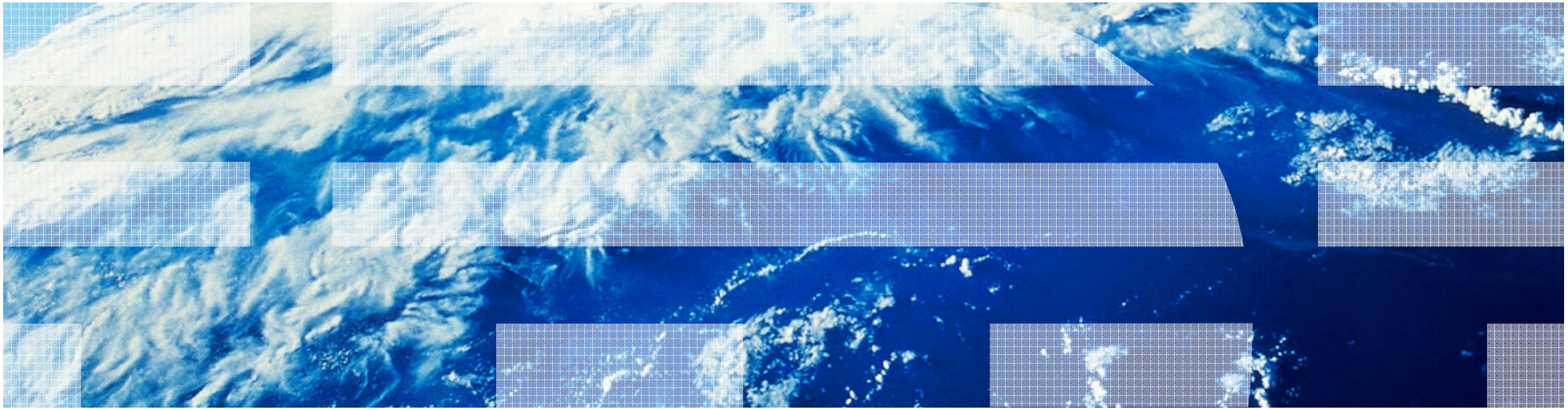
CIMDIFF: Advanced Difference Tracking Tool for CIM Compliant Devices

Ramani Routray
IBM Research – Almaden

Shripad Nadgowda
IBM System and Technology Lab, Pune



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Outline

- **Background**
- **Model and Problem Definition**
- **System Overview**
- **Implementation**
- **Results**
- **Conclusion and Future Work**

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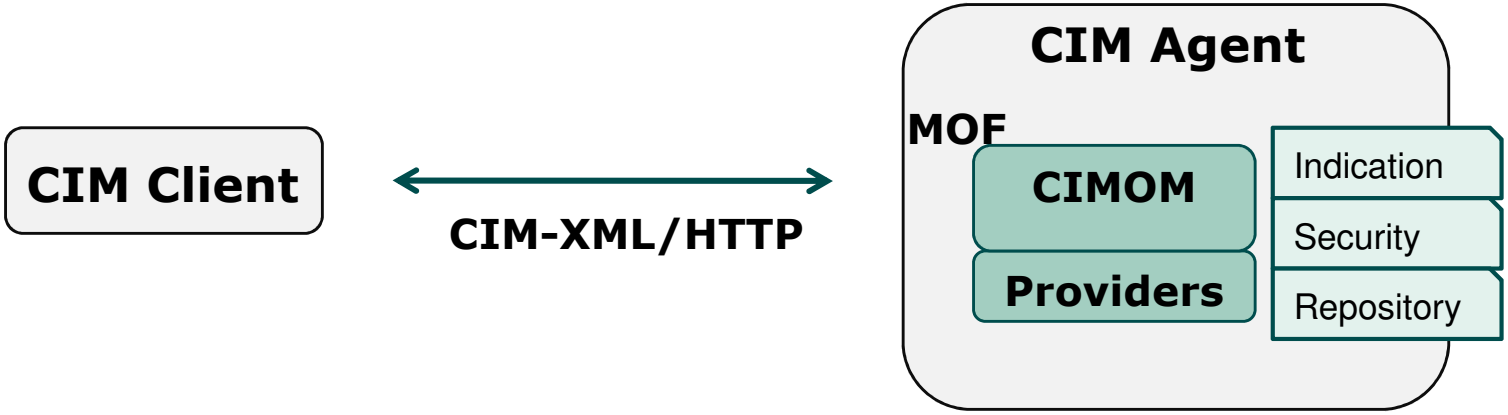
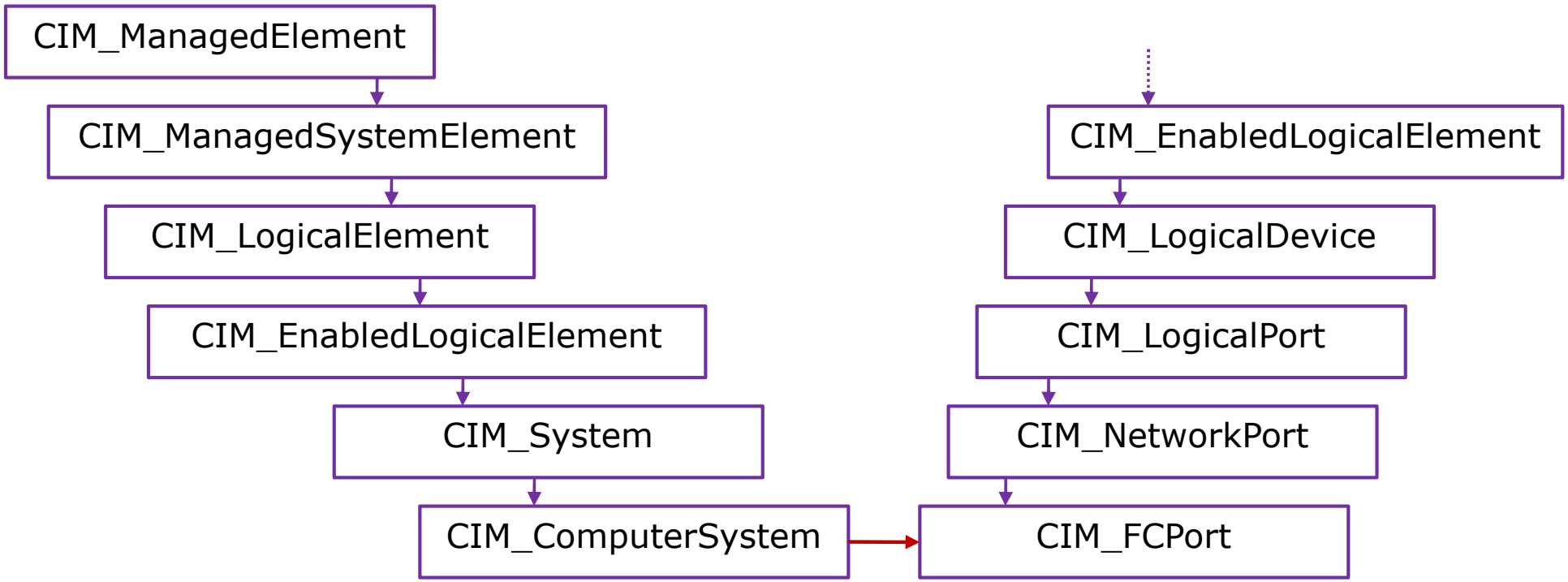
Background (I)



Web Based Enterprise Management (WBEM)



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Background (II)

```
<?xml version="1.0" ?>
<CIM CIMVERSION="2.0" DTDVERSION="2.0">
<MESSAGE ID="0" PROTOCOLVERSION="1.0">
...
  <INSTANCENAME CLASSNAME="IBMTSDS_StorageSystem">
    <KEYBINDING NAME="Name">
      <KEYVALUE VALUETYPE="string">
        IBM.1750-6887010
      </KEYVALUE>
    </KEYBINDING>
  <KEYBINDING NAME="CreationClassName">
    <KEYVALUE VALUETYPE="string">
      IBMTSDS_StorageSystem
    </KEYVALUE>
  </KEYBINDING>
  </INSTANCENAME>
  <INSTANCE CLASSNAME="IBMTSDS_StorageSystem">
    <PROPERTY NAME="CodeLevel" TYPE="string">
      <VALUE TYPE="string">5.2.2.399</VALUE>
    </PROPERTY>
    <PROPERTY NAME="NVSMemory" TYPE="uint32">
      <VALUE TYPE="uint32">256</VALUE>
    </PROPERTY>
    <PROPERTY NAME="CacheMemory" TYPE="uint32">
      <VALUE TYPE="uint32">2629</VALUE>
    </PROPERTY>
    ...
  </INSTANCE>
```


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Motivation and Problem Definition

- Discovery operation by System Management tool
- Administrators Query difference between systems

- XML Document difference tracking
- NP Hard
- Meaningful Difference Tracking

$$C_r = \{ N^+ \}$$
$$N = \{ C_i \mid C_{op} \mid C_p \}$$
$$C_i = \{ C_{op}, C_p \}$$
$$C_{op} = \{ C_p^+ \}$$

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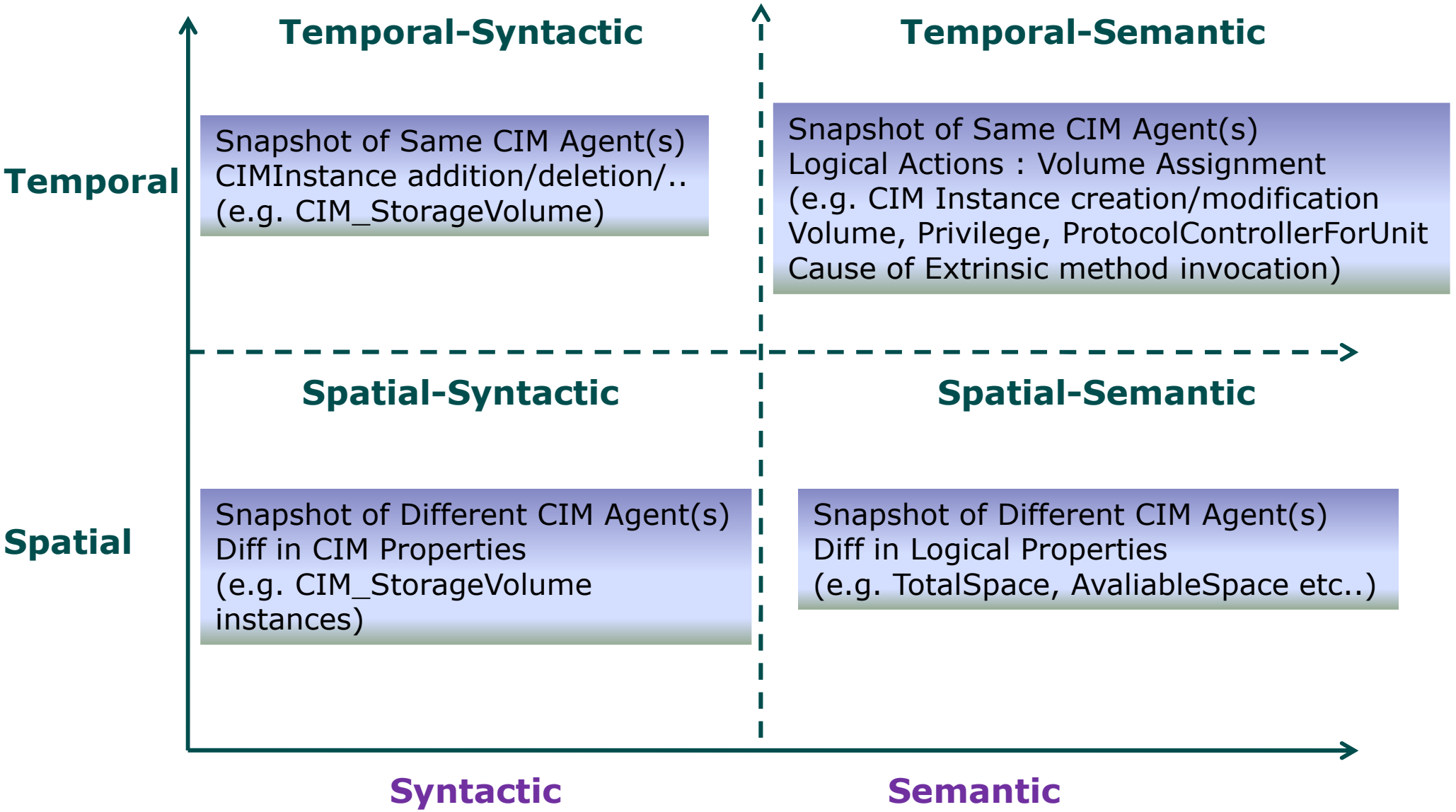
Model and Problem Definition (II)



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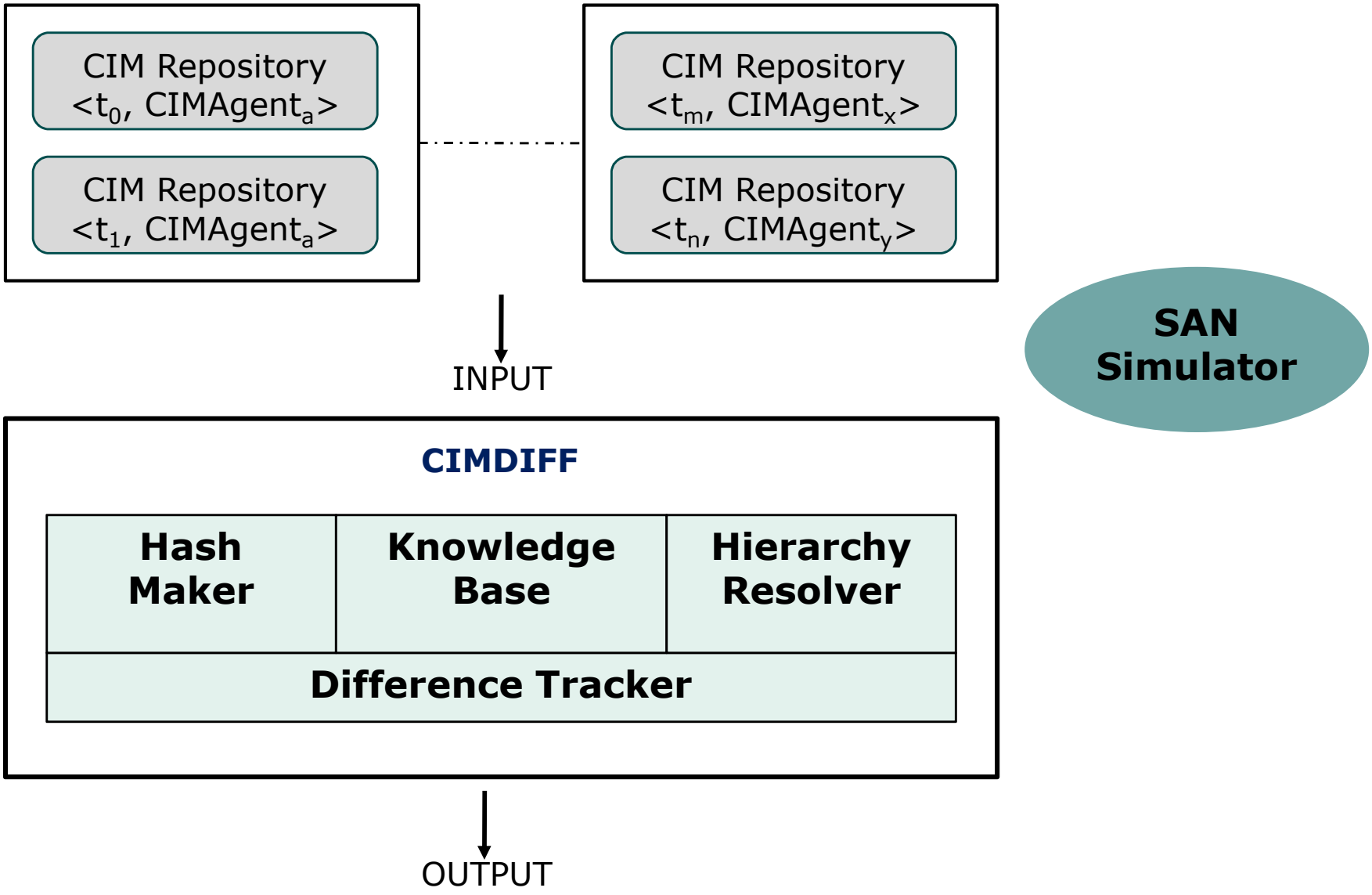
System Overview



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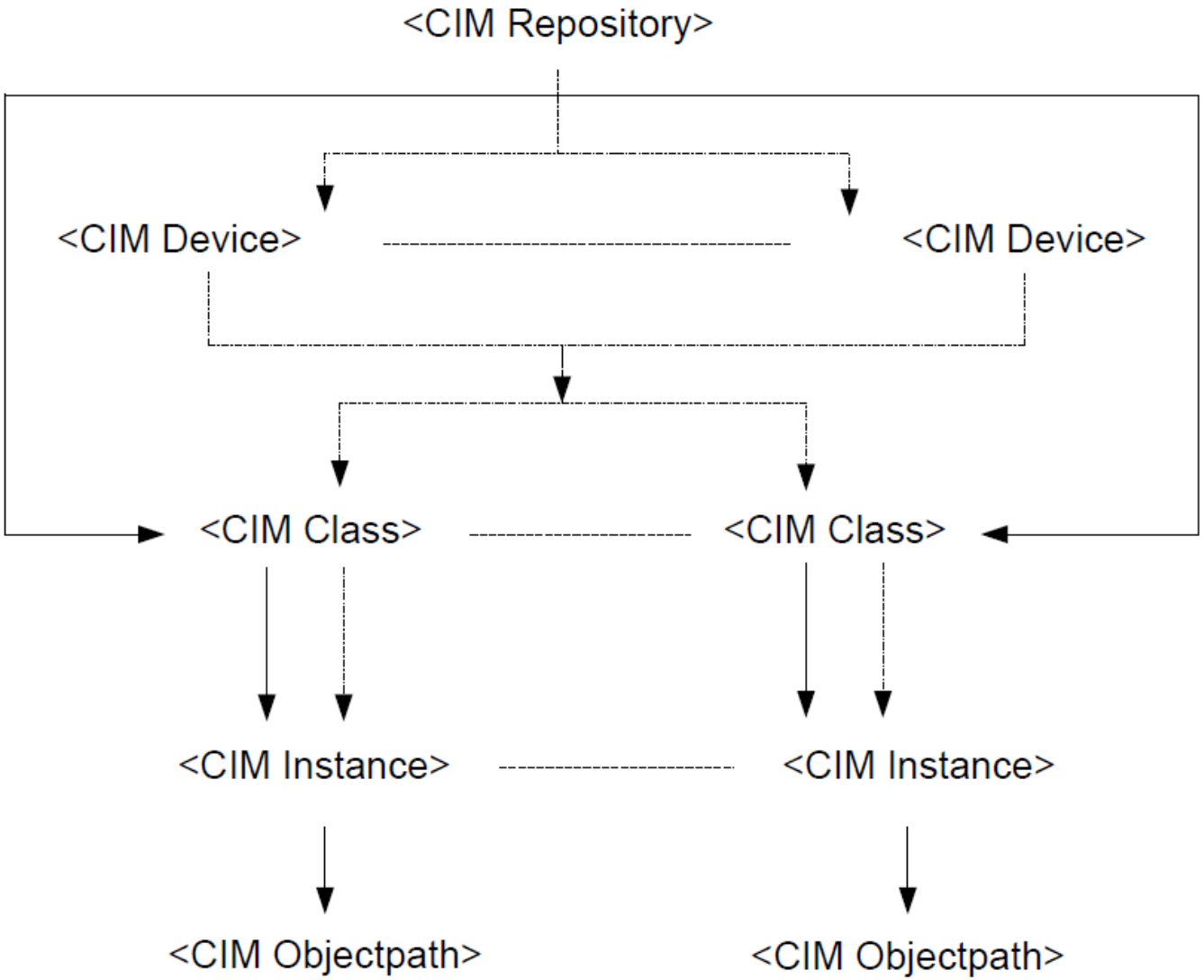
Hash Maker



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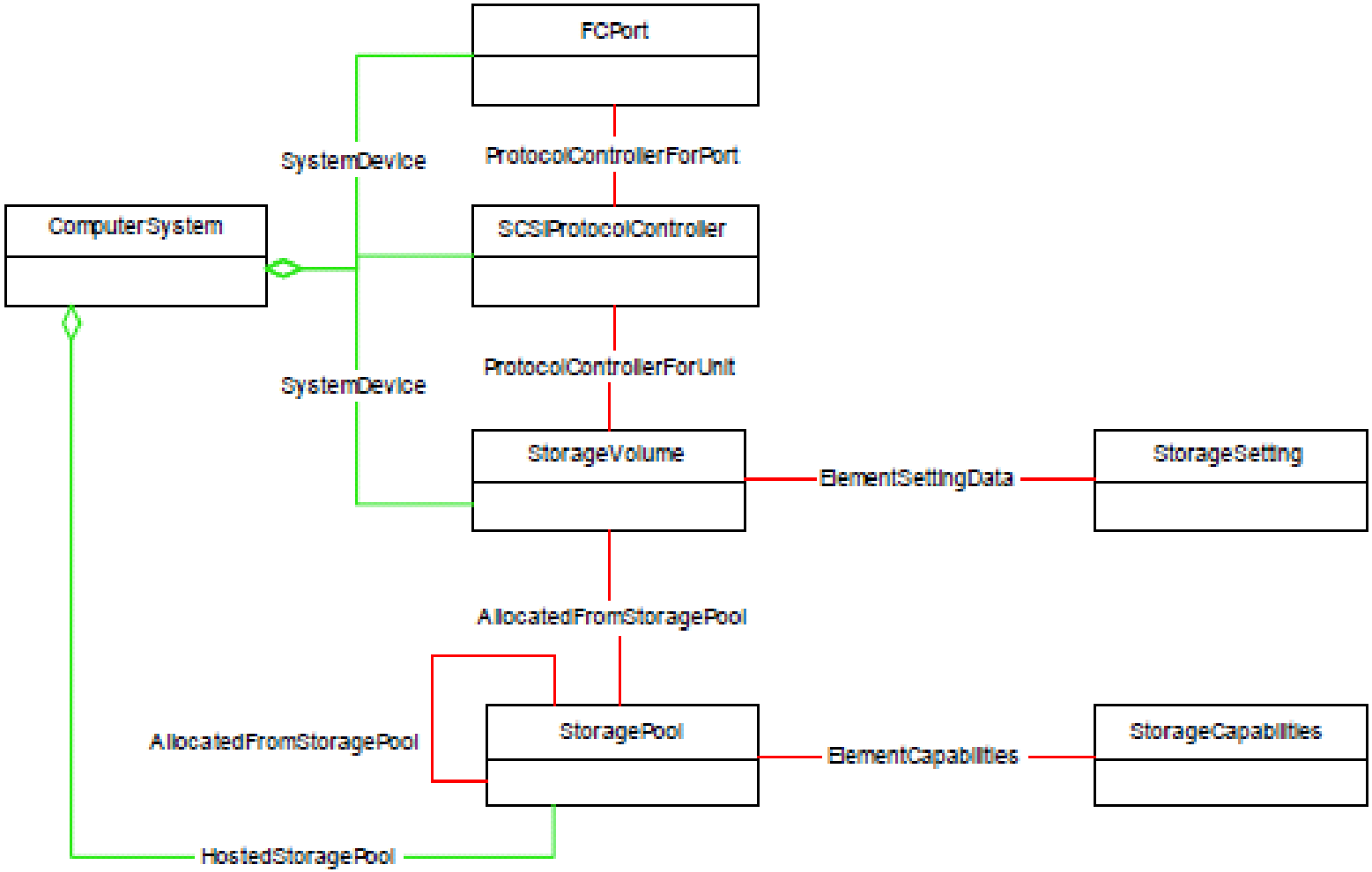
KnowledgeBase (I)



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KnowledgeBase - Recipe

```
//Create Storage Volume on an Array [10GB RAID-5 Volume]
// RequestedSize = 10 * 1024 * 1024 * 1024 // 10 GB

1. Enumerate all StoragePools associated with $StorageArray
2. For each StoragePool {
     if(StoragePool is non-primordial) {
       get StorageCapabilities associated with StoragePool
       if(StorageCapabilities == Volume Requirements) {
         if (StoragePool has free space available) {
           invoke GetSupportedSizes and(or) getSupportedSizeRange
           //Round up using integer arthimetic
           get valid capacity of newly created volume
           Select StoragePool and Select VolumeSize }
       } } }
3. Services[] = AssociatorNames(StorageArray)
4. StorageConfigurationService = Services[0]
5. InArguments[ElementType] = 2 // Storage Volume
   InArguments[Goal] = GeneratedStorageSetting
   InArguments[Size] = VolumeSize
   InArguments[InPool] = StoragePool
   InArguments[TheElement] = null
   ReturnValue = InvokeMethod(
                   StorageConfigurationService,
                   CreateOrModifyElementFromStoragePool,
                   InArguments, OutArguments)
6. if ((ReturnValue == 0 || ReturnValue == 4096 &&
   OutArguments[TheElement] != null)) {
       //Reference to the newly created volume
       CreatedVolume-> = OutArguments[TheElement] }
```


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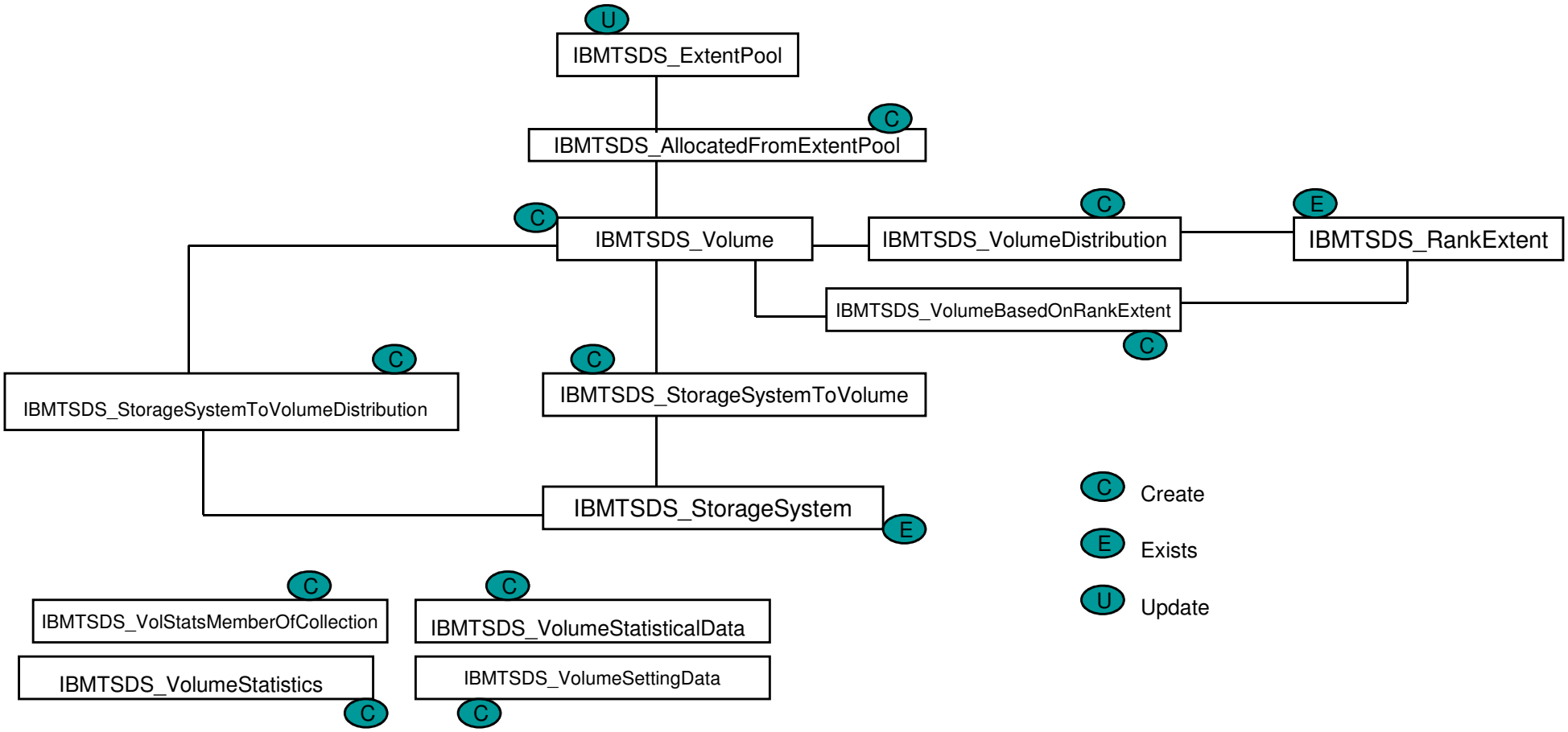
KnowledgeBase – StorageVolume Creation



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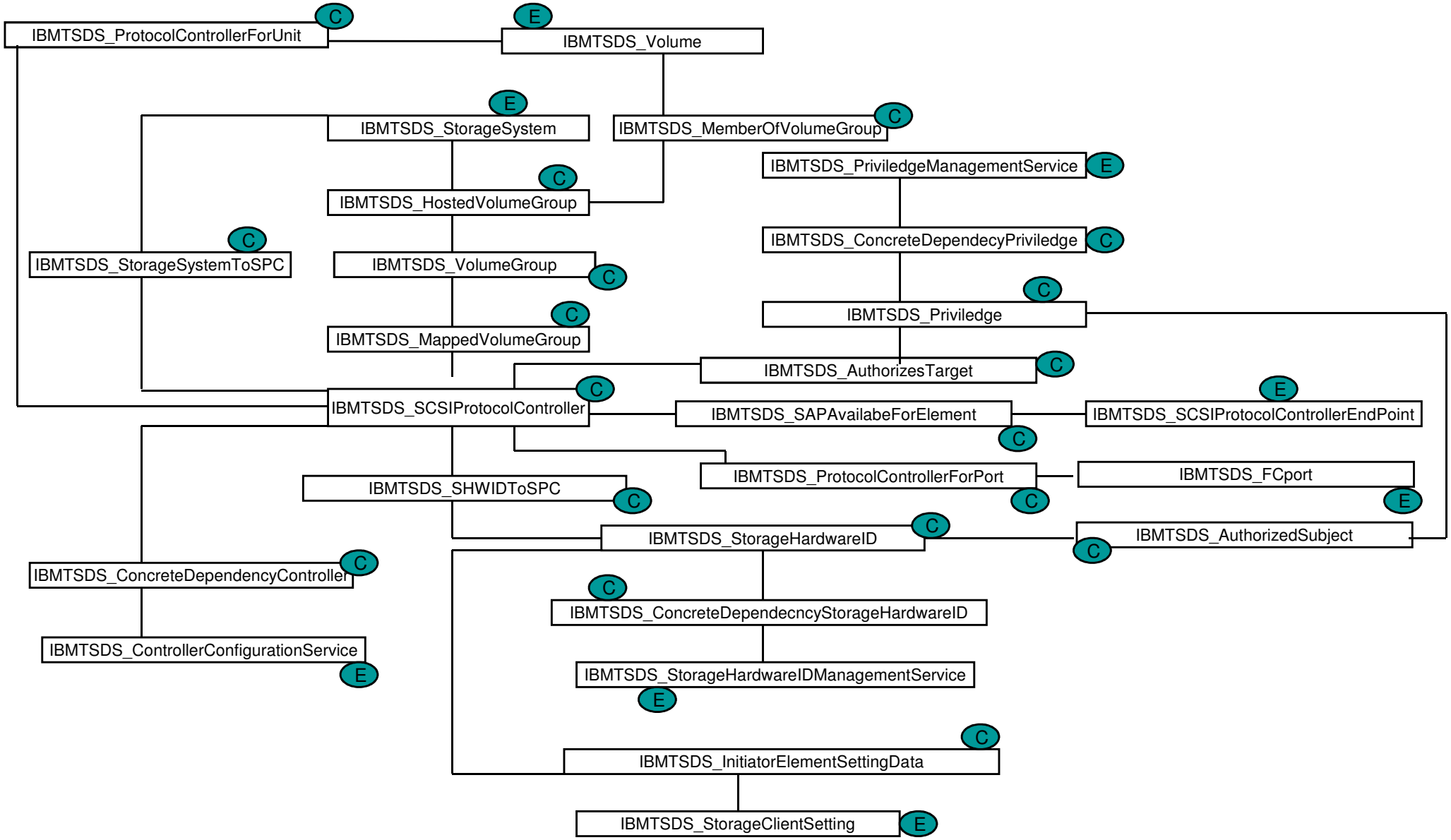
KnowledgeBase – StorageVolume Assignment



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Difference Tracker

```
calculateMinCostEditScripts(C^r1,C^r2)
{
  /* Hashing */
  Map C^r1 to T^1, Map C^r2 to T^2
  Hash T^1, Hash T^2
  /* Traverse CIM Agent Hierarchy */
  /* Traverse Managed Device Hierarchy */
  Traverse CIM Agent hierarchy &
  Traverse Managed Device hierarchy
  {
    /* Check tree isomorphism based on Hash */
    /* Compute Insert, Delete, Update */
    for all Node N in T^1 and T^2
      for all CIMClass(es)
        for all CIMInstance(s)
          Compare CIMObjectpath
            Compare CIMProperties
  }
}
```


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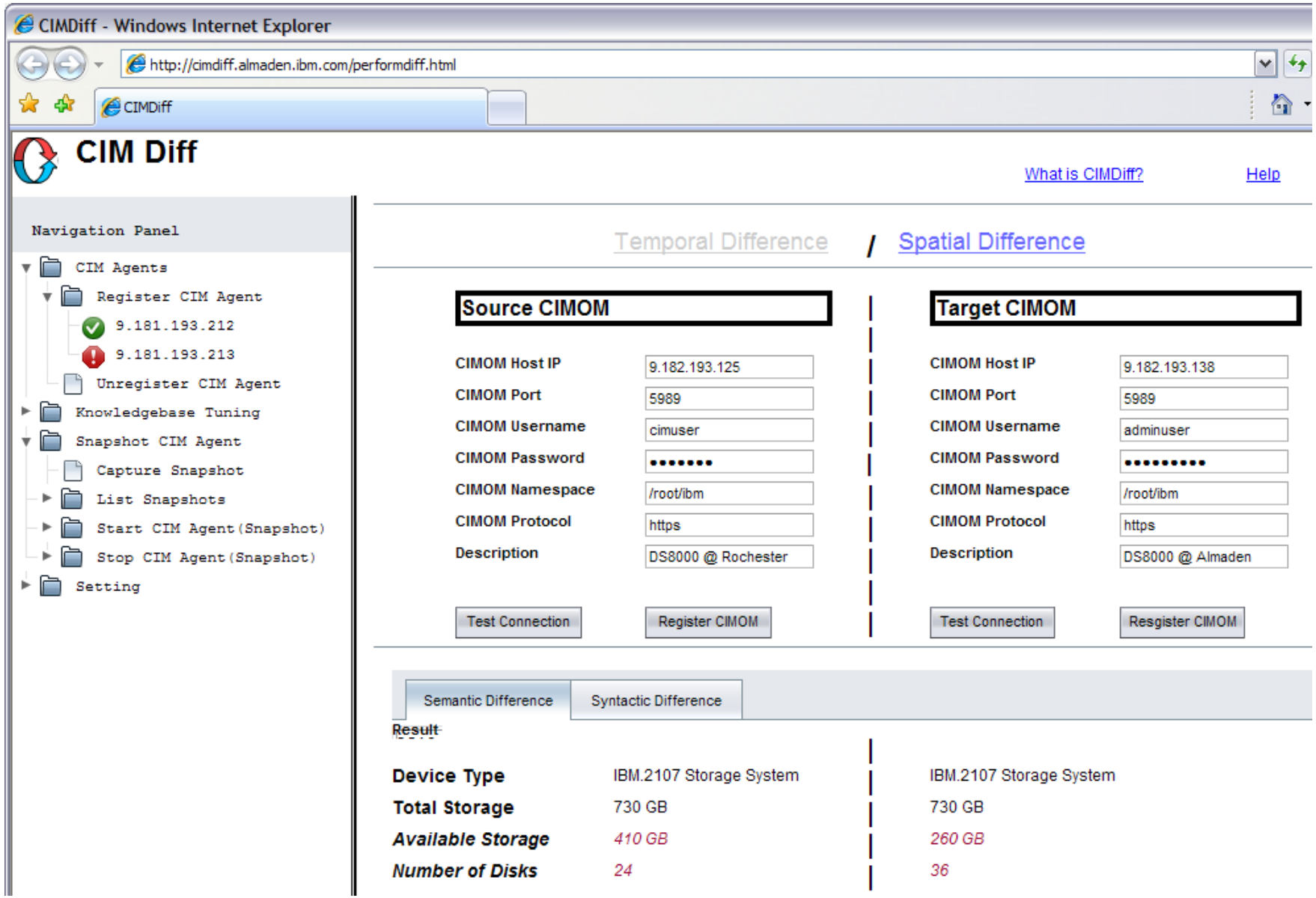
Implementation



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Results

CIMDIFF	
CIM Repository An	CIM Repository Bm
74 CIM Classes	78 CIM Classes
1874 CIM Instances	2436 CIM Instances
IBMTSDS_Volume PowerOnHours CIMProperty	LSISSI_StorageVolume NO Corresponding CIMProperty
IBMTSDS_Volume No Corresponding CIMProperty	LSISSI_StorageVolume RaidLevel CIMProperty
IBMTSDS_Volume 212 CIM Instances	LSISSI_StorageVolume 120 CIM Instances
IBMTSDS_ExtentPool 7 CIM Instances (Extends from CIM_StoragePool)	LSISSI_StoragePool 5 CIM Instances (Extends from CIM_StoragePool)
IBMTSDS_DiskDrive 36 CIM Instances	LSISSI_DiskDrive 12 CIM Instances

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Results

CIMDIFF	
CIM Repository An	CIM Repository Bm
RemainingManagedSpace 840 GB	RemainingManagedSpace 300 GB
Remaining RAID-5 Space 640 GB	Remaining RAID-5 Space 300 GB
Remaining RAID-1 Space 140 GB	Remaining RAID-1 Space 0 GB

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Results

CIMDIFF	
CIMRepository-A0	CIMRepository-A1
1874 CIM Instances	1942 CIM Instances
IBMTSDS-Volume 212 CIM Instances	IBMTSDS-Volume 224 CIM Instances [SAME] 216 CIM Instances [DELETED] 5 CIM Instances [NEW] 17 CIM Instances [MODIFIED] 1 CIM Instances

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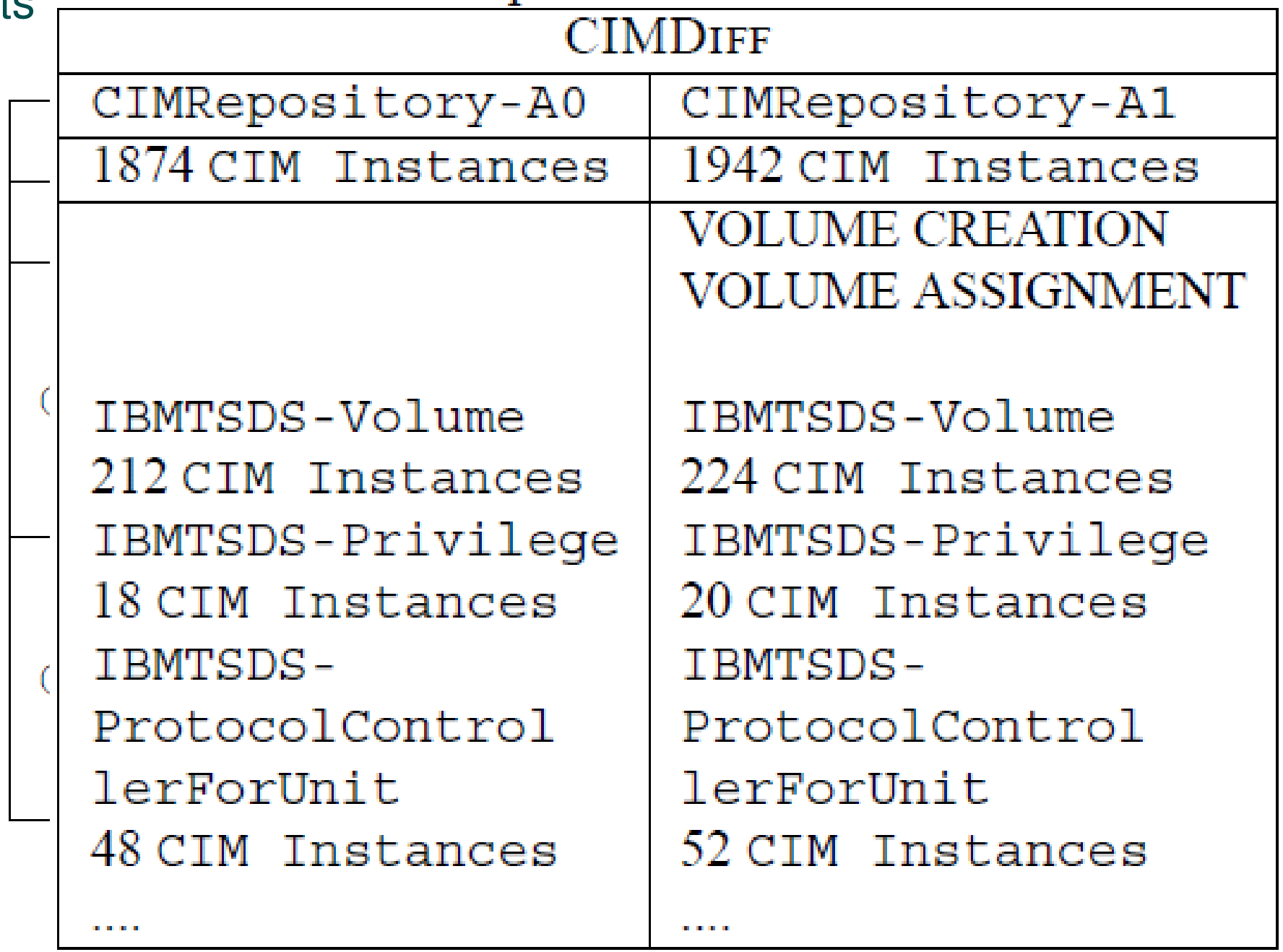
Results



CIMDIFF	
CIMRepository-A0	CIMRepository-A1
1874 CIM Instances	1942 CIM Instances
	VOLUME CREATION VOLUME ASSIGNMENT
IBMTSDS-Volume 212 CIM Instances	IBMTSDS-Volume 224 CIM Instances
IBMTSDS-Privilege 18 CIM Instances	IBMTSDS-Privilege 20 CIM Instances
IBMTSDS- ProtocolControl lerForUnit 48 CIM Instances	IBMTSDS- ProtocolControl lerForUnit 52 CIM Instances
....	....

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Conclusion and Future Work

- Diff Utility
  - XML, GNU, CVS,…
- Multi-Hierarchical XML Document
  - Standards Based
  - KnowledgeBase Driven
  - Meaningful Diff Tracking

- Powerful tool for system administrators
  & system management tool developers and testers
- Tool can be used in SNIA CTP Environment
- Fast Changing Virtual Environment

- Using Machine learning for automatic pattern detection
- Visual tool for administrator to specify pattern

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Thank You!

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