Implementing a build manager in Ada

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Ada DevRoom

Introducing Porion

- Why a new build manager ?
  - Jenkins is slow and uses 1.3Gb memory RSS
  - Requires Java on build nodes
  - Regular security vulnerabilities
- Some requirements :
  - Security & perf : safe design in Ada
  - CLI and web interface
  - Flexible build nodes (ssh, docker, virsh,...)

What a build manager must know

- Define projects with source control method
- Define recipes to build the project
- Define project dependencies
- Define build nodes (different systems, CPUs,...)
- Define build information to track build results
- Define build and project metrics
- Store credentials to connect to build nodes
- Store API secret keys to publish
- More secret keys to sign builds…

What a build manager must do

- Probe source changes in projects
- Schedule builds according to changes (management of a build queue)
- Launch builds (locally or remotely)
- Control and track build execution
- Collect build results (coverage, tests, logs)
- Publish build results
- Send build notifications
- Keep managers happy by providing reports

What a build manager must protect

- A build manager has access to sensitive data
- It must protect sources files (proprietary projects)
- It must protect API secret keys
- It must protect credentials (checkout sources, connect to build nodes)
- It must protect the secret keys to sign or to publish
- It must protect build results and build logs
- It must not leak API secret keys through logs
- ...

Porion numbers

- Cost : 1.5 engineer month so far
  (260 hours on my free time)
- 95 % Ada, 2 % HTML, 0.4 % Typescript
- 32K CLOC Ada (16K generated)
- 43 Ada packages, 30 private Ada packages
- 19 database tables

Architecture

Web Server

Command Line

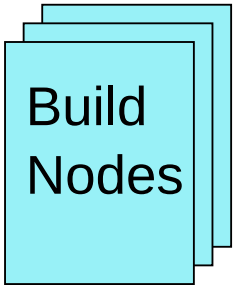
porion-server

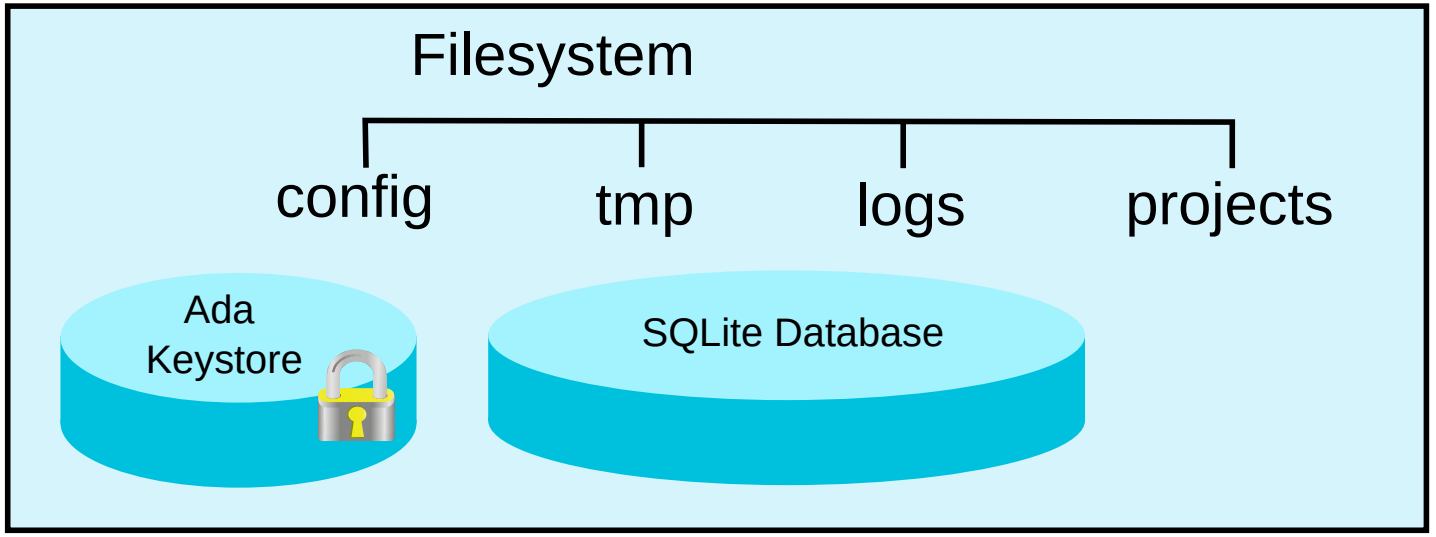
AWA

AWS

porion

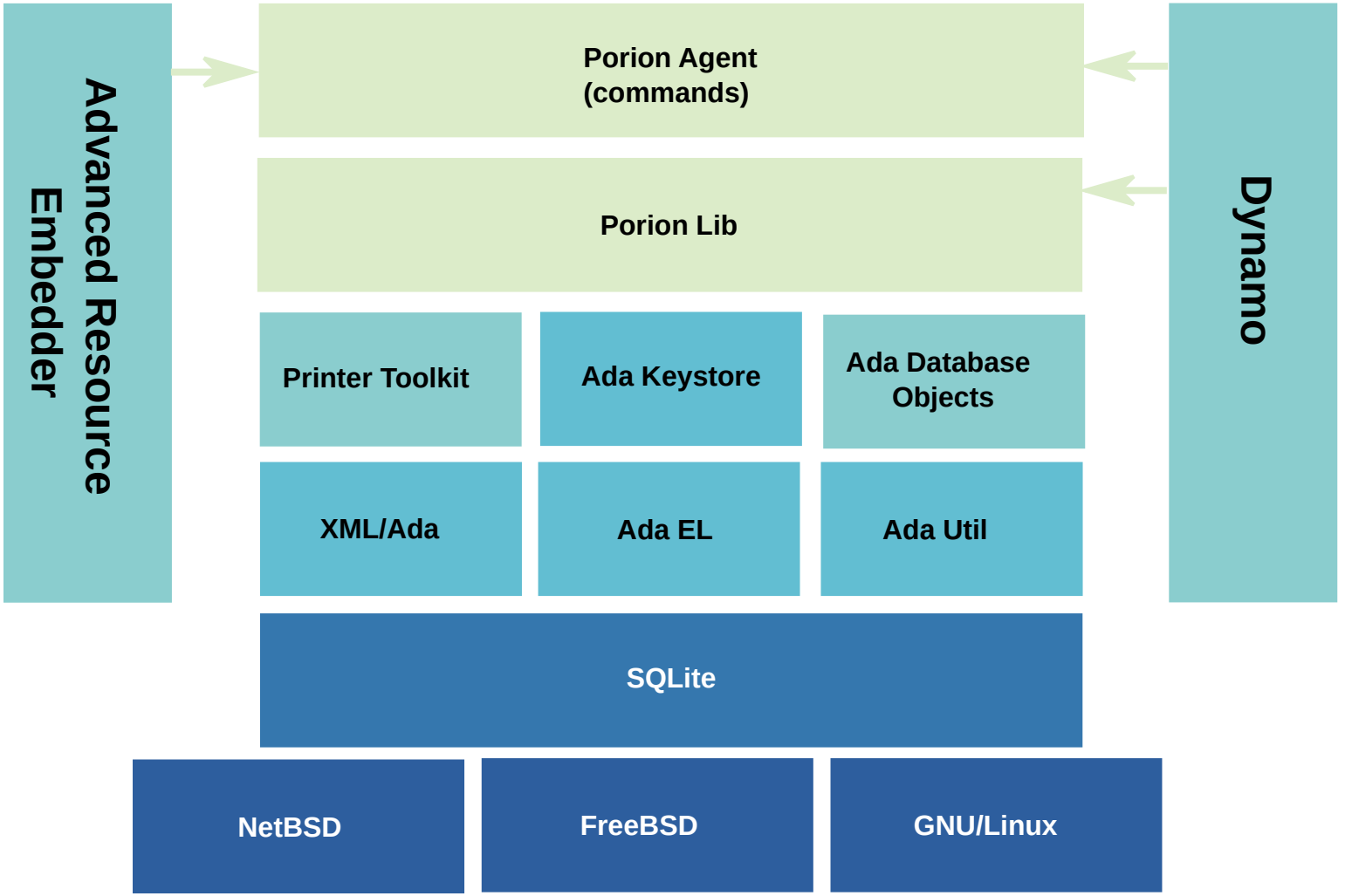
Ada Database Objects





https://gitlab.com/stcarrez/porion

Porion Agent Architecture



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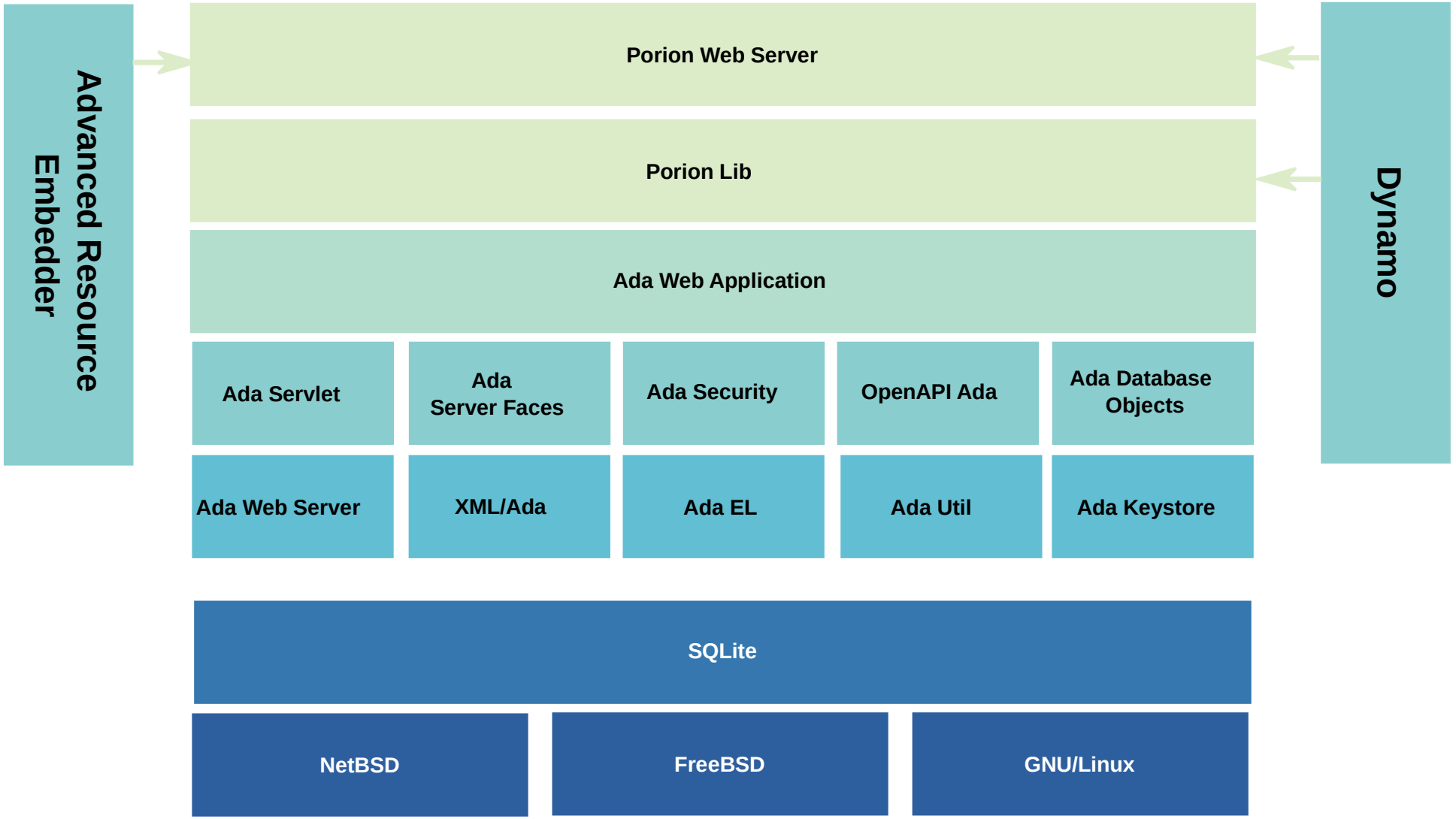
Porion Server Architecture



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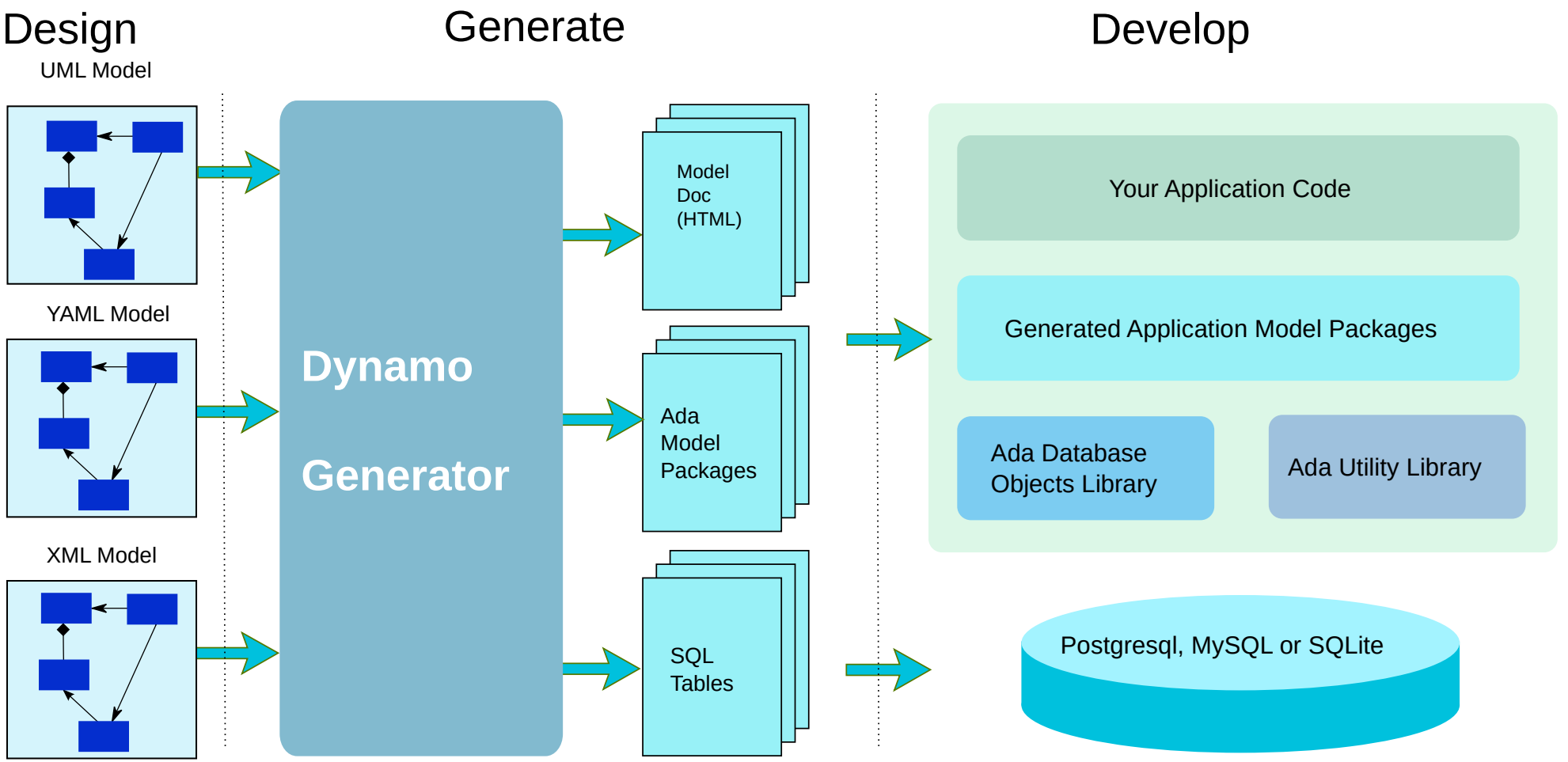
UML to Ada generation

- Described the database model in UML :
  - 19 tables organized in 5 packages
- Used ArgoUML (Java tool) :
  - Tool migrated from tigris.org to GitHub
  - Works very well to define the UML class model
- Used Dynamo for the code generation :
  - It reads ArgoUML file
  - It generates Ada model for the UML classes
  - It generates SQL table creation schema

Database Modeling



https://gitlab.com/stcarrez/dynamo

UML generated Ada code

- 14K CLOC generated in 6 Ada packages
- Handles SQL insert, update, delete, queries
- Uses Ada.Containers.Vectors for lists
- Reference counting for objects

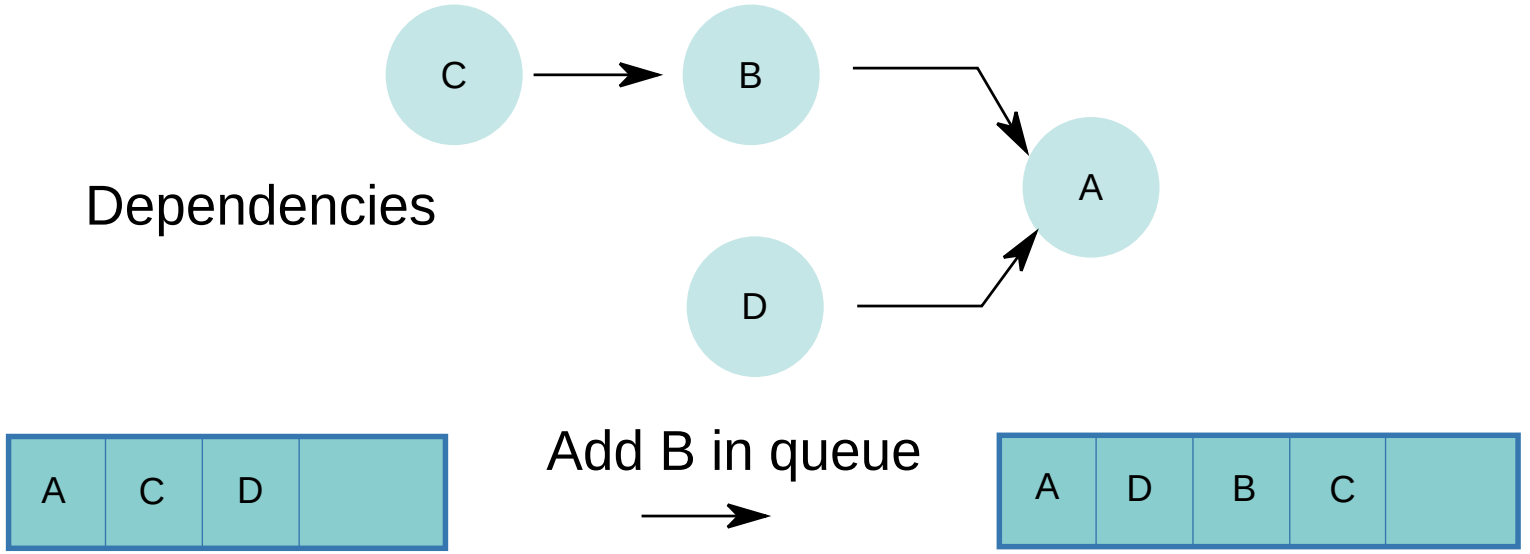
A tour to Porion UML model

Benefit of UML and Ada

- UML database model is not right at the first time
- Several iterations to add new tables, new relations or new attributes in UML model
- Easy and fast generation of Ada from UML
- Changes in UML model breaks the compilation and can be identified and fixed
- Consistency between Ada and SQL
- Refactoring is safe due to Ada strong typing !

Focus : build queue scheduler 1/3

- Role of the build queue and its scheduler :
  - Keep an ordered list of recipes that must be built
  - Minimize the number of builds
  - Take into account project dependencies



Focus : build queue scheduler 2/3

- Load the build queue in an Ada vector

```
with Porion.Builds.Models;

Queues : Porion.Builds.Models.Build_Queue_Vector;
Query : ADO.Queries.Context;
DB : ADO.Sessions.Session;

Query.Set_Filter ("o.node_id = :node_id");
Query.Bind_Param ("node_id", Node_Id) ;
Porion.Builds.Models.List (Queues, DB, Query);
```

- Compare two build queue entries

```
function "<" (Left, Right : in Build_Queue_Ref) return Boolean;
```

Focus : build queue scheduler 3/3

- Instantiate the sort package

```
package Sort_Queue is
  new Build_Queue_Vectors.Generic_Sorting ("<" => "<");
```

- Sort the build queue vector

```
Queues.Append (New_Item);
Sort_Queue.Sort (Queues);
```

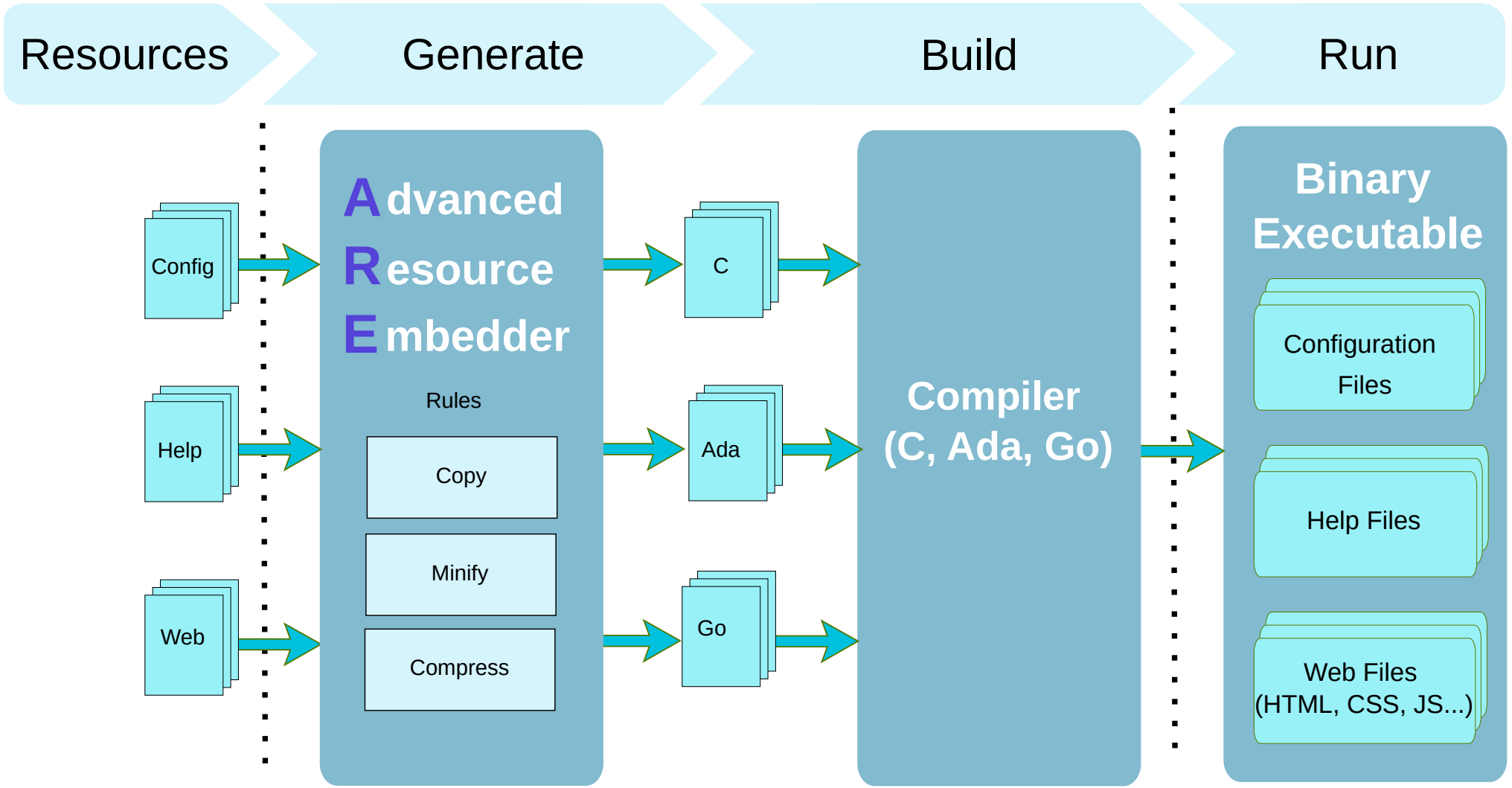
- Update the queue order and save in the database

```
declare
   Order : Natural := 0;
begin
   for Queue of Queues loop
      Queue.Set_Order (Order);
      Queue.Save (Service.DB);
      Order := Order + 1;
   end loop;
end;
```

Embedding resource

- Problem :
  - How to configure the database ?
- Solution :
  - Embed the SQL schema definition in the binary
  - Have an array of String with each String being an SQL create table statement
  - Use ARE to embed the SQL schema
  - Generates 2K CLOC in 3 Ada packages

Advanced Resource Embedder



https://gitlab.com/stcarrez/resource-embedder

ARE generated code

- Types are declared in a parent package

```
package Porion.Resources is

   type Content_Array is array (Natural range <>)
     of access constant String;
   type Content_Access is access constant Content_Array;

end Porion.Resources;
```

- ARE generates a child package with function declaration and static constant array of strings

```
package Porion.Resources.Schema is

   function Get_Content (Name : String) return Content_Access;

end Porion.Resources.Schema;
```

Conclusion

- Lessons learned :
  - Writing a build manager is hard (secure is harder!)
  - Ada helps by forcing to think more about your design
- Code generation can speed up development :
  - Dynamo : UML => Ada mapping & SQL schema
  - ARE : SQL files => Ada package with static content
- High level database representation is key :
  - Load, insert, update database objects easily
  - Implement complex algorithm easily

Questions

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