JNetDirect Combine™ Introductory Guide

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The primary purpose of this document, as well as the samples, diagrams, concepts, and all other content provided in this document, is to demonstrate reasonable use of particular features of Combine™. Most samples, diagrams, and other examples provided in this document do not include all of the code and operational scenarios that would normally be found in a full production system, as this document is only focused on concepts and fundamental associated with the basic operation of Combine™ Technical support is not available for the samples demonstrated in this document.

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Key Features of JNetDirect Combine™

Combine™ is the first development, change management, and code deployment tool designed to automate the lifecycle of database projects and provide agile code deployment solutions from Development, to Quality Assurance (QA), and to Production. Combine™ is designed to scale as it allows developers to collaborate and work on DB project releases together, and then deploy the entire database code release by a click of a button on any number of databases and servers in parallel. Combine™ is therefore extremely useful for small, mid-size, and up to very large SQL server environments. Additional features in Combine™ include the ability to run queries and execute scripts on any number of databases and servers in parallel (patent-pending technology). Some of these novel features are highlighted below and are discussed throughout this document (for a complete list of features, please visit our Web site at http://www.jnetdirect.com):

1. Collaborative code development, code packaging, one-click package deployment on all databases and servers - Using Combine™ (much like Visual Studio® for .Net developers), database developers can use source control and change management systems to collaborate and compose project releases together. When done, developers package all SQL scripts, queries, and any other SQL code components for their release into a single code package file. Each script in the package is associated with a group of target databases. The entire code package is then deployed by a click of a button onto any number of databases and servers, as the tool will automatically connect and execute each script on all the appropriate target databases in the group.

2. Easy transfer and agile package deployment between Dev, QA, and Production - Combine™ allows users to map groups of target databases in Development to a corresponding group of target databases in QA and in Production. Each group of target databases is identified by a user-configured name. When developers compose a code package, the name of the desired target database group is assigned to each script. Packages are composed and configured once by the developers. When the code package is ready, developers send the package file to QA. QA engineers can open the package using Combine™, review the content and settings of the package, and deploy the package on the target databases and servers in the QA environment without modifying the package settings. In addition, QA engineers can choose to deploy only parts of the package, or deploy code only on selected databases and servers. The same concept applies when sending packages to Production. Furthermore, deployment results from each environment can be saved into a single file, stored for auditing purposes, or sent back to the developers.

3. Run queries on multiple databases and servers in parallel - Users can run scripts and queries against a group of target databases on any number of servers in parallel, or against a single database. When running queries against multiple databases, Combine™ automatically connects and executes the queries on all target databases. Results returned from all databases are then formatted and displayed together, and can be automatically saved to central database, for monitoring and reporting applications.

4. Easy configuration and maintenance - Combine™ does **not** require a designated repository database. To make best use of the tool, users can configure the groups of target databases in Dev, QA, and Production by using a rich set of built-in configuration options and features. If users already maintain a repository database with information about their databases, the tool can be easily configured to retrieve the group settings by querying the repository (to find out more about the repository database, or to implement such a repository, please mail to JNetDirect support at support@jnetdirect.com). In addition, once a single person configures the target groups, these settings can be exported and imported by other users.

5. With security in mind - Combine is designed to be secure. Developers, QA engineers, and Production DBAs only need to configure the sets of target databases in their own environment. Moreover, users can choose whether to store user-credentials using strong encryption techniques or to require credentials to be entered at each use.

Containers and Environments

Introduction

Containers are used in Combine to deploy SQL code and execute queries against multiple databases in parallel, and retrieve unified results from all queried databases. Containers and Environments are extremely useful for passing SQL code packages between the *Development (Dev)*, *Quality Assurance (QA)*, and *Production* SQL server environments, and easily deploying release packages on any number of databases and servers in those environments. The use of Containers and Environments in the Dev-QA-Production change management and code release process is described below, and continued in the section titled The Dev-QA-Production Release Process.

General Note: Be sure to register all servers that you will be working with in the Object Browser in Combine before defining Containers or executing code in the editor. Combine servers are used throughout the application and hold the connection information for all databases and servers.

Containers

A *Container* is a group of one or more databases, either on the same server or on different servers. Each database in the group is identified by the database name and its SQL server instance name (or IP address). A single database can belong to several Containers. In other words, a database that belongs to one Container can belong to other Containers as well.

Containers allow users to group multiple databases into a single entity so that scripts and queries could be run against all databases in the Container in parallel. Throughout this document, the term *script* is used to denote all types of SQL and T-SQL statements, such as table and user creation statements, stored procedure and SQL job execution commands, queries, or any other data definition or data manipulation statements.

Think of the group of databases in a Container as the set of target databases on which SQL scripts will be executed. To deploy code and scripts on several databases simultaneously, the user is only required to create a Container that consists of all desired target databases, and then execute the script against the Container (see samples and figures below). Combine will then automatically connect to all databases defined in the Container and execute the script on those databases. In addition, if any result sets (e.g., data sets, data tables) are returned from one or more target databases in response to the deployment of the script, Combine will automatically format and aggregate the results returned from all servers, and will then display the unified results to the user.

As an example, consider the following diagram that describes three different Containers: Container1 consists of all user-defined databases on the DevSvr1 and DevSvr2 servers. The

target databases of Container2 are the DBA databases named DBAMaint on the two servers, and Container3 holds the set of Web databases, namely Web1Dev and Web2Dev. With these mappings, the user can now run scripts and queries against several databases in parallel. For instance, if we execute the SQL statement `SELECT * FROM sysindexes` against Container1, then the content of sysindexes will be returned from all six databases in the container. Similarly, running a script that creates a stored procedure against Container3 will create the stored procedure on the Web1Dev and Web2Dev databases at the same time. Additional examples are provided in the images below. By running scripts and queries against Containers, database administrators can easily collect information about indexes, jobs, and all other database objects by a click of a button.

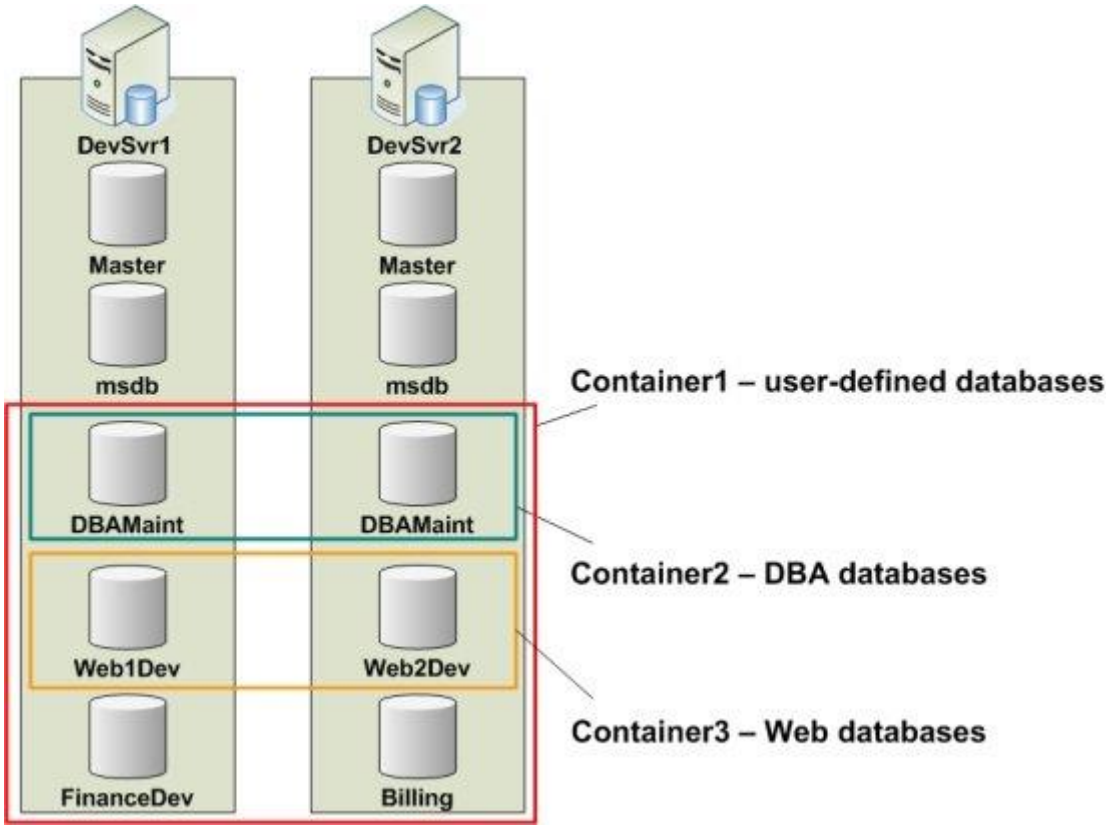


Figure 1: An example of mapping databases to Containers.

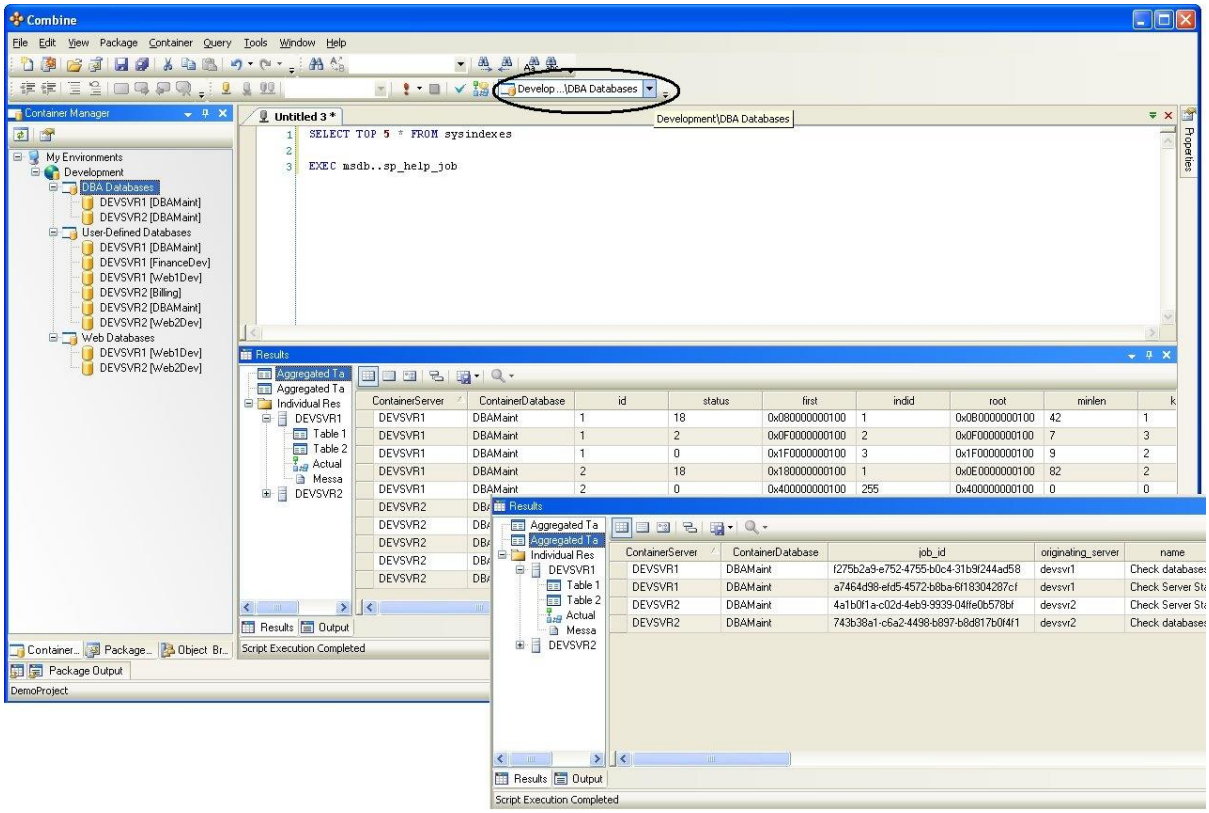


Figure 2: The results displayed by Combine after selecting top 5 rows from sysindexes and running EXEC msdb..sp_help_job against the DBA Databases container.

Static vs. Dynamic Containers

Two types of Containers are supported, *Static Containers* and *Dynamic Containers.* Each type uses a different technique to store and identify the set of target databases.

A Static Container consists of a fixed group of databases. Databases are added to the Static Container by specifying the typical connection information, such as the database name and SQL server name (or IP address). To add or remove databases from the Static Container, the user must open the Container Manager and manually edit the Container configuration.

When scripts and queries are run against a Static Container, Combine will retrieve the identifiers (i.e., database and server names) of the target databases from the Container configuration, and then run the scripts on all those databases using the authentication type and credentials entered for the Container. Static Containers are therefore useful to store

groups of databases that are relatively "static" (i.e., when databases that belong to the group are not created, dropped, or moved between servers frequently). To demonstrate this fact, consider the following counter example where Static Containers should not be used: A Static Container named "MSDB Databases" consists of all msdb databases over all servers in the production environment, and assume that a new instance of SQL server is installed every day. In order to ensure that the "MSDB Databases" Static Container indeed holds all msdb databases, the user must manually add the msdb database to the Container for each new server, daily. This maintenance overhead can be overcome by using Dynamic Containers.

Note: The main advantage of Dynamic Container is that they allow users to share Environment and Container information from a single data repository. Using Dynamic Containers, developers only need to configure the Environments and Containers in their user-interface once, and a single person can maintain the data repository from that point on.

Dynamic Containers assume that a list of servers and databases is already available in some tables. Throughout, we use the term *Repository*, or *Reference*, to denote the database in which the server-to-database mappings reside. When a script is run against a Dynamic Container, Combine first connects to the Reference database and runs a user-provided query that returns the identifiers of all target databases. Then, as in the case of Static Containers, Combine connects and deploys the script on all target databases.

The following steps are required to create a Dynamic Container:

1. Locate the Reference database and table(s) that holds the server and database information.
2. Write a query that returns the database and server names for all target databases.
3. Create a Static Container and add the Reference database to it. The Reference database should be the only database in this Container.
4. Use the Dynamic Container Wizard to create the Dynamic Container. When prompted, associate the Static Container in (3) and the query in (2) with the Dynamic Container.

The example below illustrated the concept of Dynamic Containers. Here, we create a Dynamic Container with five DBAMaint target databases on five different servers, and call this Container "DBA Databases". First, a Reference database is required. Assume that the ServerRepository database on ProdSvr5 has the server-database mappings, and that the data is stored in a table named DBServers (the content of the DBServers table is given in Figure 4).

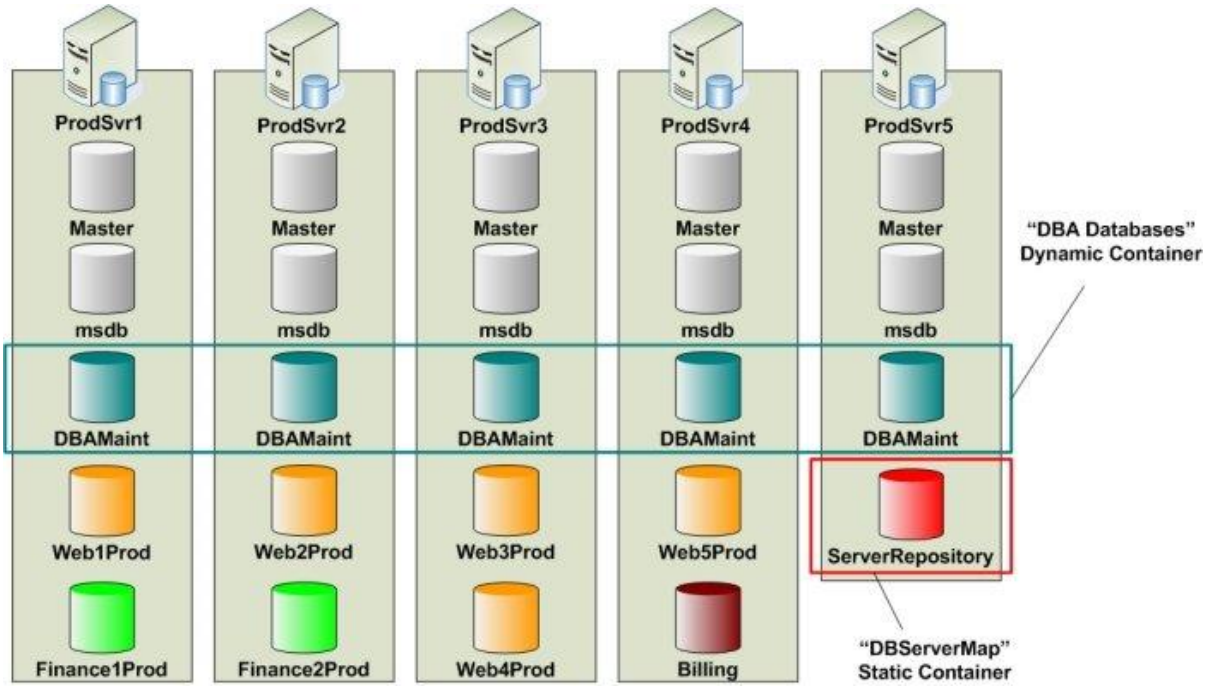


Figure 3: Using the ServerRepository Reference database to build the "DBA Databases" Dynamic Container.

NameOfServer	IPAddress	NameOfDatabase	IsDBA	...
ProdSvr1	192.168.1.21	DBAMaint	1	...
ProdSvr1	192.168.1.21	Web1Prod	0	...
ProdSvr2	192.168.1.22	DBAMaint	1	...
ProdSvr2	192.168.1.22	Web2Prod	0	...
ProdSvr3	192.168.1.23	DBAMaint	1	...
ProdSvr3	192.168.1.23	Web3Prod	0	...
ProdSvr3	192.168.1.23	Web4Prod	0	...
ProdSvr4	192.168.1.24	DBAMaint	1	...
ProdSvr4	192.168.1.24	Web5Prod	0	...
ProdSvr5	192.168.1.25	DBAMaint	1	...
...	...	...	...	...

Figure 4: The server-database mappings in table DBServers on the Reference database.

Now, either one of the following queries (or many other queries) will return the set of DBAMaint target databases:

```
SELECT NameOfServer AS ServerName,
NameOfDatabase AS DatabaseName
FROM DBServers
WHERE IsDBA = 1

SELECT DISTINCT NameOfServer AS ServerName,
'DBAMaint' AS DatabaseName
FROM DBServers
```

Next, we create a Static Container (named DBServerMap in Figure 3) that holds the ServerRepository target database. Finally, we create the Dynamic Container using the Dynamic Container Wizard, and when prompted, assign the DBServerMap Container and the query as part of the Dynamic Container configuration. Once the "DBA Databases" Container is created, every time scripts are run against this Container, Combine performs the steps in Figure 5 to deploy code on all DBAMaint target databases.

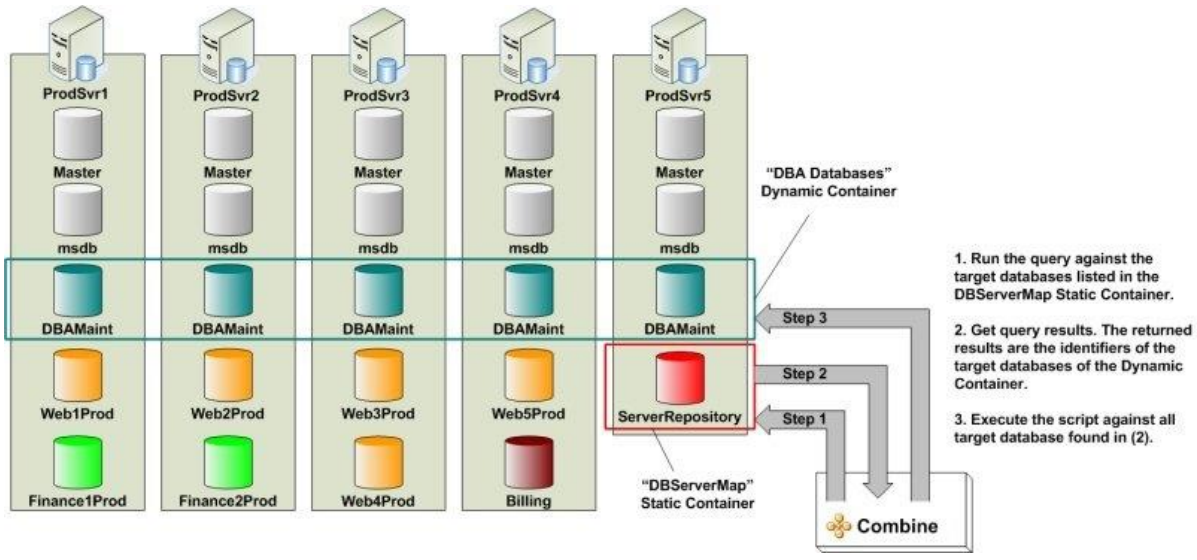


Figure 5: The steps taken by Combine to execute a script against the "DBA Databases" Dynamic Container.

Environments

Each *Environment* consists of any number of Static and Dynamic Containers, with the restriction that Container names in a single Environment must be unique. However, Containers that belong to different Environments can (and in many cases should) have the same name. *Environments* are introduced in Combine to relate groups of databases (i.e., Containers) between separate physical SQL server environments. The primary benefit of Environments is that they allow developers, software testers, and DB administrators to pass SQL scripts and code packages between Development, QA, and Production, respectively, while guaranteeing fast deployment on each environment.

For now, consider three Environments, namely the *Development (Dev) environment*, the *Quality Assurance (QA) environment*, and the *Production environment*. In most companies, databases and servers used by developers to write SQL code are separate from the databases and servers used by software engineers in QA, which are also distinct from the databases and servers in production. By using Combine Environments it is now possible to map groups of databases between these physical environments on the basis of their functionality.

The *Development environment* - Assume that developers write code and test scripts on two SQL servers, namely the DevSvr1 and DevSvr2 servers (see Figure 6). The DevSvr1 server contains the FinanceDev, Web1Dev, and DBAMaint user-databases, whereas the DevSvr2 server contains the Billing, Web2Dev, and DBAMaint user-databases. For the purpose of this example, assume that the schema in the Web1Dev and Web2Dev databases is similar, so that scripts developed for Web1Dev must also be deployed on the Web2Dev database.

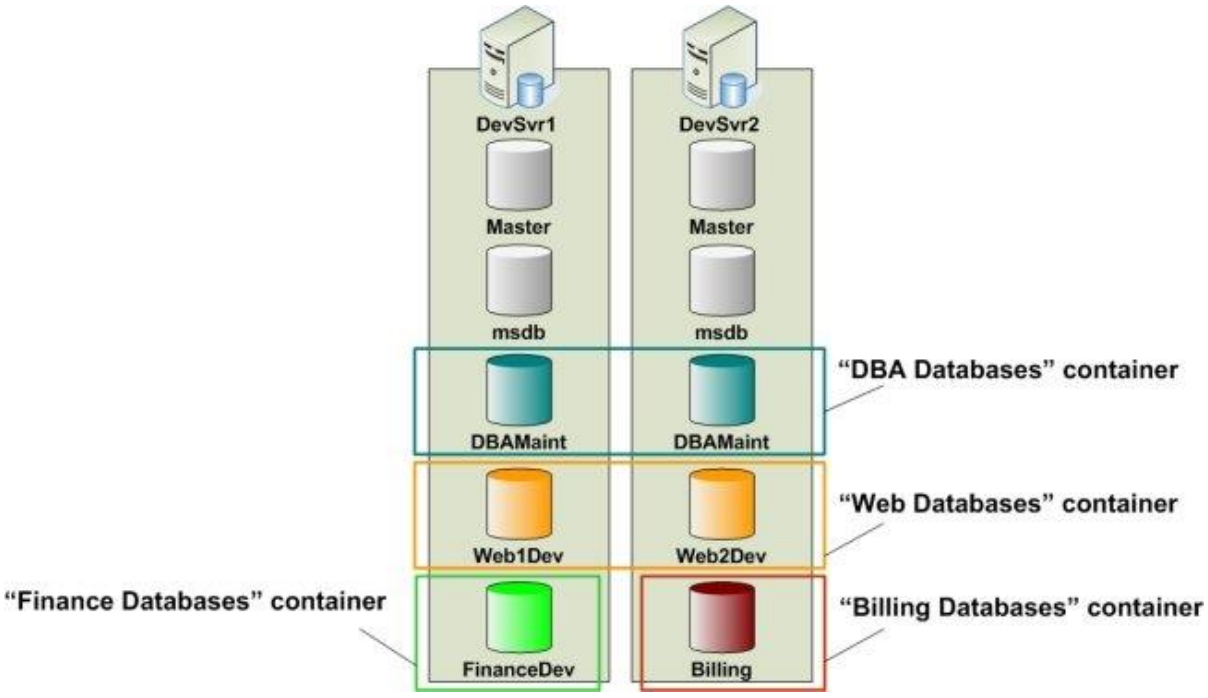


Figure 6: Containers and their target databases in the Development environment.

The *QA environment* - In the QA environment, assume that three SQL servers are available, namely QASvr1, QASvr2, and QASvr3, as illustrated in Figure 7. When scripts written by developers for the Billing database (in Development) are passed to QA, these scripts must then be deployed on the Billing database on the QASvr2 server. Similarly, scripts composed for the FinanceDev database on the DevSvr1 server are later deployed on the FinanceQA database in the QA environment. In the same manner, code developed on the Web1Dev and Web2Dev databases is then deployed on the Web1QA, Web2QA, Web3QA and Web4QA databases in QA, and the same concept applies to the DBAMaint databases as well.

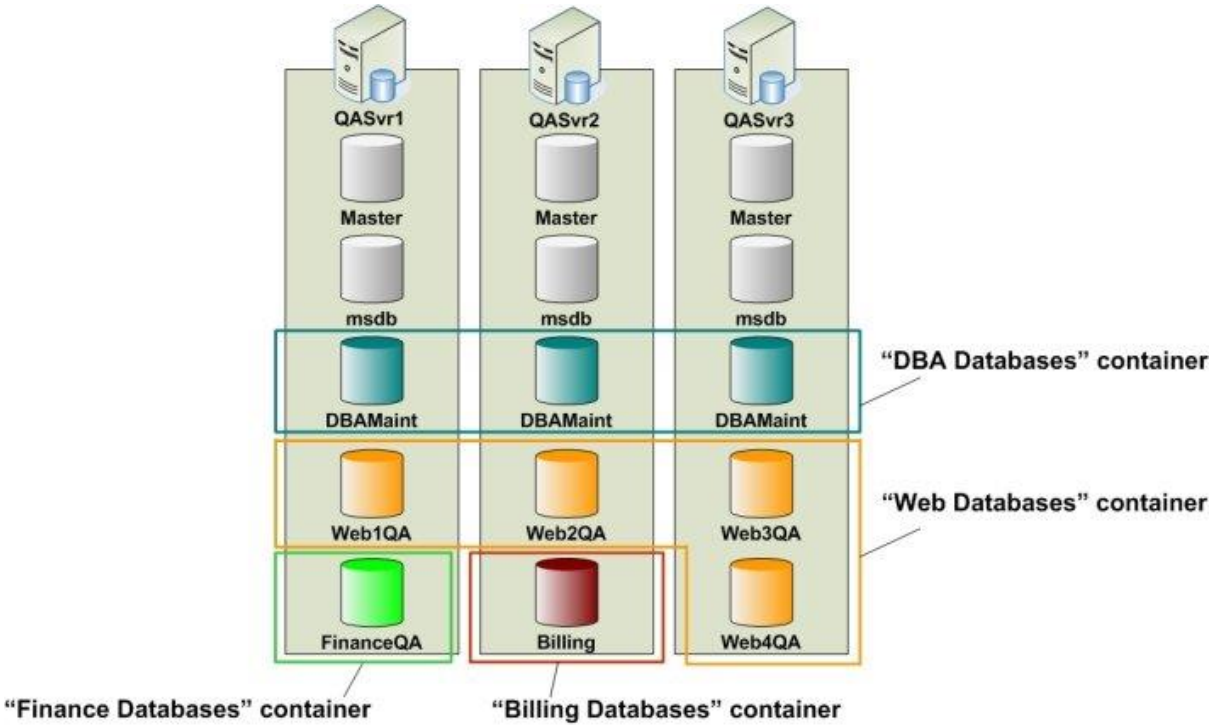


Figure 7: Containers and their target databases in the QA environment.

The *Production environment* - Releases that pass all quality assurance tests are forwarded to production for final deployment. Here, assume that there are four SQL servers: ProdSvr1, ProdSvr2, ProdSvr3, and ProdSvr4 (see Figure 8). In production, scripts developed for the Billing database are deployed on the Billing database on the ProdSvr4 server; scripts written for the FinanceDev database are now executed on the Finance1Prod and Finance2Prod databases, whereas all Web scripts are now run on five production databases, namely Web1Prod, Web2Prod, Web3Prod, Web4Prod, and Web5Prod. The same idea is followed by the DBAMaint databases.

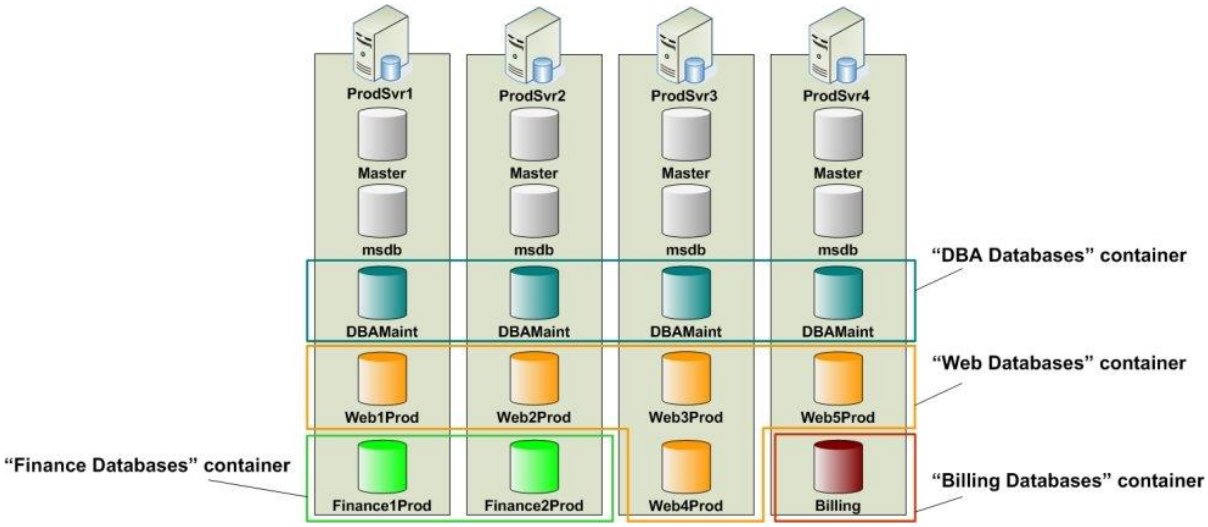


Figure 8: Containers and their target databases in the Production environment.

To summarize, the following figure describes the flow of code deployment between Dev, QA, and Production, where each color denotes the appropriate group of target databases (i.e., Containers) across all environments.

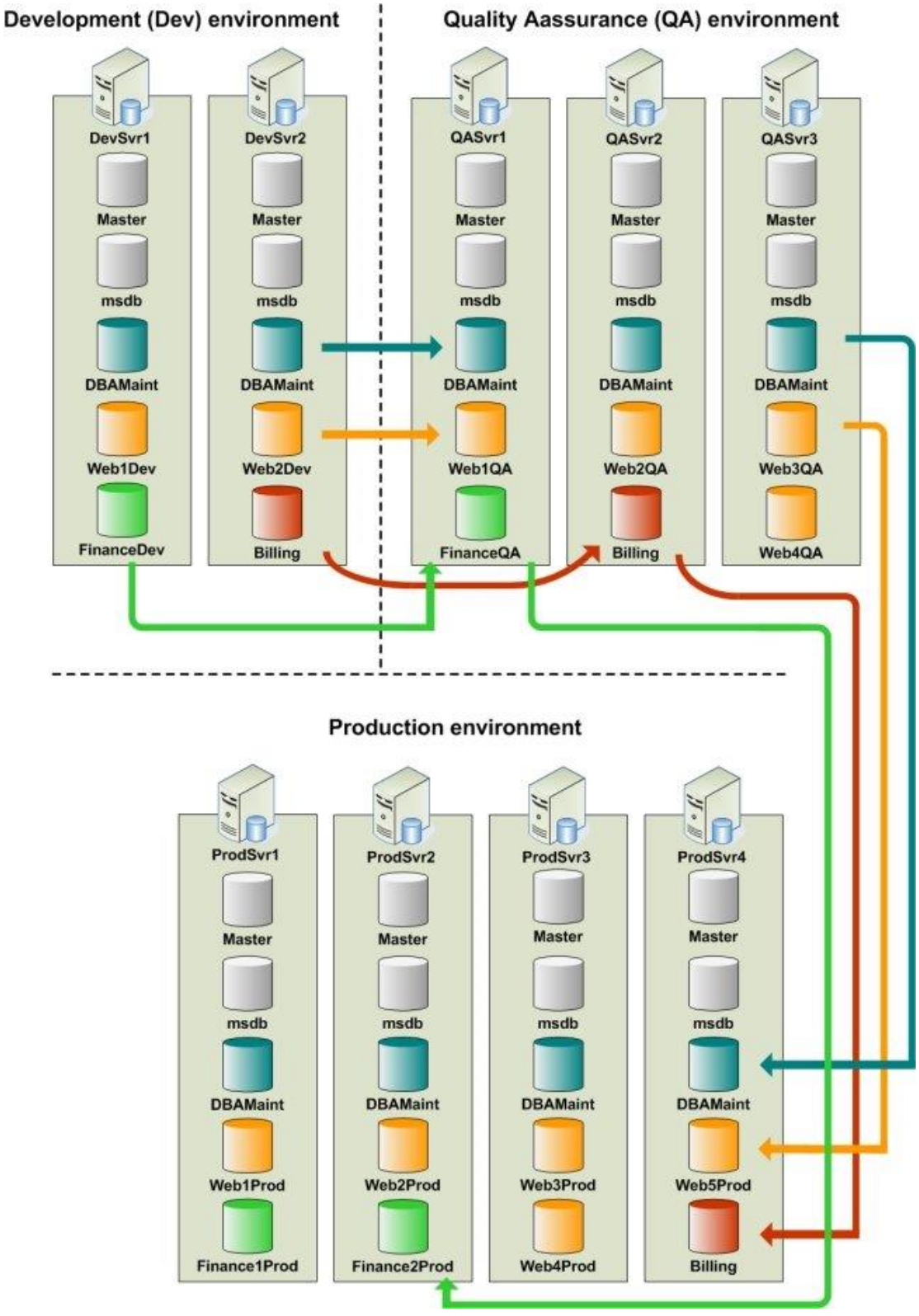


Figure 9: Database groups and the flow of code releases between the Dev, QA, and Production environments.

The Dev-QA-Production Release Process

Change management and code release processes are supported in Combine through several key features:

1. Code packages: A code package consists of scripts. Each script in the package is assigned to a Container. When running a code package, each script will be deployed on all target databases in the associated Container.

2. Passing code packages between Dev, QA, and Production: Scripts are packaged into a single .cpa file. This file contains the text of the scripts and the name of the Container assigned to each script. Entire releases can therefore be saved as a single file that can be passed, viewed, edited, and deployed by individuals running Combine. More importantly, once all Containers are configured properly in the Dev, QA, and Production environments in the Combine Container Manager, each Container in Dev has a corresponding Container (i.e., Container with the same name) in QA and a matching Container in Production. This fact ensures fast release deployment for the following reasons: After developers write the release code and build a code package, software engineers in QA can easily open the package and deploy the entire package on the servers in QA by a click of a button, without altering the package content. Since each script in the package is already associated with a Container name, code deployed on target databases of Containers in Development is now deployed on the target databases of the corresponding Containers in QA. This principle also applies when passing packages from QA to Production. Examples that demonstrate the transfer and fast deployment of code packages between Dev, QA, and Production are provided below.

3. Sharing Environments and Container settings: Once Environments and Containers are defined, users can utilize a Combine Repository to share the definitions and settings. For additional information please refer to the Best Practices section below.

Important note: The three Environments (Dev, QA, Production) need not be defined on each Machine running Combine: Developers only need the Dev Environment with the correct Containers settings, QA engineers need only have the QA Environment with Containers having the same name as in Dev, and Production DBAs only need the Production Environment, again, with same Containers names as in Dev and QA.

As an example, below is a snapshot of the Container Manager that stores the configuration of all three Environments and Containers for the physical Dev, QA, and Production environments previously described in Figure 9 when all Containers are Static Containers.

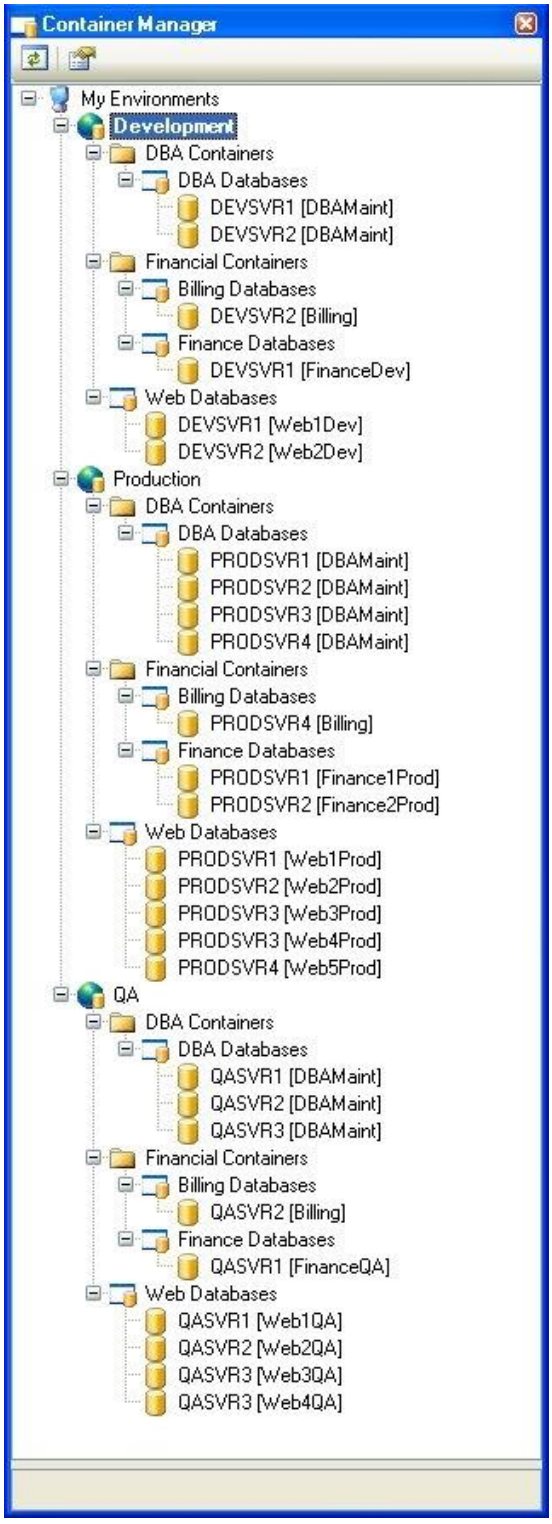


Figure 10: Environments and Containers in the Container Manager where the settings of all three Environments are defined in Combine. Note that the folders names and Container names must be the same in the Dev, QA, and Production Environments.

As stated earlier, it is sufficient for developers to maintain the Dev Containers, for QA engineers to maintain the Containers that belong to the QA Environment, and for DBAs to keep the Production Environment Container settings. In this case, the following figure shows the Container Manager viewed by developers, QA engineers, and DBAs, respectively, when all the Containers are Static Containers. Keep in mind that Containers in different Environments need not be of the same type - Static Containers in one Environment could correspond to Dynamic Containers in another Environment as long as they have the same Container name (and they are placed under folders with same names in the Container Manager).

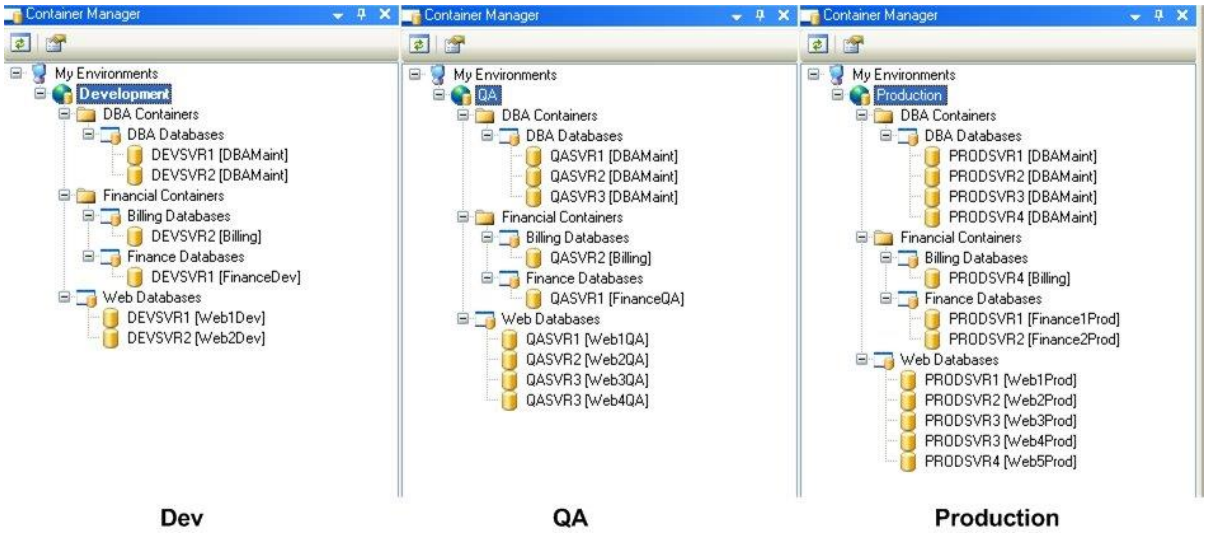
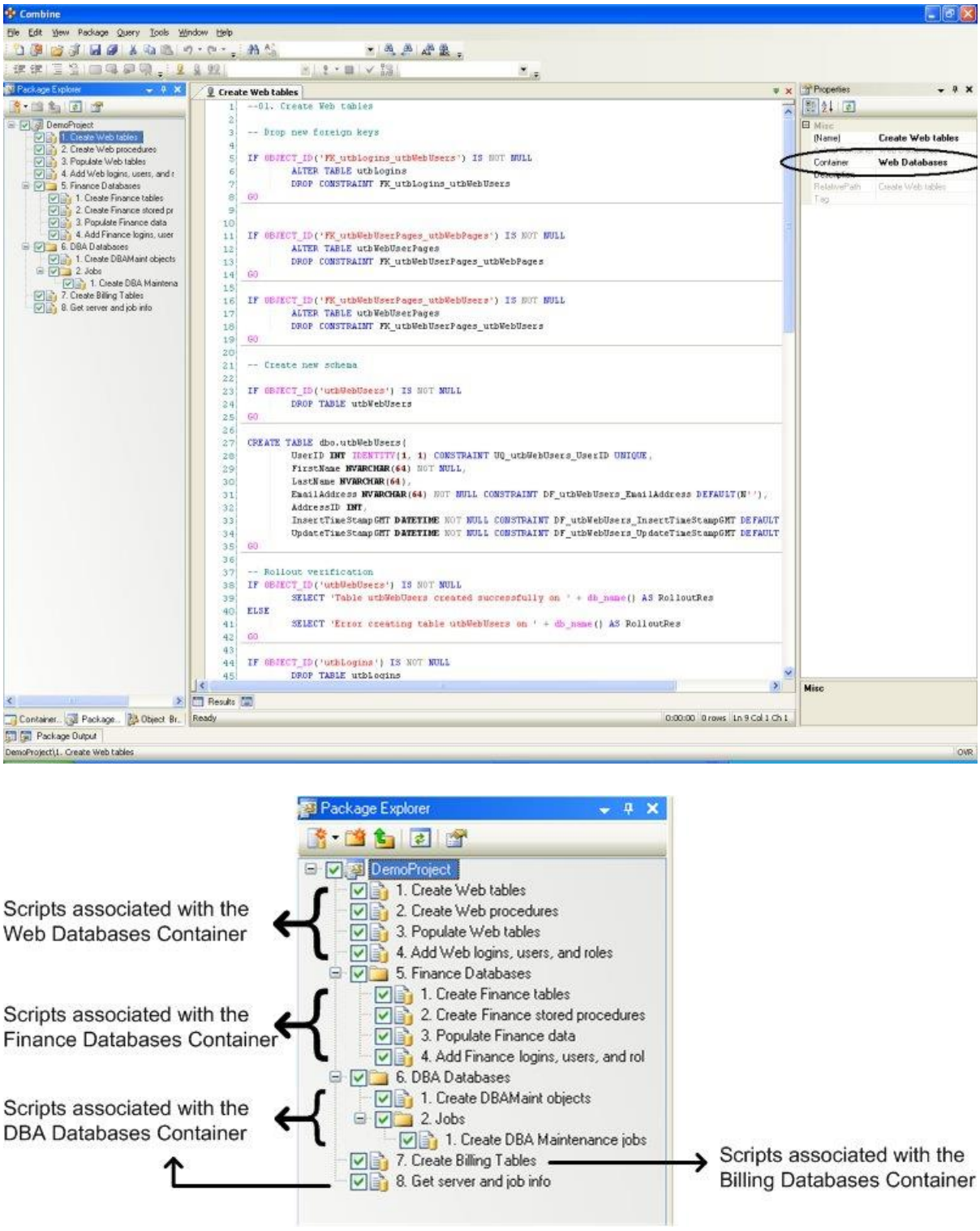


Figure 11: Environments and Containers in the Container Manager seen by developers, QA engineers, and Production DBAs, when users only configure their own Environment.

Passing packaged between Dev, QA, and Production using Combine guarantees fast deployment in each environment as now demonstrated (see the section titled Code Packages to learn more about packages): Consider the code package in Figure 12. Each script in the package is associated with a Container name. In this sample package, scripts 01 to 04 are associated with the Web Databases Container, scripts under the Finance Databases folders are associated with the Finance Databases Container, scripts under DBA Databases as well as the script 08 are mapped to the DBA Databases Container, and script 07 is associated with the Billing Databases Container.



<u>Figure 12:</u> A sample package that deploys scripts to all databases and servers in the Web Databases, Billing Databases, Finance Databases, and DBA Databases Containers.

Notice that each script in the sample package of Figure 12 includes a SQL statement that verifies that changes and objects created in the script are indeed deployed successfully. For example, once a table is created the script verifies that a valid OBJECT_ID is available for the new table (i.e., OBJECT_ID(TableName) IS NOT NULL) and returns a single row to inform the user of the rollout results.

Scripts in the package are executed according to their order in the package tree. When developers run the package, scripts will be deployed on databases in the Containers of the Development Environment listed in Figure 11, and the deployment results are given in Figure 13. When the package is passed to QA engineers, the package is deployed by a click of a button on all the target databases in the QA Environment shown in Figure 11 without making any modification to the package configuration or package content. Execution results in the QA Environment are presented in Figure 14. In the same manner, after the package is sent to Production, DBAs need not make any package changes and can deploy the entire package on all target databases in the Production Environment by a click of a button as shown in Figure 16 below. Notice that the ContainerServer and ContainerDatabase columns in the grids result in the images below are added automatically by Combine to reflect the target database from which each row in the grid is returned). Results returned from the package execution are displayed as aggregated results from all target databases and also include the execution plan and results for each individual database.

Notes:

1. Once a package is executed, Combine performs a set of tests and verifications to ensure that scripts in the package will be executed successfully. For example, database and server connectivity as well as proper authentication and credentials are verified for all databases involved in the package execution before Combine deploys any of the scripts in the package. If any tests and checks are not successful, Combine will notify you of all issues and will not execute any portions of the package. In addition, several screens are displayed before the package scripts are deployed to provide users with better control and visibility to the execution. These screens and many other details involving the package execution can be found in the Combine User Manual.

2. If multiple Environments are used to deploy code from one client machine as in the example of Figure 10, then using the Container Manager the user must set the *Active Environment* against which the package will be deployed. At any given time, only a single Environment can be active and the active Environment is the one displayed in bold letters in the Container Manager (for example, in Figure 10 the Development Environment is the active Environment). By setting the appropriate active Environment in the Container Manager, the Dev-QA-Production release process can also be followed from a single client machine that has access to all databases and servers.

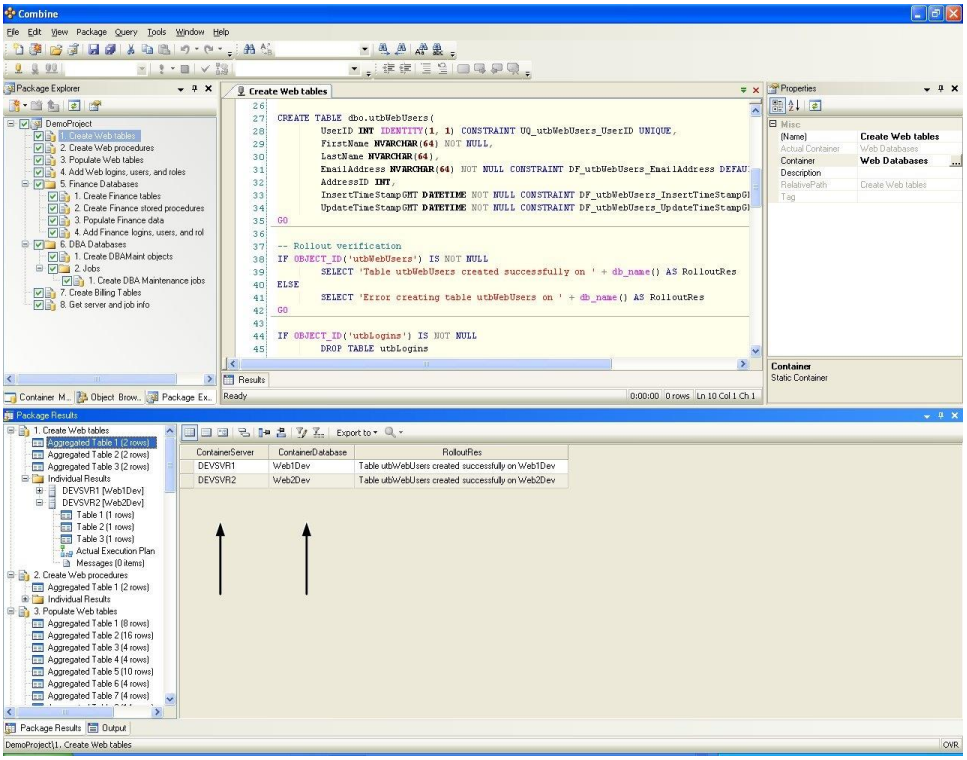


Figure 13: **Execution results of the code package in Figure 12 against the Development Environment.**

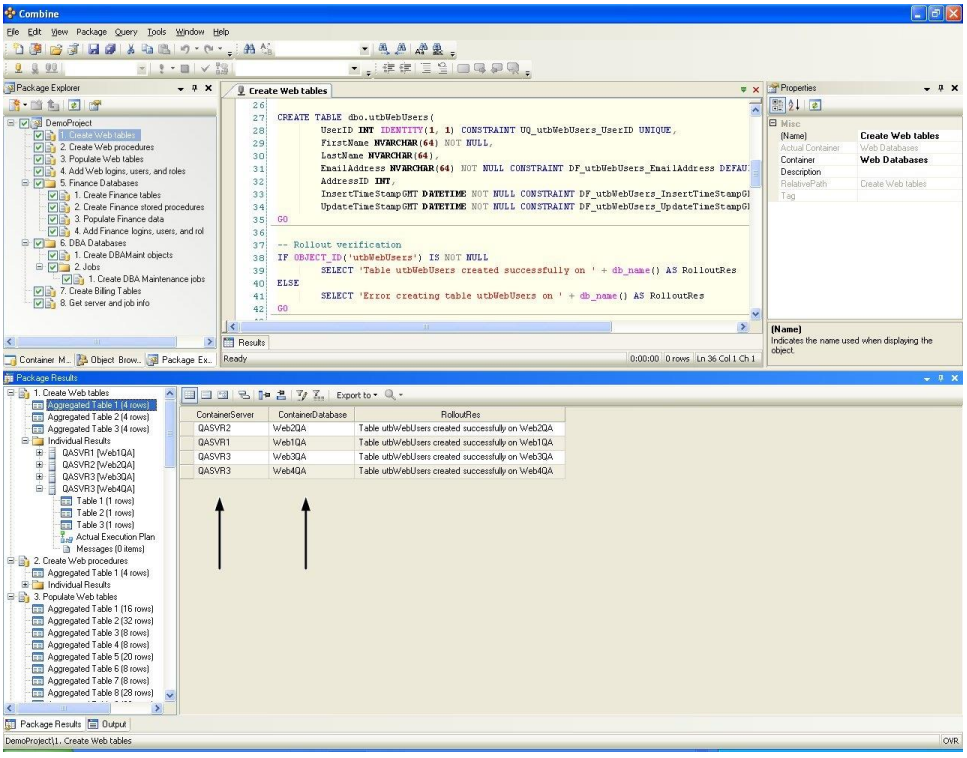
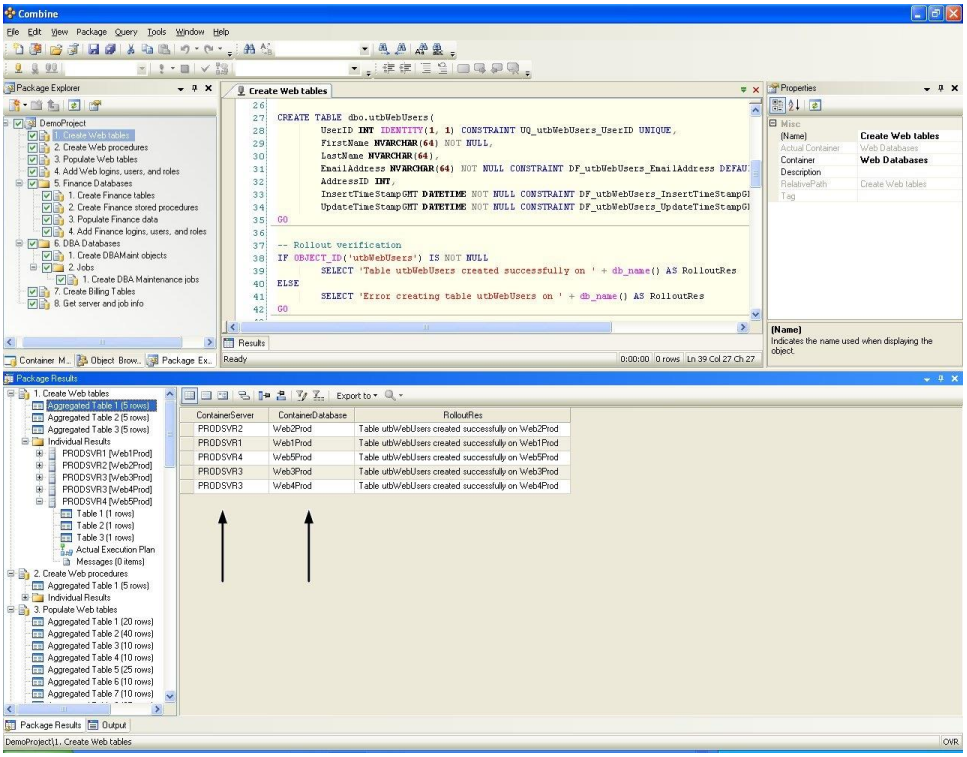


Figure 14: **Non-sorted execution results of the code package in Figure 12 against the QA Environment. Results can be sorted using tools in the grid.**



<u>Figure 15:</u> Non-sorted execution results of the code package in Figure 12 against the Production Environment. Results can be sorted using tools in the grid.

Best Practices I: Sharing Environments and Containers by using a Combine Repository with Dynamic Containers

Environments and Containers defined under the MyEnvironments node in the Container Manager are stored on the local user machine. This includes Environment names, Environment Variables, Container names, databases in Static Containers, as well as the Reference (Repository) Static Container and the Queries used by Dynamic Containers.

In order to share the settings of Environments and Containers, you can use a Combine Repository (see installation scripts and manual for the repository on SQL Farms' website or in the application F1 help) and add it to the Container Manager. Once added, you can define your Environments and Container settings directly in the repository. Alternatively, you can first create Environments and Containers under the MyEnvironments node and then copy-paste them to the repository. Once the settings are available in the repository, then all users can share the same configurations and settings.

The repository includes three built in roles: read-only, change managers, and admins. Using these roles you can restrict the access and update permissions to the repository content. For additional information please refer to the Combine Repository user manual and installation scripts on SQL Farms' website or in the application F1 help.

Best Practices II: Tracking Deployments and DB Changes by Using a Change History Repository

Combine™ enables users to install a Change History repository and then record deployments and package executions in a central repository database, for tracking and auditing purposes. Users can then access the repository using the Change History tool to view and search information relating to previously deployed code packages.

The scripts to create a Change History Repository database are available on SQL Farms' website, as well as in the SQL Farm Combine application installation directory. For additional information, please refer to the built-in F1 help in the application.