Build and Provision:

Two Sides of the Coin We Love to Hate

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The Software Pipeline

- Software artifacts flow from developer to developer and ultimately to the clients in pipeline fashion
  - Each intermediate stage involves provisioning the developer's environment and building that environment's contents
  - The final stage involves provisioning the client's execution environment
- The pipeline is fundamental to the smooth flow of goods from producer to consumer
- All its stage are amenable to automation

Build

- Build is the process of converting source artifacts into target (typically binary) artifacts
- In order to build we must establish the environment in which the build operates, i.e., we must
  - Provision the source artifacts that are to be built
  - Provision the binary artifacts against which to build
- Builds are like the weather
  - We want it to be nice
  - More often than we'd like, it's unpredictably horrible
  - We love to complain about it
  - But is it really beyond our control?

Provisioning

- Provisioning is the process by which source and binary artifacts are found and retrieved to make them available for local use
- In order to provision we must establish well known locations where the artifacts can be found
  - Source and binary repositories
- Provisioning is an issue both for developers and for the clients of what they produce

The Growth of the Software Pipeline

- Software is becoming increasingly complex
  - Modularity helps manage this complexity
  - But modules increase the length and therefore fragility of the software pipeline
  - So module dependencies must be carefully managed

Release Engineering

- A release engineer is the domain expert who specializes in managing the pipeline
  - It's a thankless job
    - When things go wrong, it's all your fault
    - When things go right, you're completely taken for granted
    - It's considered menial labor, despite the technical challenge
- The release engineering task is often assigned to junior developers as an entry level task
    - High turnover leads to hacked designs
    - Change is motivated primarily to address symptoms
    - The result is a constant source of recurring problems

Release Engineering Technology

- Release engineering tools and technologies tend to be of stone age quality
- There is a virtual tower of Babel of scripting languages
  - Let's use an XML syntax and call it Ant, that will solve all the problems!
- A generous helping of spit and glue helps keep it all from falling apart
  - Let's just poke it here and kick it a few times there and hope it works after that!
  - Better yet, let's use chewing gum and duct tape instead!

Why Are Builds Always Broken?

- It's ironic that builds are always broken because developers are doing them constantly all day long just to do their jobs
- A key problem is that the automated build on the build machine is **not** the same as the local build done by the developers
- So there are really two builds
  - One that mostly works because the developers use it constantly and would otherwise sit idle
  - One that always breaks because it's done in some other apparently more fragile way by someone else

Why Are Builds So Hard to Set Up?

- Provisioning the development environment is tedious and error prone
  - The more dependencies, the more tedious and error prone the problem becomes
  - Developers must follow a mysterious poorly documented golden path to set up everything correctly
  - It's so much work they are understandably reluctant to repeat the process as often as they should
    - So they don't pick up new dependencies regularly
    - And so they don't notice new upstream problems until long after they've been introduced

Why Does the Output of the Software Pipeline Fail to Function Properly?

- It's caused by yet another provisioning problem
  - In a highly modular system, it's difficult to ensure that all the appropriate versions of the modules are installed
  - Installing a new module can break other modules
  - The environment itself often has differences, e.g., an inappropriate JVM

Problems, Problems, and More Problems

- How do I reproduce a build?
  - In open source to be truly open conducive to participation and contribution it's important that anyone can reproduce your builds
- Provisioning is a moving target
  - The things we need constantly change, including their dependencies
- How do we solve these problems?
  - Let's make someone else responsible
  - Let's steer clear of the whole mess
  - No! Take responsibility!!

Build Solutions

- Declarative data is the key
  - Describe what's in a module
  - Describe how modules depend on other modules
  - Describe what needs to be built rather than detail how to build it
  - Drive the build process directly from the description
- Eclipse declares what's needed with
  - MANIFEST.MF
  - plugin.xml/feature.xml
  - build.properties
- Much of this information is needed at runtime as well as at build time

Provision Solutions

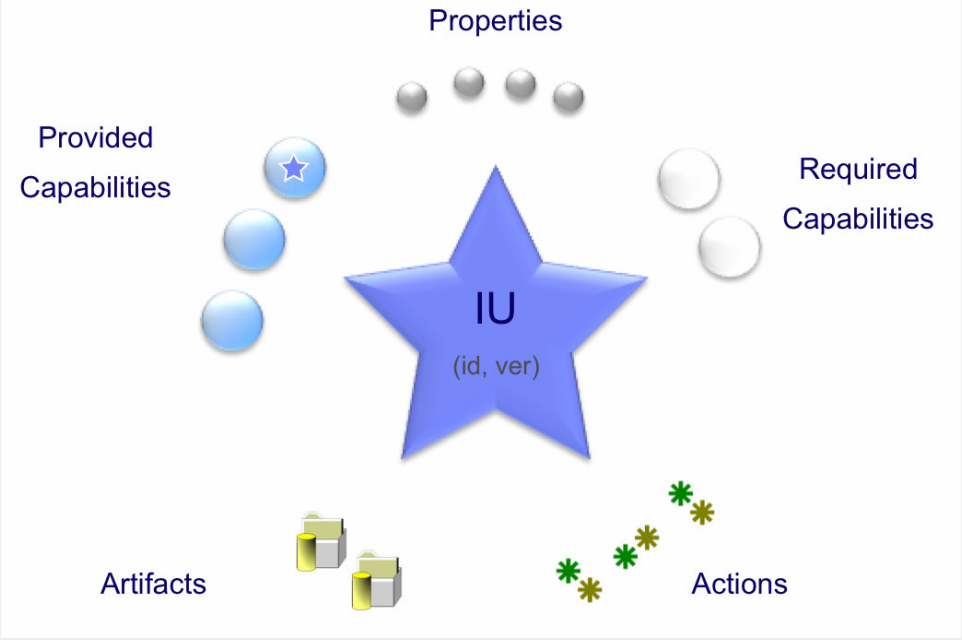
- Declarative data is the key
  - Describe what's available
  - Describe dependencies between them
  - Describe where these things are located
- Eclipse describes such things today with
  - Project set files for source artifacts
  - Installable units (p2) for binary artifacts
  - Buckminster provides a more complete provisioning solution that builds on these

Equinox and OSGi

- Equinox is Eclipse's implementation of an OSGi runtime
  - A container for bundles with well defined dependencies
- Bundles
  - The fundamental modular unit of OSGi
  - Contains code
  - Describes dependencies on bundles or packages
- Plug-ins
  - Eclipse bundles that can define extension points or contribute extensions to extension points
- Features
  - A grouping of plugins that are expected to be installed together
- Fragments
  - A special type of bundle that augments some host plug-in
- Product
  - A top level grouping mechanism

p2 Installable Units

- Eclipse's provisioning technology
- Installable Units are the central concept
  - Identified by namespace and version



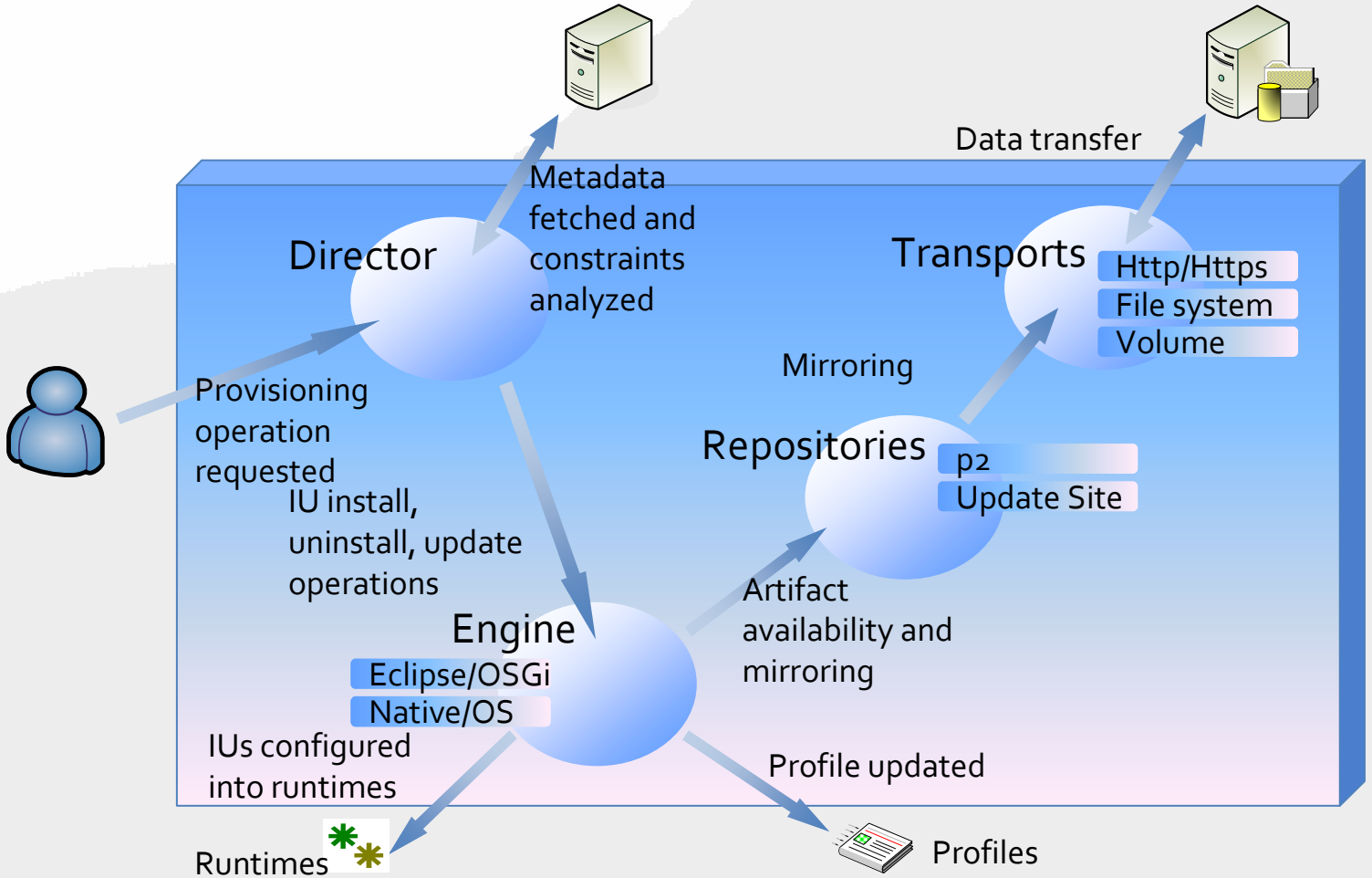
p2 Repositories

- Metadata Repositories
  - Information about the installable units available
- Artifact Repositories
  - The actual contents of the installable units
- Typically they are collocated at a given URI

p2 Profiles

- Installable units are fetched from repositories and installed into a profile
  - Maintains history of what's been installed
  - Supports rollback

p2 in Action



Eclipse's Development Environment

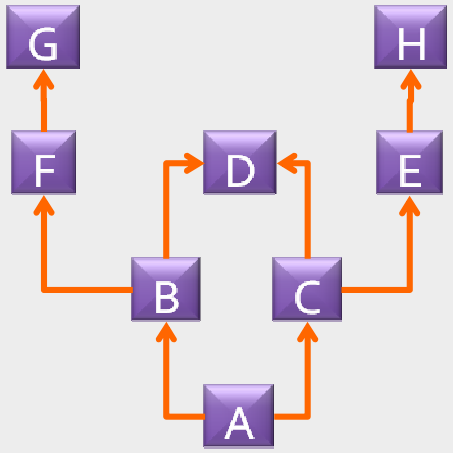
- Workspace
  - A container for a set of projects, i.e., source plug-ins, source features, and so on
  - Typically provisioned from one or more team project set files that extract the source from a repository
- Target Platform
  - A set of plug-ins and features used when building projects in the workspace and when running the build result in launched processes

PDE

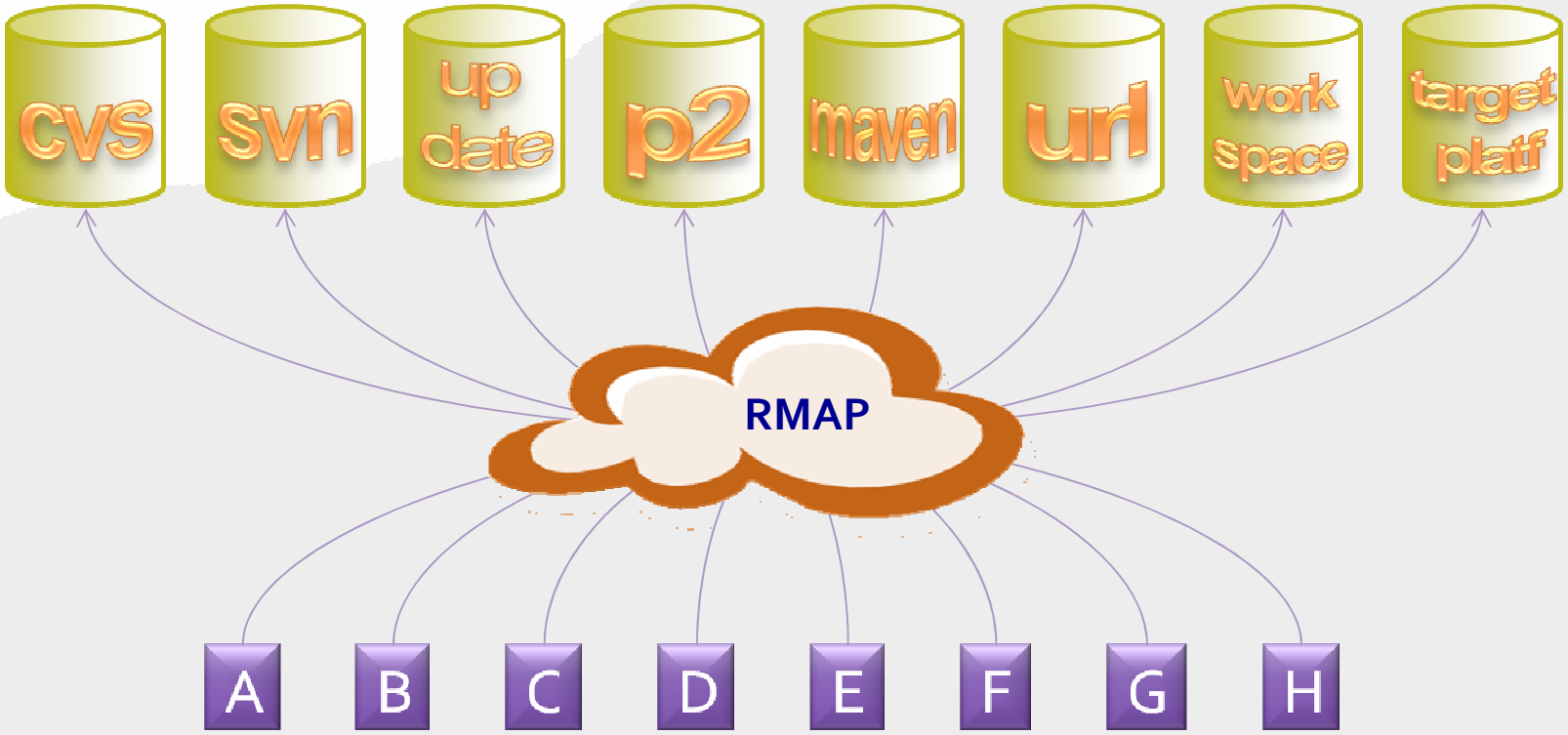
- Eclipse's Java-centric tools for developing plug-ins/bundles
  - Manage the classpath based on MANIFEST.MF dependencies
  - Editing support for MANFIEST.MF, plugin.xml, build.properties
  - Generate build.xml ANT scripts for driving headless PDE build

Buckminster

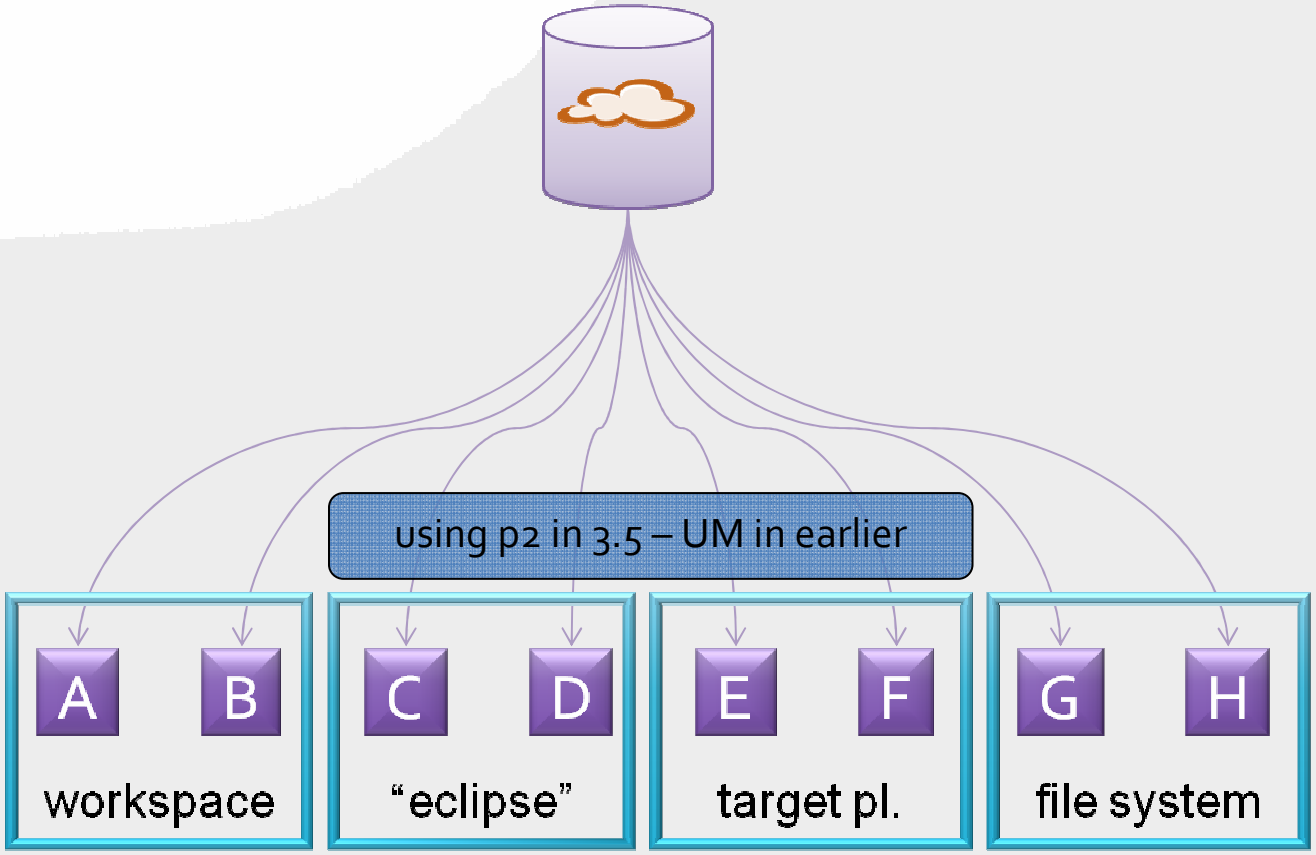
- Automated provisioning of Eclipse installations, workspaces, and target platforms
- Exploits workspace build directly even for headless/automated builds
- Exploits knowledge about dependencies between modular units to ensure that the entire dependency closure is materialized



Buckminster Repository Support



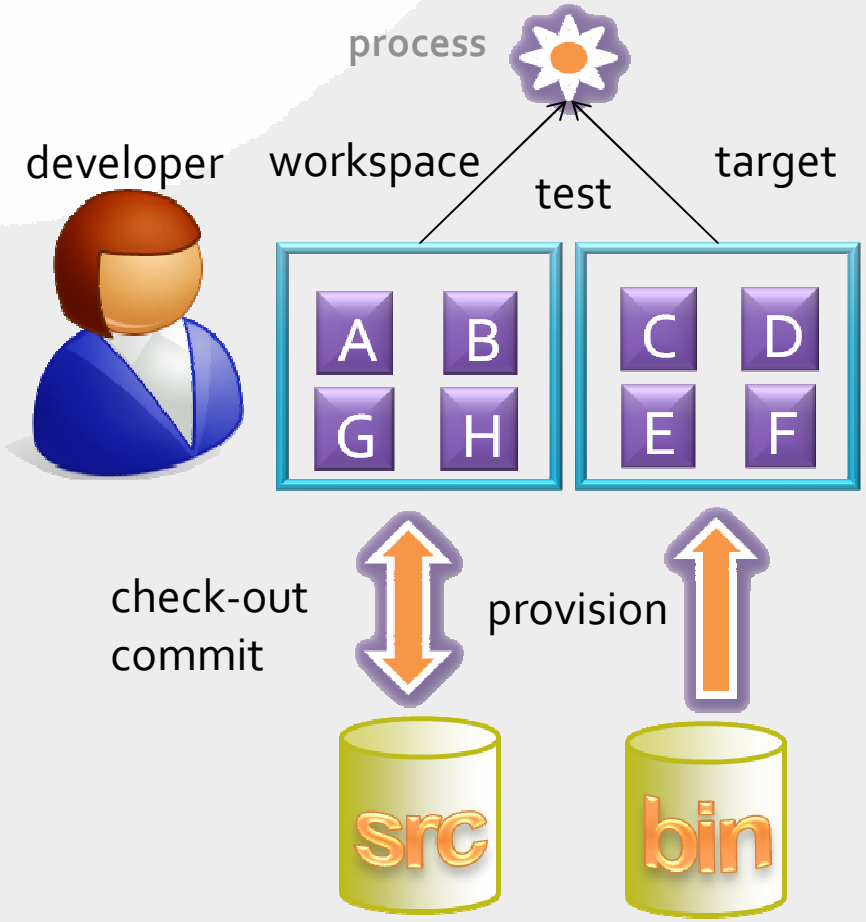
Buckminster Materialization



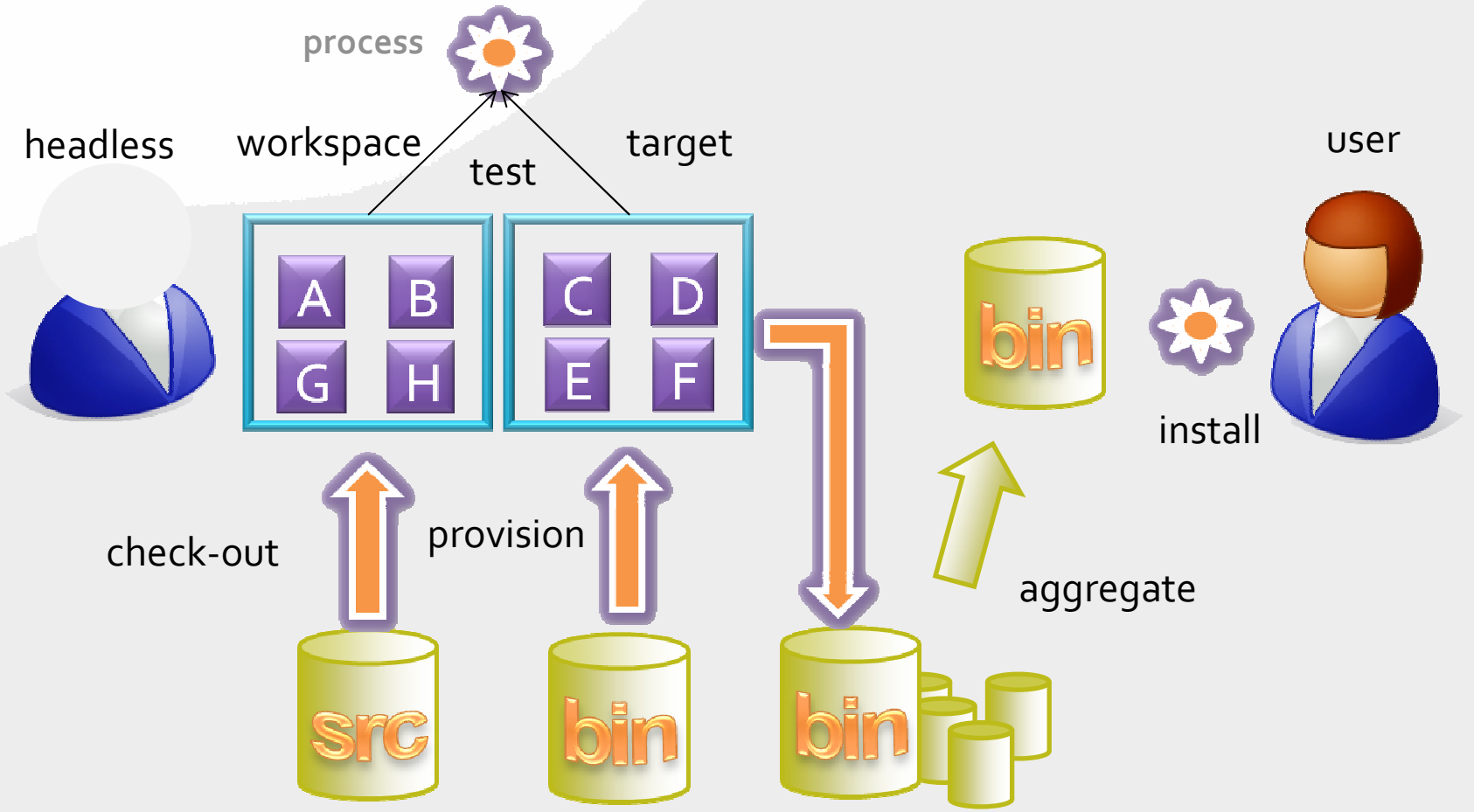
b3

- A proposed incubator project focused on simplifying the build and assembly process
  - http://wiki.eclipse.org/PDE/Incubator/b3/Proposal
- A declarative model-based approach for build definition and execution that unifies developer builds and automated builds
  - Clear separation between description and execution
  - Direct execution of build models
- Expand upon PDE's declarative data and Buckminster's provisioning support

The Eclipse Developer



The Eclipse Software Pipeline



Conclusion: Reuse Technology

- Reuse the information already captured to describe the contents and dependencies of modular units for use in a componentized runtime to also drive a streamlined, robust software build and assembly pipeline
- Reuse modeling technology to describe declaratively all aspects of the build process
- Reuse the same build infrastructure exercised continuously by the developers to drive the headless automated build
- Reuse provisioning technology to drive both development and deployment

References

- http://download.eclipse.org/downloads/tools/buckminster/doc/BuckyBook.pdf
- http://wiki.eclipse.org/PDE/Incubator/b3/Proposal