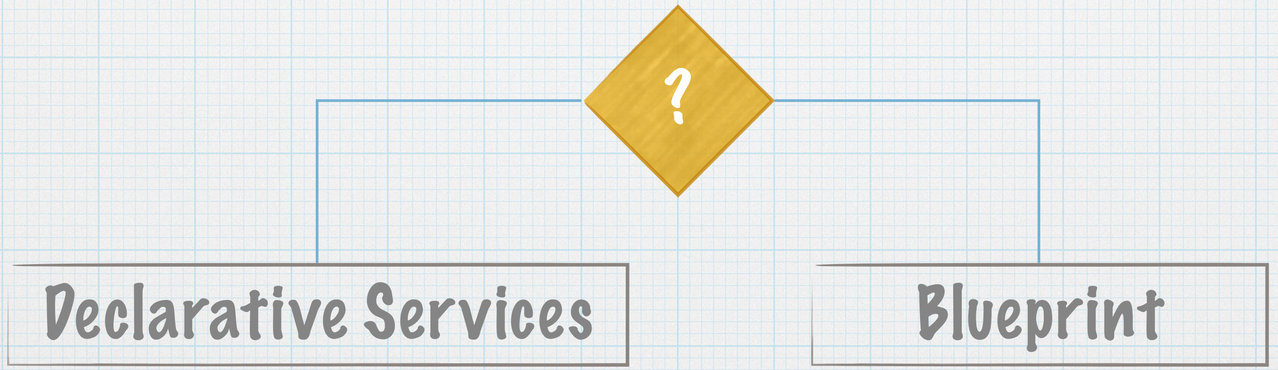

yes, there are others.
We focused on these two.

Declarative Services

- We chose DS for two main reasons:
  - Timing: Blueprint and Aries were just getting started
  - Integration with Configuration Admin and Metatype!
    - Config injected as one unit
      - activate/modified/updated methods
    - Service instance creation based on metatype-declared factory pid
    - DS target filters can be set via configuration

DS is AWESOME!

* DS is a central part of the Liberty runtime
* CA + M + DS = "magic"
  We do insane things with config-derived target filters
* Our runtime would not be what it is without DS in the middle of it
* BUT..

Service dynamics can hurt!

* Service dynamics are a huge hurdle for "new" developers
* DI and IoC can turn even experienced brains inside out if they aren't prepared.
  Thankfully, they do seem to recover.
* Utilities created to "help" can have unintended consequences.
  Especially if cut and paste are involved.
* There is definitely a "better way" to do things with DS..

Let DS do it. Really.

* DS is excellent at managing service dynamics.
* DS is excellent at managing non-trivial service dependencies
* It is very unlikely that you will be able to do better— just let DS do it. That means:
  * Don't register services inside a component
  * Don't manage references inside a component

Isolation

* We mean this in a good way.
* Liberty runtime serves two masters:
  * Typical Application Server paradigm
    (apps strictly separated from runtime) — API
  * Platform extender paradigm
    (the "app" is the runtime) — SPI
* Persistent problem:
  how to allow apps or extensions to use their own versions of libraries that don't conflict with the runtime!?

Subsystems, Resolver Hooks, and Regions... (oh my!)

* Features must explicitly declare API and SPI packages (IBM-* metadata in the feature manifest)
* Isolation between API/SPI, apps/extensions/runtime is enforced in a few ways:
  * Subsystems (the Aries impl) for OSGi Applications (API)
  * Resolver hooks and/or Eclipse Regions for isolation between runtime, extensions (SPI), and containers (API).

</cleanSlate>

Of course, we didn't really get a clean slate.
Application compatibility had to be preserved.

But that still gave us a LOT of room...

Dealing with our legacy

* We did start over with our kernel
* Used the new base to re-group...
  * Lots of code still common with full profile
  * Wrap/Shim: New face on old code
  * Patch: tweak and replace bits where necessary

Thank you!

* Questions?