Static Assurance of Runtime Architectures

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Conformance Checking Strategy

We extend the **extract-abstract-check** strategy

- **Document as-designed** architecture
- **Abstract as-built** architecture from code
  - **Annotate** code to clarify architectural intent
  - **Extract** sound approximation of runtime object graphs
  - **Abstract** into as-built runtime architecture
- **Check** and **measure** structural conformance
  - Structurally **compare as-built and as-designed** views
  - **Trace to code** unexpected conformance finding

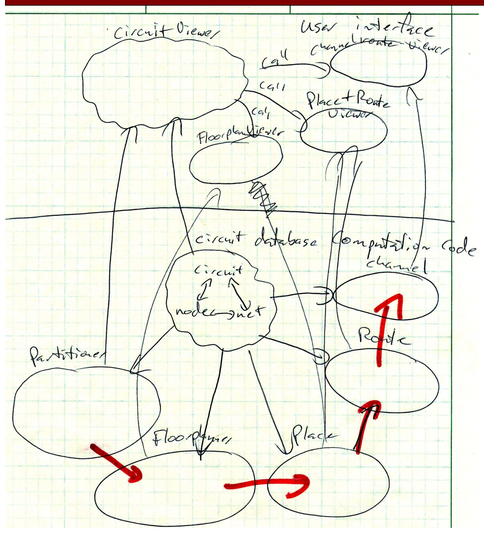
Conformance Checking Analysis

- Consider as-designed **view more authoritative**
- Allow as-built view to contain low-level details
- Account **for all communication** in as-built view that is not in as-designed view
- Include **transitive communication** through elided objects

Conformance check highlights key differences:

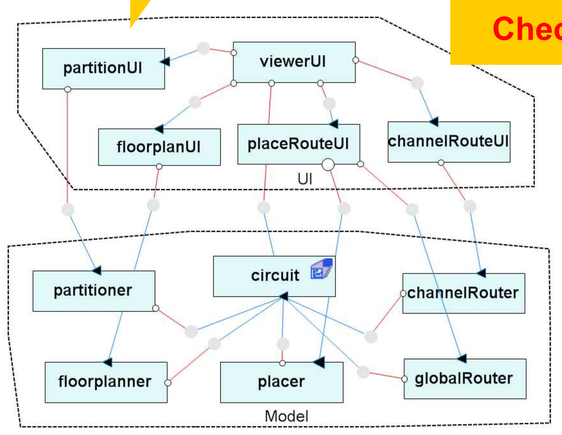
- **Convergence**: node or edge **in both** as-built and in as-designed view
- **Divergence**: node or edge **in as-built** but **not in as-designed** view
- **Absence**: node or edge **in as-designed** but **not in as- built** view

Illustration of End-To-End Approach on Aphyds (8-KLOC)



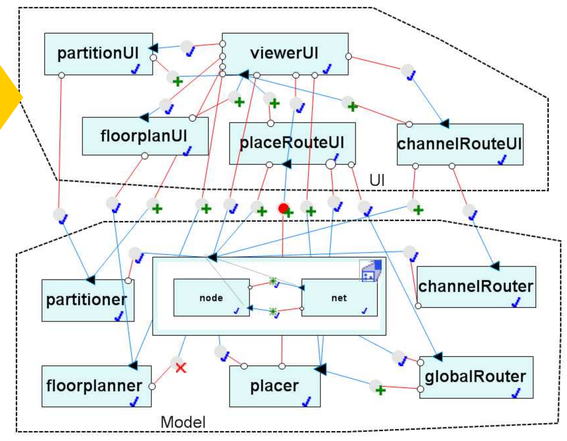
Aphyds as-designed architecture, drawn by original developer.

Document



In Eclipse AcmeStudio perspective, document as-designed architecture in architecture description language.

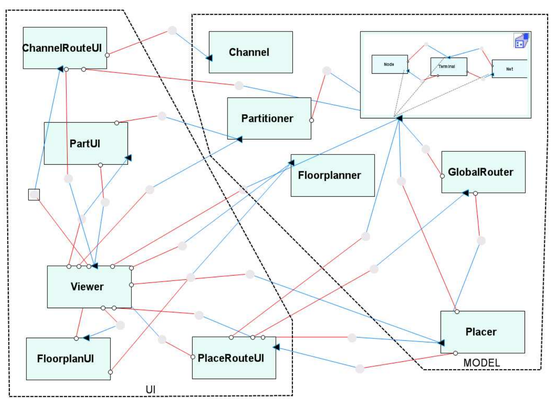
Check



ArchConf conformance checking tool displays results Study conformance view. Investigate differences.

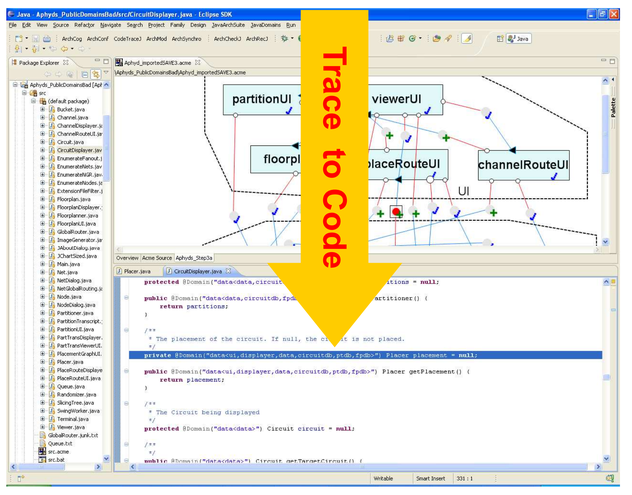
```
1  class Circuit {
2    public domain DB; // Declare public domain DB
3    domain OWNED; // Declare private domain OWNED
4    DB Node node; // Declare Node reference in DB
5    // Outer annotation is for container; inner one for its elements
6    OWNED Hashtable<String, DB Node> nodes;
7  }
8  class Viewer<M> { // Declare domain parameter M
9    M Circuit circuit; // Declare Circuit reference in M
10 }
11 class Main {
12   domain MODEL, UI; // Declare top−level domains
13   MODEL Circuit circuit;
14   // Bind domain parameter M to actual domain MODEL
15   UI Viewer<MODEL> viewer;
16 }
```

Ownership Domain annotations express:
- object encapsulation
- logical containment
- architectural tiers
- communication permissions



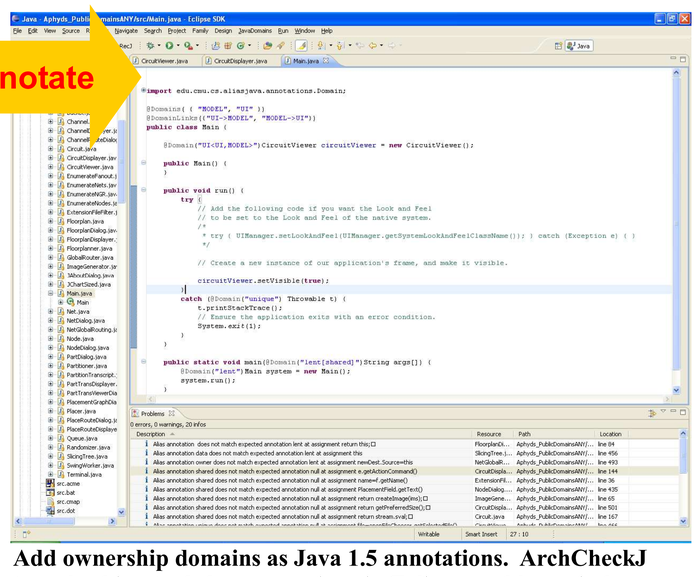
ArchCog abstraction tool maps hierarchical runtime object graph to as-built runtime architecture.

Trace to Code



Relate architectural elements to code. Fix serious architectural violations. Or refine as-designed architecture.

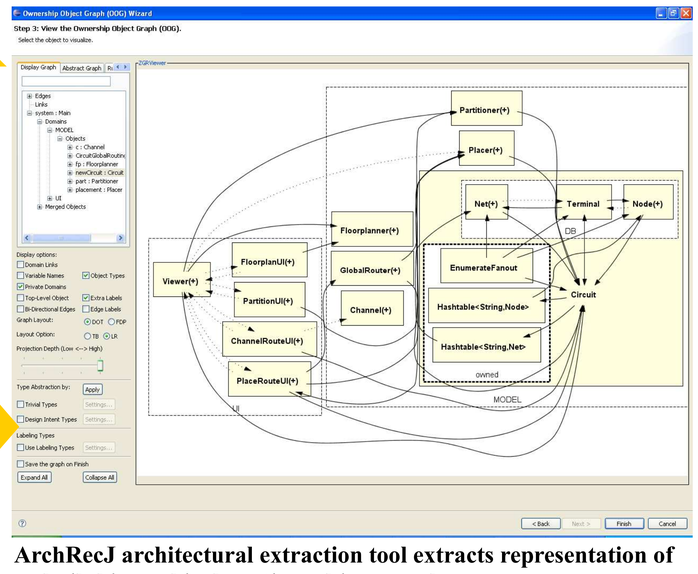
Annotate



Add ownership domains as Java 1.5 annotations. ArchCheckJ typechecking tool shows warnings in Eclipse problem window.

Abstract

Extract



ArchRecJ architectural extraction tool extracts representation of as-built hierarchical runtime object graph.