

Coign - Automatic Distributed Partitioning System

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Overview

- **Motivation/Introduction**
- **System Description**
- **Coign Runtime Description**
- **Experimental Results**
- **Conclusion**

Motivation/Introduction

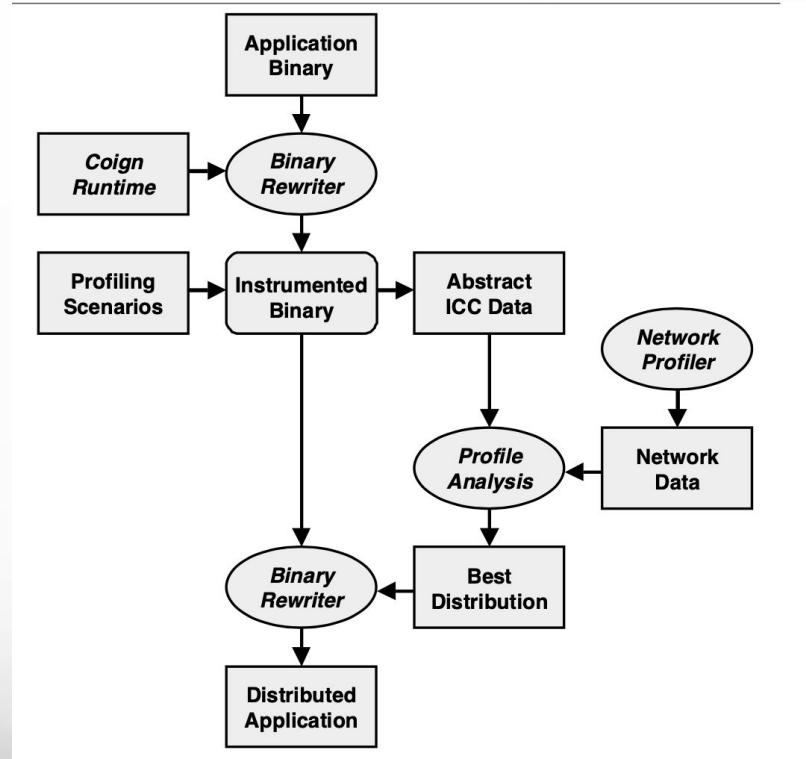
- **Moving away from manual**
- **System software**
- **"Popular" acceptance of the Internet fuels distributed systems and applications**
- **Many challenges for distributed vs non-distributed application**
- **Partition and position - done manually**

Motivation/Introduction

- **Programmers resist repartitioning applications**
- **Cogin, automates the development of distributed applications**
- **Binary application (over 2 million lines of application code)**
- **Components conforming to Microsoft's COM**
- **Scenario based profiling (profiles inter-component communications)**

System Description

1. Coign run-time
2. Binary Rewriter
3. Network Profiler
4. Profile Analysis Engine



System Description

- **Binary Rewriter**
- **Inserts an entry into the first slot DLL**
- **Adds data segment containing configuration information**

System Description

- **Coign run-time**
- **Always loads and executes before application or any of its DLLs**
- **At load time, inserts binary instrumentation into images of system libraries**

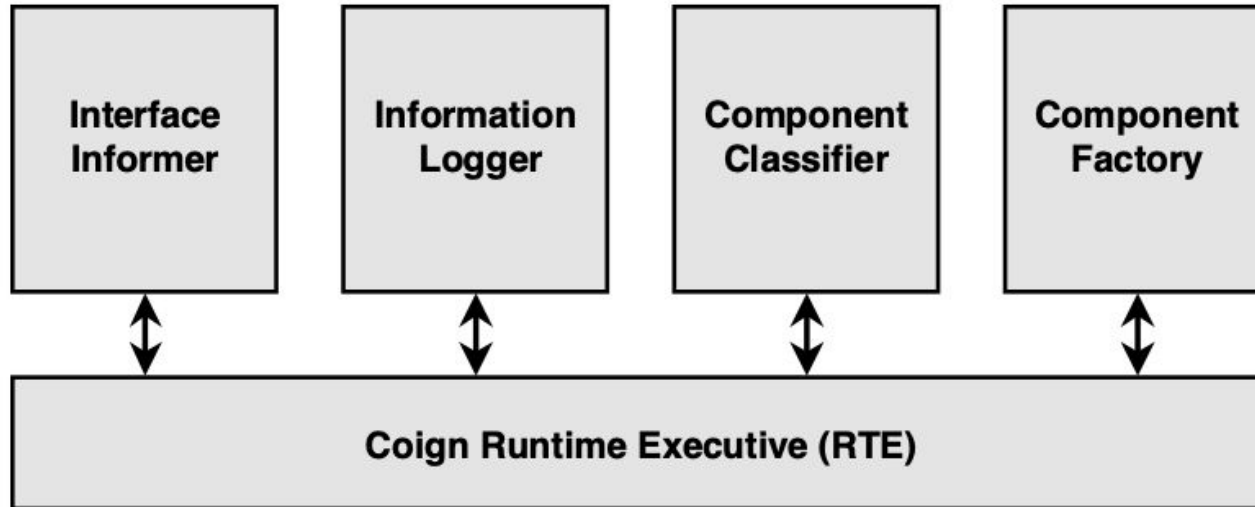
System Description

- **Network Profiler**
- **Gathers in background, small degradation (up to 85%)**
- **Every inter-component call is executed via a COM interface**
- **Measures number of bytes that is transferred**
- **Uses lift-to-front minimum-cut graph-cutting algorithm**

System Description

- **Profile Analysis Engine**
- **Combines component communication and location constraints**
- **Creates inter-component communication (ICC) graph**
- **Only two machines and client-server applications**
- **Three or more is NP-Hard**

Coign Runtime Description



Coign Runtime Description

- **Coign Runtime Executive**
- **Interception of component instantiation requests**
- **Interface wrapping**
- **Address space and private stack management**
- **Access to configuration information store in the application binary**

Coign Runtime Description

- **Interface Informer**
- **Manages static interface metadata**
- **Profiling Informer (analyze all function call parameters - measurements)**
- **Distribution Informer (only examines function call parameters - identify interface pointers)**

Coign Runtime Description

- **Information Logger**
- **Data for distributed partitioning analysis**
- **Profiling logger - inter-component communication**
- **Event Logger - all component related events during application execution**
- **Null Logger - During distributed execution**

Coign Runtime Description

- **Instance Classifier**
- **Two instances should be similar**
- **Internal-function called-by classifier used most often**

Coign Runtime Description

Classifier Descriptors:

Incremental Classifier:

[10] (for 10th call to CoCreateInstance)

Procedure Called-By (PCB) Classifier:

[C :: Z, B :: Y, B :: X, A :: W, A :: V]

Static-Type (ST) Classifier:

[D]

Static-Type Called-By (STCB) Classifier:

[D, C, B, B, A]

Internal-Function Called-By (IFCB) Classifier:

[D, [c, Z], [b2, Y], [b1, X], [a, W], [a, V]]

Entry-Point Called-By (EPCB) Classifier:

[D, [c, Z], [b2, Y], [b1, X], [a, V]]

Instantiated-By (IB) Classifier:

[D, c]

Coign Runtime Description

- **Component Factory**
- **Manipulates instance placement**
- **Uses instance classifier and profile analysis engine**
- **Acts like peers, requests on own machine**

Experimental Results

- **Wide class of COM applications**
- **Microsoft PhotoDraw 2000 (112 COM components, 1.8 million lines of C++)**
- **Octarine (150 COM components, 120,000 lines of C and 500 lines of x86 assembly)**
- **Corporate Benefits Sample (two client front-end, four middle tier servers, one dozen COM components, 5,300 lines of Visual Basic, and 32,000 lines of C++)**

Experimental Results

	Scenario	Description
Octarine	o_newdoc	Create text document.
	o_newmus	Create music document.
	o_newtbl	Create table document.
	o_oldtb0	View 5-page table.
	o_oldtb3	View 150-page table.
	o_oldwp0	View 5-page text document.
	o_oldwp3	View 13-page text document.
	o_oldwp7	View 208-page text document.
	o_oldbth	View 5-page text doc. with tables.
	o_offtb3	o_newdoc then o_oldtb3.
	o_offwp7	o_newdoc then o_oldwp3.
	o_bigone	All of the above in one scenario.
PhotoDraw	p_newdoc	Create new image.
	p_newmsr	Create new composition.
	p_oldcur	View line drawing.
	p_oldmsr	View composition.
	p_offcur	p_newdoc then p_oldcur.
	p_offmsr	p_newdoc then p_oldmsr.
	p_bigone	All of the above in one scenario.
Benefits	b_vueone	View records for an employee.
	b_addone	Add new employee.
	b_delone	Delete employee.
	b_bigone	All of the above in one scenario.

Experimental Results

- Instance Classifier

Instance Classifier	Profiled Classifications	New (bigone) Classifications	Ave. Instances / Classification	Average Correlation
Incremental	1090	2561	1.0	0.225
Procedure Called-By	1262	0	2.9	0.766
Static-Type	80	0	45.6	0.574
Static-Type Called-By	713	0	5.1	0.809
Internal-Func. Called-By	1434	0	2.6	0.848
Entry-Pointer Called-By	1032	0	3.5	0.829
Instantiated-By	590	0	6.2	0.809

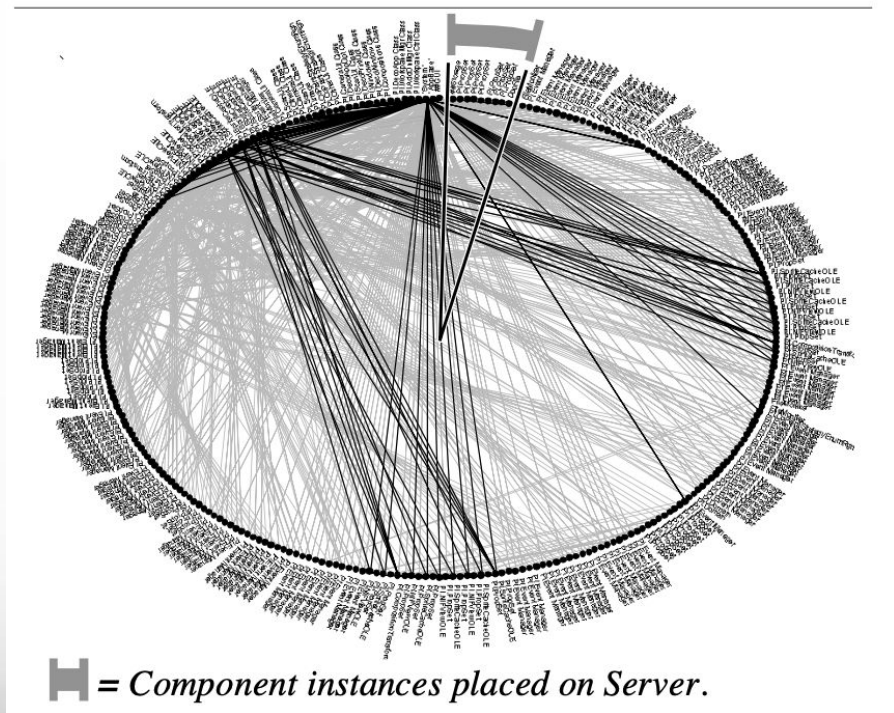
Experimental Results

- Varying Stack-Walk Depth

<i>Internal-Function Called-By Classifier Stack-Walk Depth</i>	Profiled Classifications	Ave. Instances / Classification	Average Correlation
1	590	6.2	0.809
2	977	3.7	0.829
3	1184	3.1	0.848
4	1383	2.6	0.848
8	1434	2.6	0.848
16	1434	2.6	0.848
Complete	1434	2.6	0.848

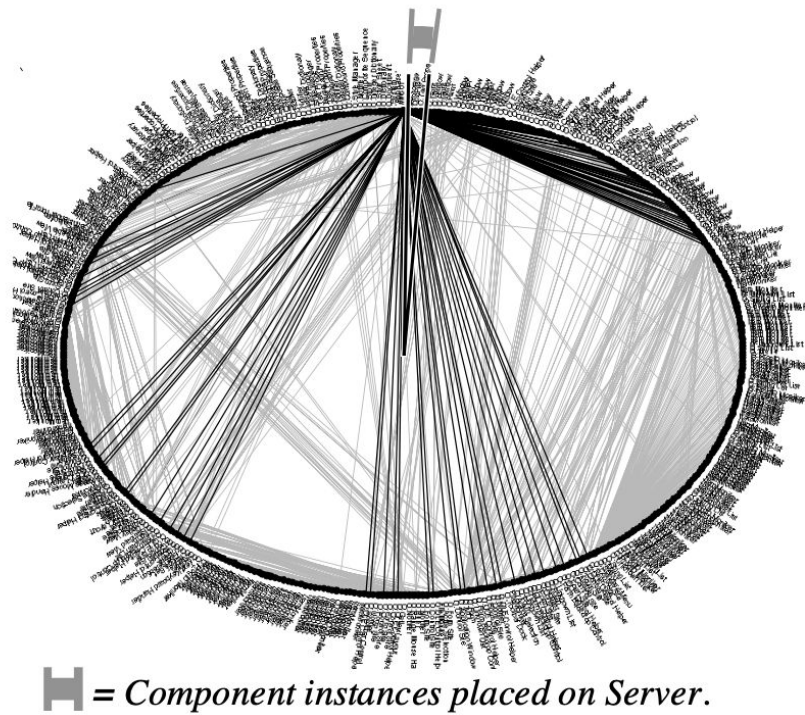
Experimental Results

- PhotoDraw distribution
- 8 on server
- 295 components



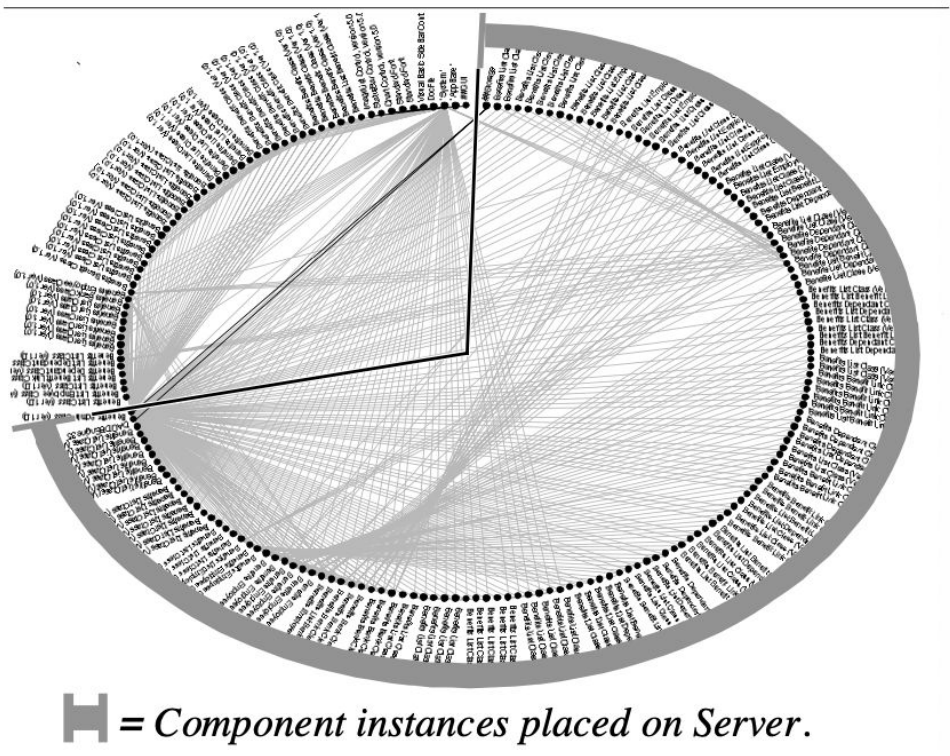
Experimental Results

- Octarine distribution
- 2 on server
- 458 components
- GUI problem



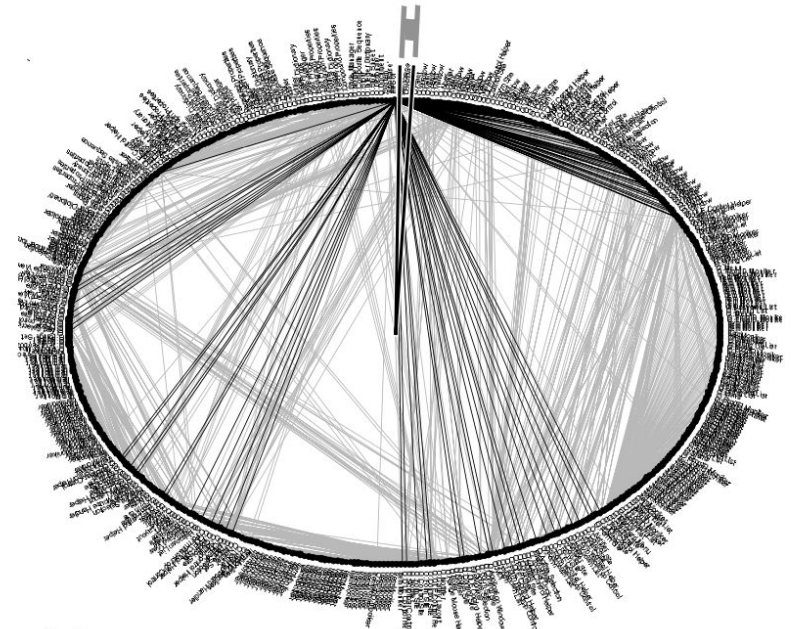
Experimental Results

- Corporate Benefits distribution
- 135 on middle tier
- 187 by programmer
- 196 components
- Reduce coms 35%



Experimental Results

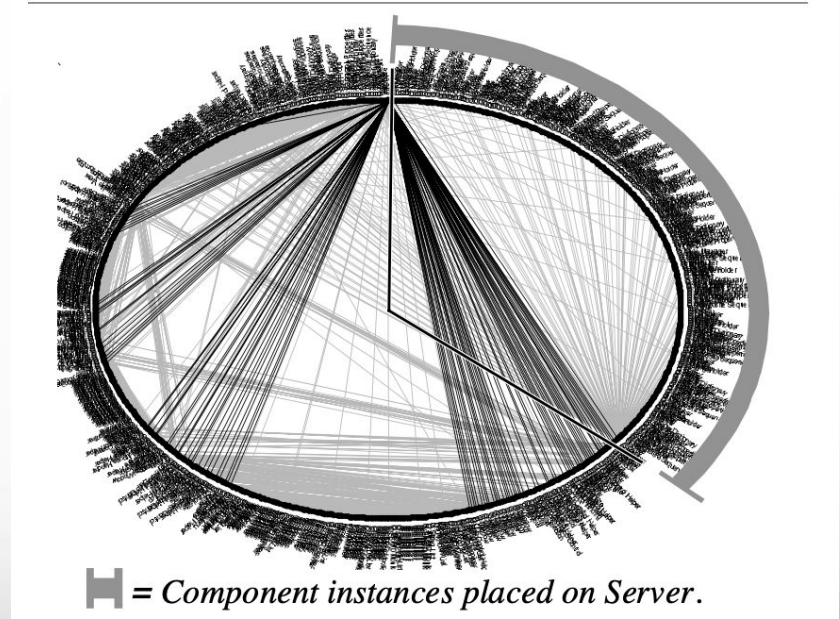
- Octarine with Multi-page Table
(a single 5pg table)
- Single component on server
- 476 components



H = *Component instances placed on Server.*

Experimental Results

- Octarine with Multi-page Table
(a single 5pg table few dozen)
- 281 component on server
- 786 components



Experimental Results

● Communication time

Scenario	Comm. Time (secs.)		Savings
	Default	Coign	
o_newdoc	0.152	0.152	0%
o_newmus	0.149	0.149	0%
o_newtbl	0.006	0.006	0%
o_oldtb0	1.058	1.048	1%
o_oldtb3	15.064	0.042	99%
o_oldwp0	0.143	0.143	0%
o_oldwp3	0.696	0.696	0%
o_oldwp7	21.089	1.099	95%
o_oldbth	1.734	0.562	68%
o_offtb3	15.079	0.037	99%
o_offwp7	20.878	1.090	95%
o_bigone	27.497	22.630	18%
p_newdoc	4.726	4.496	5%
p_newmsr	17.016	15.014	12%
p_oldcur	2.384	1.613	32%
p_oldmsr	14.517	11.482	21%
p_offcur	1.583	0.722	54%
p_offmsr	14.650	11.497	22%
p_bigone	33.032	27.084	18%
b_vueone	1.465	0.954	35%
b_addone	2.322	1.601	31%
b_delone	3.414	2.834	17%
b_bigone	1.754	1.414	19%

Experimental Results

- Prediction time
by graph cutting
algorithm

Scenario	Execution Time (sec.)		Error
	Predicted	Measured	
o_newdoc	10.7	10.7	0%
o_newmus	10.9	10.9	0%
o_newtbl	9.3	9.3	0%
o_oldtb0	19.0	19.1	0%
o_oldtb3	231.1	231.1	0%
o_oldwp0	5.5	5.7	-3%
o_oldwp3	7.2	7.3	-2%
o_oldwp7	33.4	33.6	-1%
o_oldbth	33.6	33.6	0%
o_offtb3	232.7	232.7	0%
o_offwp7	67.2	65.6	2%
o_bigone	416.1	429.7	-3%
p_newdoc	14.3	14.3	0%
p_newmsr	76.8	72.9	5%
p_oldcur	18.8	18.8	0%
p_oldmsr	49.0	49.5	-1%
p_offcur	18.1	18.1	0%
p_offmsr	53.8	54.2	-1%
p_bigone	139.6	136.3	2%
b_vueone	9.4	8.9	6%
b_addone	14.6	13.9	5%
b_delone	8.9	8.4	7%
b_bigone	5.6	5.2	8%

Conclusion

- **Motivation/Introduction**
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- **Experimental Results**

Questions

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