An Interactive Graph-Based Automation Assistant: A Case Study to Manage the GIPSY's Distributed Multi-tier Run-Time System

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Abstract

The GIPSY system provides a framework for a distributed multi-tier demanddriven evaluation of heterogeneous programs, in which certain tiers can generate demands, while others can respond to demands to work on them. They are connected through a virtual network that can be flexibly reconfigured at run-time. Although the demand generator components were originally designed specifically for the eductive (demand-driven) evaluation of Lucid intensional programs, the GIPSY's runtime's flexible framework design enables it to perform the execution of various kinds of programs that can be evaluated using the demand-driven computational model. Management of the GISPY networks has become a tedious (although scripted) task that took manual command-line console to do, which does not scale for large experiments. Therefore a new component has been designed and developed to allow users to represent, visualize, and interactively create, configure and seamlessly manage such a network as a graph. Consequently, this work presents a Graphical GMT Manager, an interactive graph-based assistant component for the GIPSY network creation and configuration management. Besides allowing the management of the nodes and tiers (mapped to hosts where store, workers, and generators reside), it lets the user to visually control the network parameters and the interconnection between computational nodes at run-time. In this paper we motivate and present the key features of this newly implemented graph-based component. We give the graph representation details, mapping of the graph nodes to tiers, tier groups, and specific commands. We provide the requirements and design specification of the tool and its implementation. Then we detail and discuss some experimental results. **Key**words: graph-based management, visualization, GIPSY network, demand-driven computation, GUI

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1 Introduction

The GIPSY (General Intensional Programming System) project is an ongoing research project developed at Concordia University. Its initial goal was to investigate on a general solution for the evaluation of programs written in the Lucid intensional programming family of languages using a distributed demand-driven evaluation model. In order to meet the flexibility goals of the project, the system has been designed using a framework approach integrating a Lucid compiler framework, as well as a demand-driven run-time system framework.

In its eductive model of execution, the system assumes the presence of demand generators, as well as a demand workers. Each demand generated is paired along with the context in which it is made and is uniquely identified. The demands are migrated using a communication node that enables the connection between demand generators and demand workers. Through the communication node, any demand worker can pick-up demands, compute its resulting value, and send it back to the communication node to be picked up by the generator.

Notably, the framework has demonstrated its flexibility by having the run-time system put to use in the demand-driven distributed evaluation of programs not involving the Lucid language. The work presented here goes in this direction and makes abstraction of the intensional programming aspect of the project and concentrates on the demanddriven evaluation of heterogeneous programs. We concentrate on showing how a virtual network of demand-driven computational nodes can be represented graphically at runtime, enabling the user to map the demand-driven computation nodes over an underlying physical network of computers, and to control their execution and connectivity at runtime.

In the current implementation, the node's connectivity is expressed in a set of configuration files. Upon starting, a node reads its configuration file and establishes its own connection according to the information contained in the configuration file. The configuration can be changed at any time, so that a node can reconfigure its connectivity at run-time.

A manager node, which acts as a supernode, has been implemented to manage a GIPSY network. It enables new node(s) to automatically establish connection with it and receive commands from it. Therefore, enabling the manager node to remotely change the configuration of any registered node. The virtual network is thus constructed from the interconnection of the generators, workers, communication, and manager nodes, the later being able to establish the connectivity between the three first ones. All communication between nodes, including commands exchanged for configuration changes, are using the same demand-driven communication mode.

The rest of this paper is organized as follows: Section 2 gives on overview of the GIPSY Framework and its multi-tier architecture, the GIPSY run-time system and finally discusses the related work. Section 3 summarizes the objectives of this work. Section 4 presents how currently the GIPSY run-time system is being managed, discusses the design and implementation of the proposed solution and evaluates the results of some conducted experiments. Then, Section 5 concludes the paper and points out new research direction planned as future work.

2 Background

2.1 GIPSY Framework

The GIPSY run-time system is a distributed multi-tier and demand-driven framework. It mainly consists of a set of loosely coupled software components enabling the evaluation of programs in a distributed demand-driven manner. The run-time system is composed of the following basic entities [17]: (a) A GIPSY tier is an abstract and generic entity. Each tier instance is a separate thread (one or more) that runs within a registered process, namely (GIPSY node), and represents a computational unit that contribute to the distributed computation. Tiers cooperate in a demand-driven mode of computation; (b) A GIPSY node is a registered process that hosts one or more GIPSY tier instances belonging to different GIPSY instance(s). Node registration is done through a manager tier called the GIPSY Manager Tier (GMT). More specifically, a node is a computer running a *GIPSYNode* process; (c) A **GIPSY instance** is a group of tier instances collaborating together to achieve program execution. It can be considered as a set of interconnected GIPSY tier instances hosted/deployed on one or more GIPSY nodes executing GIPSY programs by sharing their respective resources. A GIPSY instance can be executed across different GIPSY nodes. Moreover, as shown in Figure 1, a GIPSY network is designed as an overlay network where network nodes, GIPSY tiers, are organized in a cluster called GIPSY instance. A GIPSY tier can be seen as a virtual network node and hosted on a GIPSY node. In such a network, the mapping between a GIPSY node and a physical node is made upon starting and registering the node through the GMT.

2.1.1 Multi-Tier Architecture

In [17], a distributed multi-tier architecture has been defined and adopted in the implementation of GIPSY run-time system. The architecture inherits some of the peer-to-peer network architecture principles, e.g. (1) no single-point of failure: any tier or node can fail without fatally affecting the system; (2) nodes and tiers can seamlessly join/leave the network by adding/removing them on the fly as computation is happening; (3) demands are propagated without knowing where they will be processed or stored; (4) available nodes and tiers can be affected at run-time to the execution of any GIPSY program while other nodes and tiers could be computing demands for different programs. The multi-tier architecture is composed of four distinct tiers: (a) a Demand Store Tier (DST) that acts as a middleware between tiers in order to migrate demands, provides persistent storage of demands and their resulting values (demands caching), and exposes Transport Agents (TAs) used by other tiers to connect to the DST; (b) a Demand Generator Tier (DGT) that generates demands according to the declarations and resources stored in the GEER generated for the program being evaluated. The DGT maintains a local demand processing dictionary pool that contain the definitions required to formulate demands; (c) a Demand Worker Tier (DWT) which processes demands by executing method defined in such a dictionary. The DWT connects to the DST, retrieves pending demands and returns back the computed demands to the DST; (d) a General Manager Tier (GMT) (see Figure 1), as its name implies, locally and remotely controls and monitors other tiers (DGT, DWT and DST) by exchanging system demands. Furthermore, the GMT can register new nodes, move tier instances from one node to another, or allocate/deallocate tier instance from/on a registered node.

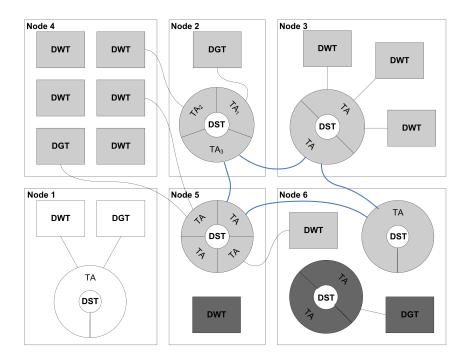


Figure 1: Example of a GIPSY Nodes Network [17]

2.1.2 Demand Types and States

A demand is a run-time request asking for a value of certain identifier defined in a GIPSY program. Demands are migrated to other tiers using the DST. There are three types of demands: (a) intensional demands, which are generated for the evaluation of a GIPSY program by a generator. GIPSY programs are written in a declarative style, where an identifier is defined as an expression using other identifiers defined in a multidimensional context space [17]. All demands for GIPSY identifiers contain the context in which they are made, and their evaluation depend on this context. The GIPSY program also uses an algebra of procedures that can be called during evaluation, which are called at runtime and become procedural demands; (b) procedural demands which are generated by the DGT when it encounters a procedural function call during the GIPSY program evaluation. Procedural demands are processed by the DWT; (c) system demands, in turn, are issued by the GMT for run-time management purposes and include demands for monitoring and controlling tiers at run-time. It is worth mentioning that system demands are requests for managerial tasks e.g. demand for node registration, tier allocation and deallocation. In contrast, intensional demands and procedural demands are computational demands, i.e. demands that are generated during the evaluation process of a specific GIPSY program.

In the GIPSY environment, each demand has a state and demand states are used to manage and propagate demands. The state transitions are managed by the demand store tier DST, who is responsible for demand migration between generator and worker tiers. We distinguish three possible states as follows: (a) **Pending:** a pending demand is a demand that has been issued by a tier to the demand store and not yet picked by another tier for further processing. Pending demands are sent to generators and workers when they notify their availability for processing [17]; (b) **Processing:** a processing demand is a demand that has been grabbed by a tier from the demand store and its evaluation still being processed. This state is assigned by the demand store in order to make sure that the same demand is grabbed by only one tier for processing. When a tier goes out of service, all its associated processing demands are put back to the pending state by the demand store, ensuring a fail-safe behavior [17]; (c) **Computed:** indicates that a demand has been computed. When a tier grabs a demand and is finished computing its corresponding value, it sends back the result to the demand store, that stores it in place of the initial demand and marks it as computed. Any further demands generation with the same context will result in the store to directly respond with the resulting value, thus saving computation time [17].

2.2 Graphical GMT Tool Support for the GIPSY Run-time System

Here we provide some details how the graph-based tool we developed assists with the automation of the startup sequence and management tasks of the system.

Configuration. The tier instantiation process has a flexible design and has been implemented using Java Reflection [5] and the Factory design pattern [4]. It uses a configurationbased system to instantiate tiers on the fly. Generic configuration instances are stored in files and their settings can be easily updated and tailored to a specific tier's implementation requirements. Configurations contain a set of key-value pairs where the key denotes the name of the configuration property while the values could be anything from a service name, port number, IP address, etc. Such a configuration system eliminates the need of writing or adapting source code to reflect a specific tier configuration. The properties stored in the **Configuration** object determine the tier class to instantiate and consist of different settings interpreted by the tier implementation class. Upon receiving a tier instantiation request, the **TierFactory** inspects the configuration instance to determine which tier implementation class to instantiate using Java Reflection [5].

Bootstrapping. as mentioned earlier, a GIPSY network consists of a set of interconnected GIPSY nodes each hosting GIPSY tiers mapped to physical machines where the GIPSY run-time is deployed. Such a network is managed by a GIPSY manager tier (GMT) that enables nodes registration to the network and tier allocation on the registered nodes. The bootstrap process of the GIPSY manager tier starts a registration demand store that is used solely for the exchange of system demands with the nodes and tiers allocated in the GIPSY network managed by this manager tier. Thus, system demands and computational demands are exchanged using different communication channels. Any computer deploying the GIPSY node run-time system can send a registration request to the manager tier, enabling this manager tier to remotely connect and control the allocation of various tiers on the registered nodes. After tiers are allocated to the registered nodes, the manager tier can connect the different tiers together, and eventually instruct a generator to start the demand-driven evaluation of a GIPSY program. Even after execution is started, the manager tier can accept new nodes registrations, or allocate/deallocate new tiers on any registered node that it manages and make newly allocated tiers to contribute to a program's evaluation on the fly [8, 7].

GIPSY Node Registration. When a node wants to join the network, first, a GIPSY node issues a request to the GMT expressed as NodeRegistration system demand having *pending* as state. Upon receiving a NodeRegistration demand, the GMT assigns a DST to the GIPSY node who issued the request. Afterward, the GMT saves the node registration information in a GMTInfoKeeper object and sends back a RegistrationResult demand having *computed* as state and containing the DST information and the assigned node ID. Finally, the GIPSY node processes the result and uses the information contained in the demand to establish a connection to the assigned DST. Establishing such connection creates a communication channel for further exchange of system demands.

Tier Allocation. Tiers are allocated inside a previously registered GIPSY node. The process of tier allocation is performed through the operation of the GMT using a pair of system demands: **TierAllocationRequest** and **TierAllocationResult**. Both demands share the same demand signature but have different states: *pending* and *computed* respectively. The following information needs to be specified in the **TierAllocationRequest** demand: the node identifier of the GIPSY node where the tiers to be allocated, the type of the tier and how many tier instances are to be allocated. When the allocation process is completed a **TierAllocationResult** demand is triggered and contains a set of tier registrations. Each tier registration contains information such as the tier identifier, which is internally assigned by the GIPSY node.

Tier Deallocation. Tier deallocation consists of removing previously allocated tiers. Similarly to the case of the tier allocation process, two system demands

TierDeallocationRequest and TierDeallocationResult are issued by the GMT to deallocate tiers upon user's request. The type and the ID of the tier to be deallocated are embedded in a TierDeallocationRequest and sent to the GIPSYNode process to deallocate the tier specified.

2.3 Related Work

Related work by several researchers on visualization of load balancing, configuration, formal systems for diagrammatic modeling and visual languages and the corresponding graph systems are presented in [20, 19, 1, 2, 10]. They all define key concepts that are relevant to our visualization mechanisms within GIPSY and its corresponding General Manager Tier [7].

3 Objectives

The GIPSY framework has been designed in a modular manner but has a lot of configurable components; hence, the need of an automation solution for configuring and managing GIPSY deployment components is crucial. Moreover, prior to this work, the run-time system was managed using primarily a command-line interface. The project should provide an integrated tool that allows the user to: create a GIPSY network and configure its components (GIPSY instances, tiers and nodes); save/load a GIPSY network configuration; start/stop GIPSY nodes and register them with the GMT, and allocate/deallocate GIPSY tiers; dynamically visualize GIPSY nodes and tiers and inspect/change their properties at run-time; change tiers connectivity at run-time; increase the usability of GIPSY run-time system as a whole; provide means and semantics for scheduling, validation, and visual mapping to Lucid programs. The GMT is the central element of our system from the user's perspective. It enables to handle the managerial tasks related to the configuration and functioning of a GIPSY network. The proposed solution should be transparent and efficient enough in order to enhance the system usability, flexibility, and end-users experience, while maintaining the structure for run-time analysis and scheduling.

4 Solution

4.1 Overview

The solution presented in this paper is a graph-based graphical user interface that provides a set of user interfaces enabling the users to directly interact with the distributed GIPSY run-time system. The main objectives (cf. Section 3) of this work consist of increasing the usability of the run-time system and enabling the user to have full control over the GIPSY network with a minimum of detailed manual intervention. It should be noted that, prior to this work, all the managerial and configuration tasks needed to bootstrap a GIPSY network required the user to manually execute shear number of commands and scripts. In this work, we designed the graphical GMT component that aims at allowing the user to manage and operate the entire GIPSY network seamlessly by translating simple graphical user interactions into complex message passing between the underlying deployment components. Our solution enables the user to easily create, configure, and control a GIPSY network through a graph-based interface. GIPSY tiers are illustrated as connected graph nodes. Tiers' properties are read from files and stored as Configuration objects embedded in the graph nodes. We use graph element shapes to differentiate GIPSY instances and colors to differentiate GIPSY nodes. When the user adds a new tier to the network graph, the color assigned to the tier is associated to the node the tier is assigned to.

According to the GIPSY multi-tier architecture, the DWT, DGT and DST expose software interfaces to be used for their mutual interactions. Since the GMT plays a key role in the GIPSY network management, it provides a handy mechanism for starting and stopping nodes, and allocating and deallocating tiers. In the current run-time implementation, the interaction with the GMT is command-based and is done through a command-line console UI, with which the user manually bootstraps and controls the nodes and tiers by entering commands the corresponding. Additionally, a set of configuration files with the appropriate settings and properties for each tier type are needed. Before performing any node or tier startup or registration, we assume that a set of configuration files with appropriate settings and properties for nodes each tier type have been created. Typically, in order to start a network, the following sequence of steps should normally be performed: 1. At first, a GIPSY node process should be created; that prompts the user to start a GMT tier. When a GMT is started, the GIPSY node is automatically registered and a registration DST is allocated [7]. The registration DST enables the GMT to receive system demands for further node and tier allocations. This is the initial bootstrapping process that enables all further operations on a GIPSY network. 2. At any time the user can expand the network by adding an additional node locally on the computer where the GMT is executing (and tiers on a remote computer). Upon successful node creation, the user is prompted to register the node to an existing GMT using the register command. 3. Then, on any registered node, DSTs are started to allow the propagation of demands between generators and workers, DGTs are registered to generate demands, and DWTs are registered to process the generated demands.

Based on this discussion, the following is a typical list of example commands that are used to interact with the run-time system in order to setup a manual GIPSY network:

1. start GMT GMTConfigFile.config

This command starts the bootstrap process explained above, where GMT is the type of the tier and GMTConfigFile.config is the configuration file that contains the settings and properties needed to instantiate a GMT tier instance.

2. allocate NodeID TierType TierTypeConfigFile DSTIndex HowMany

This command allocates a DGT or a DWT. *NodeID* is the numeric ID of the node where the tier should be allocated, *TierType* is the type of the tier ([DGT, DWT]), *DSTIndex* is the index of the DST, to which the tier in question should connect to and the *TierTypeConfigFile* is the tier-specific configuration file to use.

3. allocate NodeID DST DSTConfigFile.config HowMany

This command sends a request to the GMT with the node ID where a DST instance will be allocated, how many DST instances are needed, and a DST configuration file name.

4. deallocate NodeID TierType TierID1 TierID2 TierID*n*

This command issues a demand to be processed by the GMT to deallocate tiers. TierType is the type of the tierID[1..n] is tier instances IDs to deallocate in a node specified by its ID.

The GIPSY network configuration process requires the user not only to know all the commands and their exact syntax, but requires to keep track of the IDs of the nodes and tiers. It also requires the user to manually edit the related configuration files. The configuration files contain many configuration elements that are not of importance in the node/tier management process, thus leading to confusion and possible mistakes. Our

newly designed graphical GMT assistant rather allows the user to abstractly manipulate icons and use menu options to effectuate these operations. These GUI operations initiated by the user are then translated by the graphical GMT into the commands similar to the presented earlier. As for the changes to the configuration files, the user is presented through the GUI with only the configuration elements that are relevant in the context of use, thus reducing the information load on the user and reducing the possibility of configuration mistakes. Listing 1 shows the content of a configuration file for a DGT [7]. It provides configuration information such as to which class implementation to instantiate, the number of instances to be created, the mode of communication to use, and a maximum number of demands that can be generated. These configuration parameters are read during startup and will determine the behavior of the generator.

```
# Which implementation of the DGT class to instantiate.
gipsy.GEE.multitier.wrapper.impl=gipsy.tests.GEE.simulator.DGTSimulator
gipsy.GEE.multitier.DGT.DemandDispatcher.impl=gipsy.GEE.IDP.DemandGenerator.jini.rmi.
JiniDemandDispatcher
# 0 Concurrent asynchronously
# 1 User-controlled asynchronously
# 2 Response time tester: synchronously
# 3 Space-scalability tester.
gipsy.tests.GEE.simulator.mode=2
gipsy.tests.GEE.simulator.tester.parameter=1
# Number of instances to be created.
gipsy.tests.GEE.simulator.tester.number=2
# Number of maximum demands.
gipsy.tests.GEE.simulator.demand.payload=32
```

Listing 1: A Sample of DGT Configuration File

4.2 Design and Implementation

Our implementation relies on the graph-based visualization to illustrate a GIPSY network. We represent a GIPSY tiers network as interconnected graph nodes where each such node contains data/properties used in tier-to-tier communication configuration. Such properties are assigned and configured by the user when creating a GIPSY network. The GMT GUI was implemented using the Java JFC/Swing library. The GIPSY's Configuration class is used to store different components' configuration. We have selected the Java Universal Network/Graph (JUNG) library to implement the visualization of the management aspect of GIPSY nodes [9, 15]. JUNG is an open-source library for modeling data that can be represented as a graph or a network. JUNG provides many visualization features that can be changed at runtime such as node color, shape, and size. Thus, graph nodes can be grouped together, which enables us to differentiate the nodes by their tier type (DST, GMT, or DWT). Through JUNG, GIPSY nodes are configured while creating a connected graph of nodes and to visualize and manage their activities to alleviate manual complexity of such operations. The GMT GUI addresses the need of the automation of the managerial tasks of the GIPSY run-time system and the configuration of resources.

The implemented features are: 1. create a new GIPSY network as a graph; 2. save/load a pre-configured GIPSY network to/from files; 3. start, register and stop GIPSY nodes by

maintaining a color-differentiated list of nodes with their related commands and configurations available in a context menu; 4. allocate and deallocate DSTs, DGTs and DWTs by manipulating icons and context menus; 5. start/stop the demand-driven evaluation process on a DGT trough a contextual menu accessed on its icon.

The process of node registration and tier allocation has been embedded into our tool, and only the most relevant configuration information is shown to the user. Graphical objects representing GIPSY nodes encapsulate their related commands and hold the necessary properties for user inspection or change at setup or run-time. As for GIPSY tier graphical objects, in addition to allocate and deallocate commands, these objects provide a drag-and-drop mechanism used to change the connectivity between tiers on the fly at run-time (see Figure 2(a)). When a new tier or a GIPSY node is added to the network, it is automatically pre-configured and associated with a configuration file with the properties entered by the user (see Figure 2(b)). The GMT GUI is arranged in a tabbed form and provides two main distinct editor and operator views.

The network graph editor and resource configuration allow to create a GIPSY network or load an existing one. As shown in Figure 2(b), GIPSY instances and nodes are arranged in two lists while GIPSY tiers in a graph illustrating interconnected tiers. Instances, nodes and tiers can be easily added and configured separately. The configuration process is completely automated using dialog boxes allowing the user to fill in the configuration properties of each entity. All data entered is validated allowing only valid values to be accepted. In this editor, two GIPSY tiers could be connected together and their configuration commands automatically generated by drawing a line to connect two graph nodes.

The GMT operator lists context-menu-enabled GIPSY nodes allowing the user to start or stop GIPSY nodes and register them with the GMT by simple mouse clicks. As illustrated in Figure 2(a), GIPSY tiers are shown as connected graph nodes. Tiers belonging to the same GIPSY instance are assigned the same shape. The tier's color determines on which GIPSY node a given tier is hosted on. Moreover, inspection and visualization of any element's properties is possible at run-time. This enables the user, for instance, to know which GIPSY tier is residing on which GIPSY node. The run-time system activities such as the output of GMT, GIPSY nodes and GIPSY tiers, errors, and log messages are displayed in a separate distinct views. This provides better failure traceability and errors troubleshooting while, at the same time, providing useful information related to the overall computation process.

In Figure 3(a) is a set of JUNG-interfaced classes we produced to integrate with and visually represent, load, save, and manage GIPSY networks while in Figure 3(b) we detail the data structures used to internally represent the network graphs and map them to the GIPSY objects and the action items associated with them. NodeConnection is a semantically central data structure that links graph elements representing GIPSY tiers (the instances of GIPSYTier classes). These connections and tier properties are the actual representation of the graphs that are saved to and loader from a name:value paired configuration files (e.g. see Appendix B) by GraphDataManager. A collection of NodeConnections is managed by the GraphViewer, and both NodeConnection and GIPSYTier have action items attached to them that send the aforementioned GIPSY commands to actually do the work via the visual NodeMenu and TierMenu. Every tier has

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Node Name: NODE_2 Node ID: 1	NODE 2
IP Address: 132.205.8.229	
Instance info:	
Instance Name: INSTANCE_2 Instance ID: INSTANCE_2	
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[GIPSYGMTOperator] Starting node: NODE_1	Openning : bin/multitier/DSTProfiles/GMT.config
[JiniDSTWrapper] Allocating new Jini DST	<pre>c Openning i bin/multiter/DBTPofiles/UMT.config Openning i bin/multiter/DBTPofiles/UMT.config</pre>
[JiniDSTWrapper] Jini DST started, PID = 6424 [GIPSYNode] Node started!	Openning : bin/militier/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolites/birrolite
[GIPSYNode] Waiting for a new system demand	Openning : bin/multitier/DSTProfiles/DMT.config
	Openning : bin/multiter/DSTProfiles/DGT.config

(a) GMT Operator View

(b) Network Graph Editor View

Figure 2: GMT Operator and Network Graph Editor Views

a color and shape (VertexColorTransformer, VertexShapeSizeAspect) attached to it based on the GIPSYNode they belong to, so it is easier to differentiate and visualize the computing resource allocations. When each graph is loaded, mapping is made, and colors determined, the data structures are handed over to JUNG to do the visual layout.

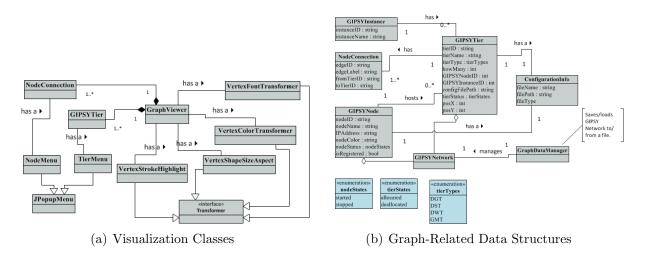


Figure 3: UML Class Diagrams of the Graph-Related Design Aspects

4.3 Results and Discussion

The results are encouraging since they demonstrate the ability of the proposed solution to assist in automation of some management functions GIPSY run-time system. We have first tested with the simulator [18, 7] which allows to generate different types of demands to be computed. We have then performed some usability testing with another tool, that was recently adapted to be distributively executed over GIPSY – MARFCAT. It is one of the realistic long-running distributed pattern recognition computation processes test cases (e.g. MARF's pattern recognition pipeline [11] with very large data sets over GIPSY for the static code analysis application for vulnerabilities and weaknesses detection and malware classification [12, 14]. MARFCAT was made to run completely over GIPSY separating the heavy and light work logic across the generator and worker tiers. The tool properly starts up all the indicated components, the network of which were created and the configurations loaded, begins the computation, logs the output to the console, and while computation proceeds, the tier state is properly reflected visually.

While us we were the only users of the proposed PoC tool thus far, by making it public and released along with the GIPSY system and via the demonstration of the tool on the GIPSY simulator and MARFCAT, we hope to gather larger feedback on the tool to improve its usability further while weeding out known bugs.

In Appendix A we summarize a complete demo procedure/manual for a creation of a specific application to run over the GIPSY network for demonstration purposes.

Platforms Tested. We tested the tool in various operating system platforms to ensure the portability is maintained: Windows XP SP3 32-bit, Windows 7 32-bit and 64-bit; Scientific Linux 6.2 32-bit and 64-bit, and Ubuntu Linux 11.03 32-bit under VMware; MacOS X 10.5 32-bit and 64-bit; Oracle JDK 6 and 7; OpenJDK 6; Apple JDK 6.

Implications. The implications of this work are multifold. First, the usability and management aspects of the multi-tier GIPSY network are of obvious mention. Additionally, having the network represented and managed as a graph allows for further reasoning and automatic scheduling [6] and load-balancing of such a network through the graph analysis. Thirdly, since Lucid is a data-flow language and was shown to have one-to-one correspondence with the data-flow graphs (DFGs) [16, 3, 13], the tool opens up more possibilities for diagrammatic programming and program-graph-execution-network translation model for detailed analysis and verification of Lucid-based programs with the added visualization benefit.

5 Conclusion and Future Work

We have presented a graph-based GUI implementation for the simplification of the management of the GIPSY run-time system components. The presented tool is proving to be an effective solution assisting with management automation of GIPSY software artifacts distributed across multiple physical machines forming an overlay network. Our solution relies on graph-based programming and visualization to represent a GIPSY network. Each graph node represents a GIPSY tier and is pre-configured and loaded with the information needed at run-time. A GIPSY network can be created, configured and saved to a file. The user can establish a connection between pairs of GIPSY tiers by drawing a line to connect two graph nodes. A GIPSY network can be easily bootstrapped and managed on the fly. Many demand generators and workers can be allocated as computation is happening. While aiming at increasing the usability of the run-time system, our solution allows the user to seamlessly inspect the status and properties of GIPSY nodes and GIPSY tiers at run-time.

The work presented in this paper is to be extended, thus, additional features and improvements are planned. Future work includes a better semantic definitions of the graph manipulation actions, so that any operation on a graph can be translated more easily into the underlying system's commands and be verifiable. We plan to add observers to any graph element, enabling for example to click on a graph link to observe the demands flowing across this link at run-time. Among the planned future works is the continual extension of the current design to support more problem-specific tiers like MARFCAT, e.g. genome sequence alignment, and similar computation problems that need a lot of manual pre-setup to run. We further plan to allow intra-tool (peer) communication to further allow start up nodes on remote computers and not only tiers. Additionally, expose an OpenGL-to-Java remote interface to allow connecting to the tool from any OpenGLenabled systems remotely, including mobile devices based on iOS and Android.

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References

- [1] Gerard Allwein and Jon Barwise, editors. *Logical reasoning with diagrams*. Oxford University Press, Inc., New York, NY, USA, 1996.
- [2] R. Bardohl, M. Minas, G. Taentzer, and A. Schürr. Application of graph transformation to visual languages. In *Handbook of Graph Grammars and Computing by Graph Transformation: Applications, Languages, and Tools*, volume 2, pages 105–180. World Scientific Publishing Co., Inc., River Edge, NJ, USA, 1999.
- [3] Yimin Ding. Automated translation between graphical and textual representations of intensional programs in the GIPSY. Master's thesis, Department of Computer Science and Software Engineering, Concordia University, Montreal, Canada, June 2004. http://newton.cs.concordia.ca/~paquet/filetransfer/publications/theses/DingYiminMSc2004.pdf.
- [4] Eric Freeman, Elisabeth Freeman, Kathy Sierra, and Bert Bates. Head First Design Patterns. O'Reilly, first edition, October 2004. http://www.oreilly. com/catalog/hfdesignpat/toc.pdf, http://www.oreilly.com/catalog/hfdesignpat/ chapter/index.html.
- [5] Dale Green. Trail: Java reflection API. [online], 2001-2012. http://docs.oracle.com/ javase/tutorial/reflect/index.html.
- [6] Khaled M. Ben Hamed. Multidimensional Programs on Distributed Parallel Computers: Analysis and Implementation. PhD thesis, Computer Science, the University of New Brunswick, February 2008.

- [7] Yi Ji. Scalability evaluation of the GIPSY runtime system. Master's thesis, Department of Computer Science and Software Engineering, Concordia University, Montreal, Canada, March 2011.
- [8] Yi Ji, Serguei A. Mokhov, and Joey Paquet. Unifying and refactoring DMF to support concurrent Jini and JMS DMS in GIPSY. In Bipin C. Desai, Sudhir P. Mudur, and Emil I. Vassev, editors, *Proceedings of the Fifth International C* Conference on Computer Science* and Software Engineering (C3S2E'12), pages 36–44, New York, NY, USA, June 2010–2012. ACM. Online e-print http://arxiv.org/abs/1012.2860.
- [9] JUNG Project. Java Universal Network/Graph Framework. [online], 2003-2012. http: //jung.sourceforge.net/, last viewed January 2012.
- [10] N. G. Miller. A Diagrammatic Formal System for Euclidean Geometry. PhD thesis, Cornell University, U.S.A, 2001.
- [11] Serguei A. Mokhov. Study of best algorithm combinations for speech processing tasks in machine learning using median vs. mean clusters in MARF. In Bipin C. Desai, editor, *Proceedings of C3S2E'08*, pages 29–43, Montreal, Quebec, Canada, May 2008. ACM.
- [12] Serguei A. Mokhov. The use of machine learning with signal- and NLP processing of source code to fingerprint, detect, and classify vulnerabilities and weaknesses with MARFCAT. [online], October 2010. Online at http://arxiv.org/abs/1010.2511.
- [13] Serguei A. Mokhov, Joey Paquet, and Mourad Debbabi. On the need for data flow graph visualization of Forensic Lucid programs and forensic evidence, and their evaluation by GIPSY. In Proceedings of the Ninth Annual International Conference on Privacy, Security and Trust (PST), 2011, pages 120–123. IEEE Computer Society, July 2011. Short paper; full version online at http://arxiv.org/abs/1009.5423.
- [14] Serguei A. Mokhov, Joey Paquet, Mourad Debbabi, and Yankui Sun. MARFCAT: Transitioning to binary and larger data sets of SATE IV. [online], May 2012. Being finalized for NIST publication; online at http://arxiv.org/abs/1207.3718.
- [15] J. O'Madadhain et al. The JUNG (Java Universal Network/Graph) framework. Technical Report UCIICS-03-17, School of Information and Computer Science, University of California, Irvine, 2003.
- [16] Joey Paquet. Scientific Intensional Programming. PhD thesis, Department of Computer Science, Laval University, Sainte-Foy, Canada, 1999.
- [17] Joey Paquet. Distributed eductive execution of hybrid intensional programs. In Proceedings of the 33rd Annual IEEE International Computer Software and Applications Conference (COMPSAC'09), pages 218–224, Seattle, Washington, USA, July 2009. IEEE Computer Society.
- [18] Amir Hossein Pourteymour, Emil Vassev, and Joey Paquet. Towards a new demand-driven message-oriented middleware in GIPSY. In *Proceedings of PDPTA 2007*, pages 91–97, Las Vegas, USA, June 2007. PDPTA, CSREA Press.
- [19] Phan C. Vinh and Jonathan P. Bowen. On the visual representation of configuration in reconfigurable computing. *Electron. Notes Theor. Comput. Sci.*, 109:3–15, 2004.
- [20] Chunfang Zheng and J. Robert Heath. Simulation and visualization of resource allocation, control, and load balancing procedures for a multiprocessor architecture. In MS'06: Proceedings of the 17th IASTED international conference on Modelling and simulation, pages 382–387, Anaheim, CA, USA, 2006. ACTA Press.

A Mini Demo User Manual / "Demo Paper"

In this section we give a brief overview on how to use the graphical PoC tool to create and manage a GIPSY network. We explain how to create and configure a network, how the network is saved/loaded to/from a file, and finally, how the network is being managed in the GMT Operator view.

This section is intended for the demonstration of the tool at the conference with a mini-user manual instructions and operational description. We will show how to create and start a complete GIPSY network for the specific MARFCAT application and perform a complete run of it. We will release the PoC tools, the application, and the source code for the audience and community at large as well.

A.1 Using the Graph editor

The graph editor is used to create a new GIPSY network or to edit an existing one.

I. Creating/Editing a GIPSY instance

Figure 4(a) and Figure 4(b) show how to create a GIPSY instance and edit its information. By clicking on the add button, the user enters a name for the new GIPSY instance to create and clicks save. Double-clicking on an instance in the list of instances allows to edit the instance name in an appropriate dialog.

II. Creating/Editing a GIPSY Node

To create a new GIPSY node, click on the "Add" button Figure 4(c), which pops up a dialog to fill in the new node's properties such as the node name, IP address and color, see Figure 5(a). Upon clicking "Save", the new node will be added to the list as shown in Figure 5(b). To edit an existing node's properties, double-click on an item in the node list and a editing dialog will pop up Figure 5(c).

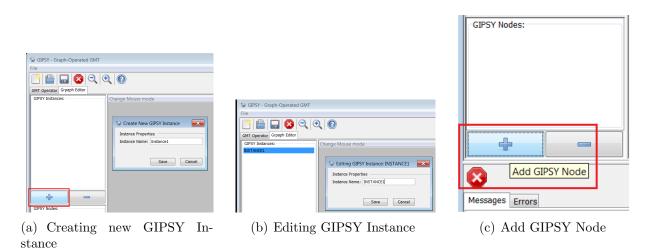


Figure 4: Adding a GIPSY Instance and a GIPSY Node

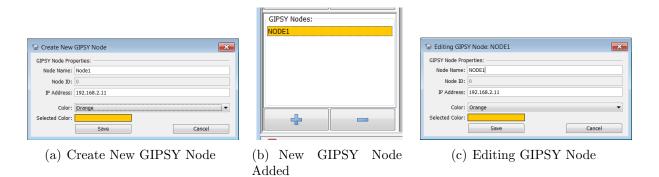


Figure 5: Creating and Editing a GIPSY Node

III. Creating/Editing a GIPSY tier

While editing, a GIPSY tier is represented as a red graph node. To create a GIPSY tier, the user must double-click on the highlighted area as shown in Figure 6(a). Then, the tier properties such as the tier name, how many instances to create, GIPSY instance to which the tier belongs to, GIPSY node on which the tier will be allocated, and finally a configuration file should be specified, cf. Figure 6. To edit a given tier's properties, right-click on a graph node and select "Edit Tier Properties", see Figure 7(b).

GIPSY - Graph-Operated GMT	🛓 Create New Tier
	Tier Properties
GMT Operator Grpsph Editor GPSY Instances: Change Mouse mode	Tier Name: Tier1
PISTAIKCEL	How many: 1
	Instance: INSTANCE1
E	Node: NODE1 -
	Tier type: DST 🔹
	Config File: jipsy\bin\multitier\DSTProfiles\p9.config
4 -	Is GMT:
C/97 Node:	Save Cancel

- (a) Creating a GIPSY Tier
- (b) Fill In Tier Configuration Properties

Figure 6: Creating and Configuring a GIPSY Tier

A.2 Saving/Loading a graph

To save/load a network to/form a file, use the save/load buttons located in the toolbar, Figure 8(a) and Figure 8.

Change Mouse mode	🛓 Editing Tier: TIER2
Delete Tier: TIER2 Edit Tier Properties	Tier Properties Tier Name: TIER2 How many: 1 Instance: INSTANCE1 Node: NODE1 Tier type: DWT Config File: psylbin\multitler\DSTProfiles\p10.config Is GMT: Save Cancel

(a) Right Click to Edit Tier Properties

(b) Edit Tier Properties

Figure 7: Editing Tier Properties

A.3 Using the GMT Operator

This feature is implemented in the "GMT Operator" tab and enabled upon loading a valid saved network graph. After loading is complete, the graph nodes (GIPSY Tiers) have the same color as the GIPSY node they belong to. Tiers' shapes, as mentioned early in this paper, indicate what GIPSY Tier belongs to what GIPSY Instance.

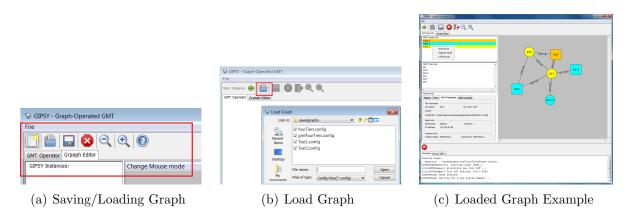


Figure 8: Saving and Loading GIPSY network Graph

I. Starting/Stopping a GIPSY node

To start a GIPSY node, right-click on a item in the nodes list and select "Start Node", Figure 9(a).

After starting the first GIPSY Node, the actions taken are logged in the log console in "Messages" tab.

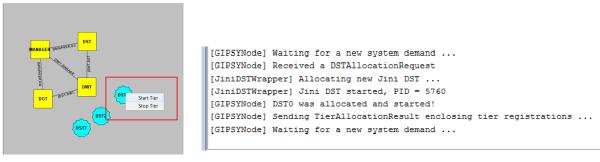
When the GMT is first started, a new tab is added to the log console where its activities are logged, see Figure 9.

GIPSY - Graph-Operated GMT File Start Instance Imm GMT Operator Graph Editor		
GIPS Video List: NODE1 NODE2 Start Node Register Node GIPS Video DWT DGT MAIAGER DST DST1 DST2 DST3 4 +	Messages Errors GMT 1 loading Graph: <u>Openning</u> : savedgraphs/gmtFourTiers.config [GIFSYMROPerator] Starting node: NODEO [JiniDSTWrapper] Allocating new Jini DST [JiniDSTWrapper] Jini DST started, PID = 5772 [GIFSYNode] Node started! [GIFSYNode] Waiting for a new system demand	Messages Errors GMT 1 Node 0 registered! Node 1 registered!
(a) Starting Node	(b) Starting Node Messages	(c) Node Registered

Figure 9: Saving and Loading GIPSY network Graph

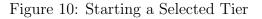
II. Allocation/Deallocating GIPSY tier

To allocate or deallocate a GIPSY Tier, right-click on a graph node and select the appropriate action, Figure 10(a). The messages and action triggered by the allocation/deallocation process are logged and showed in the console tab, Figure 10(b), Figure 11.



(a) Start Tier

(b) Allocation/Startup Console Messages



B Stored Graph Example

In the example below is a concrete on-disk representation of the GIPSY network graph from marfcat4Some.config that can be stored and retrieved and executed instantiating the designed configuration and its connectivity for the MARFCAT test case with the corresponding graph in Figure 12.

#Graph data #Mon Jun 25 23:04:50 EDT 2012



Figure 11: Allocation and Deallocation of a DST

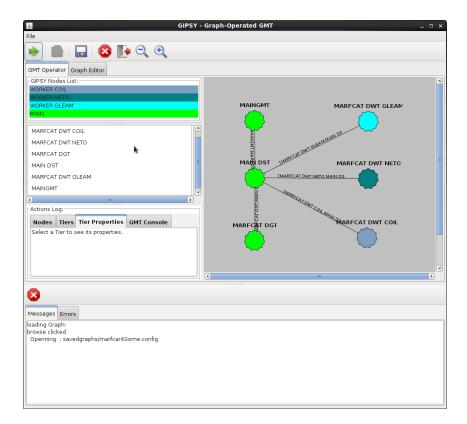


Figure 12: MARFCAT GIPSY network Graph

gipsy.tier.posx.a409cb6b-ad54-41f6-af69-f4ec78628ec6=405 gipsy.tier.isgmt.89e6605e-5c81-4d95-bf51-8e7576c8dcd7=false

- gipsy.tier.ID.1523569d-25aa-44a4-97d5-370b93790333=1523569d-25aa-44a4-97d5-370b93790333 gipsy.tier.posx.89e6605e-5c81-4d95-bf51-8e7576c8dcd7=409
- gipsy.connection.to.7802414d-437f-4382-9162-15d9d8e735c3=77fd90ec-e49e-4977-a55b-0690e2e0cd08
- gipsy.tier.howmany.a409cb6b-ad54-41f6-af69-f4ec78628ec6=1 gipsy.tier.isgmt.c341ab91-161e-419d-a7e4-6206e75ec097=false
- gips.tier.howmany.89e605e=5c81-4495-bf51-8e757c68dc71 gips.tier.node.1523569d-25aa-44a4-97d5-370b93790333=1
- gipsy.tier.posx.c341ab91-161e-419d-a7e4-6206e75ec097=74
- gipsy.ticr.howmany.c341ab91-161e-419d-a764-6206e75ec097=1 connection_key.0dd7156f-3b40-4df7-b9a9-d1b44eeb4da0=0dd7156f-3b40-4df7-b9a9-d1b44eeb4da0 gipsy.node.name.3=WORKER COIL
- gipsy.node.name.2=WORKER NETO
- gipsy.tier.posy.1523569d-25aa-44a4-97d5-370b93790333=55 gipsy.node.name.1=WORKER GLEAM
- gipsy.tier.isgmt.77fd90ec-e49e-4977-a55b-0690e2e0cd08=false
- gipsy.node.name.O=MAIN
- gipsy.tier.posx.77fd90ec-e49e-4977-a55b-0690e2e0cd08=75

gipsy.tier.howmany.77fd90ec-e49e-4977-a55b-0690e2e0cd08=1

gips, tier.node.29310d89-fd7a-498c-8a47-f80d3b5b9865=0 gipsy.connection.id.leeea2b5-ec50-4990-a7fe-be48bb5b693e=1eeea2b5-ec50-4990-a7fe-be48bb5b693e

gipsy.tier.tiertype.a409cb6b-ad54-41f6-af69-f4ec78628ec6=DWT

gipsy.connection.to.0dd7156f-3b40-4df7-b9a9-d1b44eeb4da0=77fd90ec-e49e-4977-a55b-0690e2e0cd08

gipsy.tier.posy.29310d89-fd7a-498c-8a47-f80d3b5b9865=53 gipsy.tier.ID.29310d89-fd7a-498c-8a47-f80d355b9865=29310d89-fd7a-498c-8a47-f80d3b5b9865 gipsy.tier.isgmt.1523569d-25aa-44a4-97d5-370b93790333=false gipsy.connection.id.6a9e123b-c375-4786-9d15-12faeee54c59=6a9e123b-c375-4786-9d15-12faeee54c59 gipsy.tier.posx.1523569d-25aa-44a4-97d5-370b93790333=409 gipsy.tier.instance.a409cb6b-ad54-41f6-af69-f4ec78628ec6=8f5d7614-49e9-4c8a-87fe-c8032a5c9009 gipsy.tier.howmany.1523569d-25aa-44a4-97d5-370b93790333=1 gipsy.connection.name.6a9e123b-c375-4786-9d15-12faeee54c59=[MARFCAT DGT,MAIN DST] gipsy.tier.tiertype.89e6605e-5c81-4d95-bf51-8e7576c8dcd7=DWT arys, tie: tiertype:05e000e0.ed9=497-4350-0607020000=0507 gipsy.tie: tiertype:77f490e-e49-497-435b-0690220cd08=DST gipsy.connection.id.36485580-5acf-4c12-9110-47c60e23ddc9=36485580-5acf-4c12-9110-47c60e23ddc9 gipsy.connection.name.leeea2b5-ec50-4990-a7fe-be48bb5b693e=[MARFCAT_DWT_COIL,MAIN_DST] gipsy.tier.tiertype.c341ab91-161e-419d-a7e4-6206e75ec097=DGT gipsy.tier.isgmt.29310d89-fd7a-498c-8a47-f80d3b5b9865=true gipsy.connection.name.36485580-5acf-4c12-9110-47c60e23ddc9=[MARFCAT DWT NETO,MAIN DST] gipsy.tier.posx.29310489-fd7a-498c-8447-f80d3b5b9865=74 gipsy.tier.instance.89e6605e-5c81-4d95-bf51-8e7576c8dcd7=8f5d7614-49e9-4c8a-87fe-c8032a5c9009 gipsy.connection.from.7802414d-437f-4382-9162-15d9d8e735c3=29310d89-fd7a-498c-8a47-f80d3b5b gipsy.tier.howmany.29310d89-fd7a-498c-8a47-f80d3b5b9865=1 connection_key.6a9e123b-c375-4786-9d15-12faeee54c59=6a9e123b-c375-4786-9d15-12faeee54c59 gipsy.tier.name.a409cb6b-ad54-41f6-af69-f4ec78628ec6=MARFCAT DWT COIL gipsy.tier.tiertype.1523569d-25aa-44a4-97d5-370b93790333=DWT gipsy.tier.configfile.a409cb6b-ad54-41f6-af69-f4ec78628ec6=bin/multitier/DSTProfiles/marfcatDWT.config connection_key.1eeea2b5-ec50-4990-a7fe-be48bb5b693e=1eeea2b5-ec50-4990-a7fe-be48bb5b693e tier_key.a409cb6b-ad54-41f6-af69-f4ec78628ec6=a409cb6b-ad54-41f6-af69-f4ec78628ec6 gipsy.connection.to.6a9e123b-c375-4786-9d15-12faeee54c59=77fd90ec-e49e-4977-a55b-0690e2e0cd08 tier kev.89e6605e-5c81-4d95-bf51-8e7576c8dcd7=89e6605e-5c81-4d95-bf51-8e7576c8dcd7 instance_key.8f5d7614-49e9-4c8a-87fe-c8032a5c9009=8f5d7614-49e9-4c8a-87fe-c8032a5c9009 connection_key.36485580-5acf-4c12-9110-47c60e23ddc9=36485580-5acf-4c12-9110-47c60e23ddc9 gipsy.tier.instance.77fd90ec-e49e-4977-a55b-0690e2e0cd08=8f5d7614-49e9-4c8a-87fe-c8032a5c9009 gipsy.connection.to.leeea2b5-ec50-4990-a7fe-be48bb5b693e=77fd90ec-e49e-4977-a55b-0690e2e0cd08 gipsy.connection.from.0dd7156f-3b40-4df7-b9a9-d1b44eeb4da0=1523569d-25aa-44a4-97d5-370b93790333 tier_key.c341ab91-161e-419d-a7e4-6206e75ec097=c341ab91-161e-419d-a7e4-6206e75ec097 gipsy.tier.instance.1523569d-25aa-44a4-97d5-370b93790333=8f5d7614-49e9-4c8a-87fe-c8032a5c9009 gipsy.connection.to.36485580-5acf-4c12-9110-47c60e23ddc9=77fd90ec-e49e-4977-a55b-0690e2e0cd08 gipsy.node.ipaddress.3=132.205.8.235 gipsy.node.ipaddress.2=132.205.8.235 gipsy.tier.tiertype.29310d89-fd7a-498c-8a47-f80d3b5b9865=GMT gipsy.tier.name.89e6605e-5c81-4d95-bf51-8e7576c8dcd7=MARFCAT DWT NETO gipsy.node.ipaddress.1=132.205.8.235 gipsy.tier.name.77fd90ec-e49e-4977-a55b-0690e2e0cd08=MAIN DST gipsy.node.ipaddress.0=132.205.8.235 gipsy.tier.configfile.89e6605e-5c81-4d95-bf51-8e7576c8dcd7=bin/multitier/DSTProfiles/marfcatDWT.config gipsy.tier.configfile.77fd90ec-e49e-4977-a55b-0690e2e0cd08=bin/multitier/DSTProfiles/p9.config tier_key.77fd90ec-e49e-4977-a55b-0690e2e0cd08=77fd90ec-e49e-4977-a55b-0690e2e0cd08 gipsy.tier.name.c341ab91-161e-419d-a7e4-6206e75ec097=MARFCAT DCT gipsy.instance.name.8f5d7614-49e9-4c8a-87fe-c8032a5c9009=MARFCAT 4SOME node_key.3=3 gipsy.tier.configfile.c341ab91-161e-419d-a7e4-6206e75ec097=/local/data/gipsy/cvscheckout/gipsy/gipsy/bin/multitier/marfcatDGT.config gipsy.node.ID.3= node_key.2=2 gipsy.node.ID.2=2 node_key.1=1 gipsy.instance.ID.8f5d7614-49e9-4c8a-87fe-c8032a5c9009=8f5d7614-49e9-4c8a-87fe-c8032a5c9009 node_key.0=0 gipsy.node.ID.1=1 gipsy.node.ID.0=0 gipsy.node.color.3=Lightblue gipsy.node.color.2=Teal gipsy.node.color.1=Blue gipsy.node.color.0=Green gipsy.tier.name.1523569d-25aa-44a4-97d5-370b93790333=MARFCAT DWT GLEAM tier_key.1523569d-25aa-44a4-97d5-370b93790333=1523569d-25aa-44a4-97d5-370b93790333 gipsy.tier.ID.a409cb6b-ad54-41f6-af69-f4ec78628ec6=a409cb6b-ad54-41f6-af69-f4ec78628ec6 gipsy.tier.instance.29310d89-fd7a-498c-8a47-f80d3b5b9865=8f5d7614-49e9-4c8a-87fe-c8032a5c9009 gipsy.tier.node.a409cb6b-ad54-41f6-af69-f4ec78628ec6=3 gipsy.connection.name.7802414d-437f-4382-9162-15d9d8e735c3=7802414d-437f-4382-9162-15d9d8e735c3 gipsy.connection.name.7802414d-437f-4382-9162-15d9d8e735c3=[MAINGMT,MAIN DST] gipsy.tier.posy.a409cb6b-ad54-41f6-af69-f4ec78628ec6=398 gipsy.tier.node.c341ab91-161e-419d-a7e4-6206e75ec097=0 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