Improving your Product Quality with a Smarter Test Software Process

Ideas that align the Test Engineer, the Test Manager/Director, and the CEO.

INTRASTAGE

CAL-BAY SYSTEMS
Solutions for Test, Measurement & Automation

Executive Summary: ATE Work-Flow Process

With today's tools, building a scalable solution for test doesn't have to be any more complex or expensive than building a one-off ATE (Automated Test Equipment) solution. However, we do have to plan our system differently – with a focus on optimizing for the Enterprise, rather than optimizing for the single ATE. The first step to success is our choice of tools and a scalable architecture.

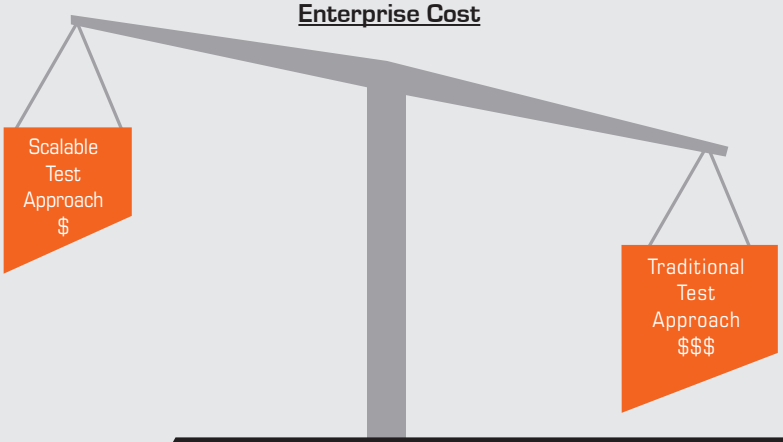
"We have to plan our system differently – with a focus on optimizing for the Enterprise."

Cal-Bay Systems, having built over 1000 ATE systems worldwide, has defined an internal process that we use for all of our projects. This "ATE Work-Flow Process" allows us to build ATE systems more quickly, more consistently, and with higher quality software. The key to success is a combination of tools (software and hardware) as well as a standardized work-flow process for development - with an Enterprise-optimized focus.

Because we often start with a single ATE, we needed a standardized process that would be cost-effective for the first system, and, in addition, could scale across the entire enterprise with the lowest cost in both the short-term and the long-term.

This White Paper describes how we accomplish a scalable roadmap – one that incorporates all stakeholders involved in improving product quality through its lifecycle (R&D, prototype, production, suppliers, Contract Manufacturers, repair, field test, etc.). The technology roadmap focuses on empowering test engineers, managers and senior managers to understand exactly how their product is performing through these different phases by generating and accessing Test Data efficiently, with visibility never-before-attained.

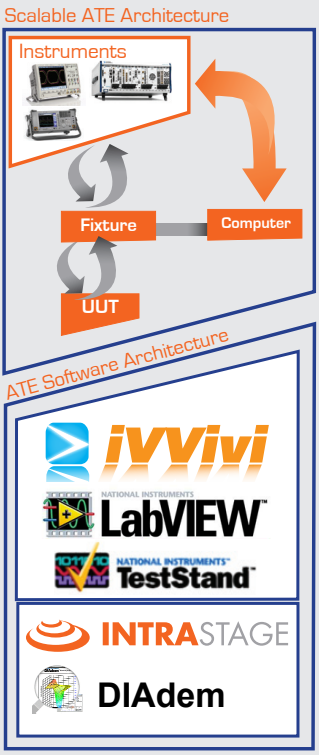
We'll present best practices to tackle the unique problems within each lifecycle area while achieving enterprise level product quality - **all at a lower total cost than what is spent in a "traditional" approach.**



Phase 1: Single ATE meets Scalable Architecture

Let's start with the simplest ATE architecture: A single computer writing test results locally. This might be an R/D functional tester, a Design Verification Tester (DVT), or some other testing system. The hardware will include a computer, instruments, cabling to the instruments, a fixture, cabling to the fixture, and a UUT (Unit Under Test). The software will be an application that controls the instruments and the UUT, captures data, and writes results to disk.

The traditional approach involves buying the instruments and cables off-the-shelf, buying a programming language such as LabVIEW, and then cabling the fixture and writing the software from scratch with in-house employees or contractors. Since the code is written from scratch, it will be optimized for the ATE (but not for the Enterprise).



The model we propose here adds a new set of tools and standards, which are optimized for the Enterprise and allow for a more efficient work-flow process of software development. We will still use off-the-shelf instruments, such as PXI, and we leverage the power of LabVIEW and TestStand. We also add DIAdem as an off-the-shelf analysis tool for the test data. The final addition, which is the key to a scalable Enterprise-optimized solution, is a plug-in architecture to standardize **precisely how to** write the LabVIEW software modules, TestStand sequences and test results. This **plug-in architecture** and **strict component definition** is accomplished with Cal-Bay's iVVivi platform and IntraStage's TDM (Test Data Management) platform.

Cal-Bay's iVVivi framework defines precisely how Test Steps, Test Scripts, Test Configurations, Instrument Drivers, UUT Drivers, and Test Results must be handled, allowing each component to be tested for compliance. Once a component is in compliance with the framework, it can be re-used on any other ATE. This process dramatically cuts the time needed for Software V&V, and it maximizes code-reuse across the enterprise.

IntraStage's TDM platform leverages the precisely-defined Test Results, allowing for 100's of out-of-the-box reports, as well as the ability to export into any analysis tool. In our single ATE solution, the IntraStage platform leverages the DIAdem tool for out-of-the-box analysis of R/D data.

iVVivi INTRASTAGE

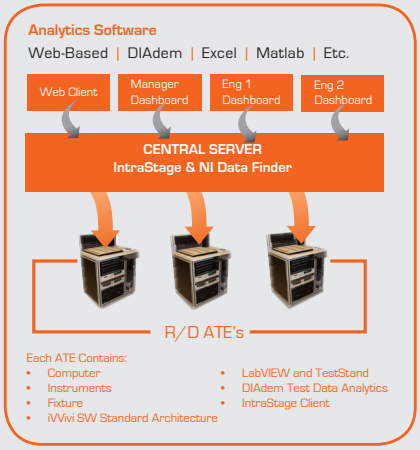
Scalable Plug-in Architecture

Standards • Documentation • Training • Templates • Examples

Phase 2: Scaling to Multiple ATE's

Why do we need all of this overhead? The answer is simple: Interconnecting multiple ATE's is only possible when they are all standardized and talking the same protocols and processes. And to **save the most money for the Enterprise,** we need all of the ATE's to interconnect.

In the first phase, we described the key components of the ATE. The most critical aspect for scalability is the plug-in architecture, provided by iVVivi and IntraStage. When we add the second ATE, we therefore re-use this architecture. Therefore, both ATE's have software that:



- Writes test data out in the same format
- Leverages the same process for test steps and configurations
- Utilizes the same Instrument Driver and UUT Driver standards (and can therefore re-use all code between systems)
- Has the same User Interfaces for Operator Modes, Troubleshooting Modes, Etc.
- Allows for the creation of test scripts in the same method

Leveraging this ATE architecture, we add the next critical component: a Central Server and software. Our server software includes IntraStage Green-Belt licenses, NI DataFinder Server Edition, MS SQL Server, a File Server for raw test data files, and other assorted tools. The IntraStage Server software then connects to each ATE in a standardized way, pulling all of the test data results into the server, storing raw data files in the file server and transforming parametric test data results into the IntraStage data model (built on top of MS SQL). The IntraStage Server can also synchronize with iVVivi on each ATE to handle test configuration management.

Since the data is in a central repository and structured database, anyone with the proper permissions can access the data via the company's intranet. That means that **managers can view web-based dashboards** for product quality parameters, and **engineers can** see web-based reports, while also having the ability to "drive-down into the details" and **export all of the test data to their favorite analytical tools,** including DIAdem, Excel, Minitab, JMP, Matlab, etc.

The web-based interfaces allow all of the stakeholders to view the product quality information with their own customized dashboards.

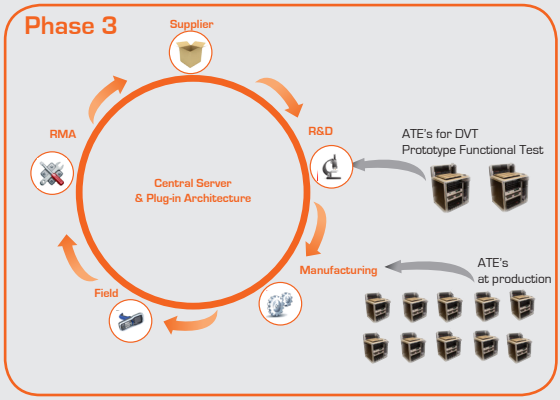
Since the data is all stored in a single database, IntraStage eliminates the need for ATE engineers to pull data files from the ATE's and parse them separately.

Phase 3: Scaling from R/D to Production ATE's

Up to this point, we have been discussing ATE's in one department. For simplicity, let's assume that the first few ATE's were in the R/D group. Now, let's assume that the product is ready for production. (Note that the ATE's can be located anywhere using this architecture. Your R/D ATE's could be in different physical buildings and production ATE's could be at a Contract Manufacturer. More on these details later.)

In most companies, the ATE software written for R/D gets little re-use in production. Luckily, with iVVivi and IntraStage as our architecture, we can re-use the following;

- The plug-in architecture itself (iVVivi and IntraStage)
- The tools, such as LabVIEW & TestStand
- Many of the TEST STEPS
  - We just need to change the configuration to be appropriate for production
- Many of the Instrument Drivers
  - If we swap out lower-cost instruments, the iVVivi architecture provides for instrument interchange without any modification needed for the Test Step code
- The UUT Driver software
- The User Interfaces



Moving to Production, we'll migrate from the IntraStage Green-Belt to the IntraStage Black-Belt server. This quick software install adds over 100 production-style reports, and includes Pareto, Cp/Cpk, and Gage R&R. For assembly stations without an ATE, we can add web-based Data Entry Forms which synchronize with IntraStage.

Now, we have a standardized mechanism to link information from all production ATE's, assembly stations, troubleshooting and rework stations, as well as R/D design test data, all in a centralized data server. R/D managers and engineers can easily compare DVT results to production results. Manufacturing managers can quickly get Yield and Pareto information, as well as Cp/Cpk information on any parametric test result.

We have accomplished all of this scale WITHOUT requiring test engineers to write SQL calls and WITHOUT having MES software designers modifying ATE code.

The plug-in architecture, with its defined interfaces, provided all of this functionality.

Phase 4: Scaling to the Enterprise

In the next phase, we want to integrate the whole system with our corporate MES, ERP, or both. In most companies, this is a daunting task, and it involves a massive software architecture and design effort.

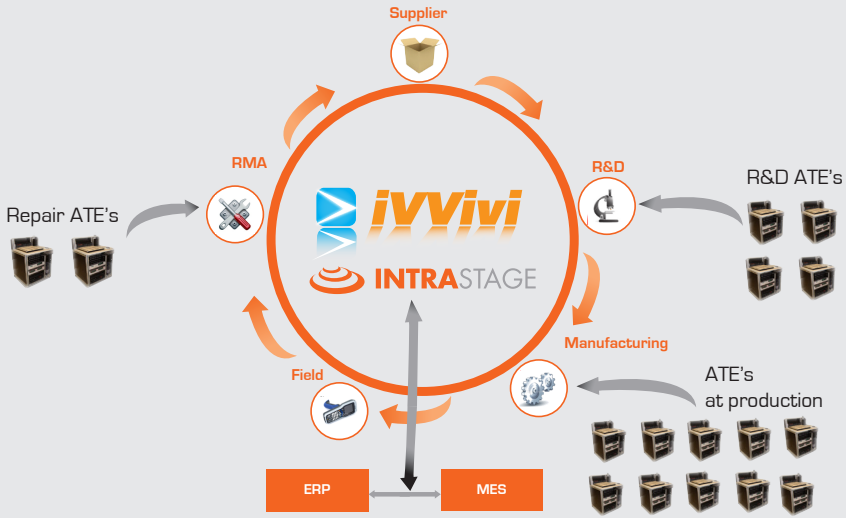
Again, the plug-in architecture makes this part easy. All of the ATE's are already talking seamlessly with IntraStage, through the iVVivi standards. So, to add in the MES or ERP, we simply need to write a custom adapter between IntraStage and the MES/ERP. Since we have previously built these adapters for many companies, using ERP systems like SAP and ORACLE (as well as others), we can often finish this integration in less than a month, **with the industry's lowest NRE costs.**

How do we accomplish this? Because all of the key functions for MES/ERP integration with ATE's are already built into the iVVivi/IntraStage architecture. Common functions such as linking Work Orders or Serial Numbers with Test Scripts and Software Downloads are built-in. The IntraStage database has all of the test results data (much more than an MES needs) and can easily transmit that information, eliminating the possibility of data entry errors by operators.

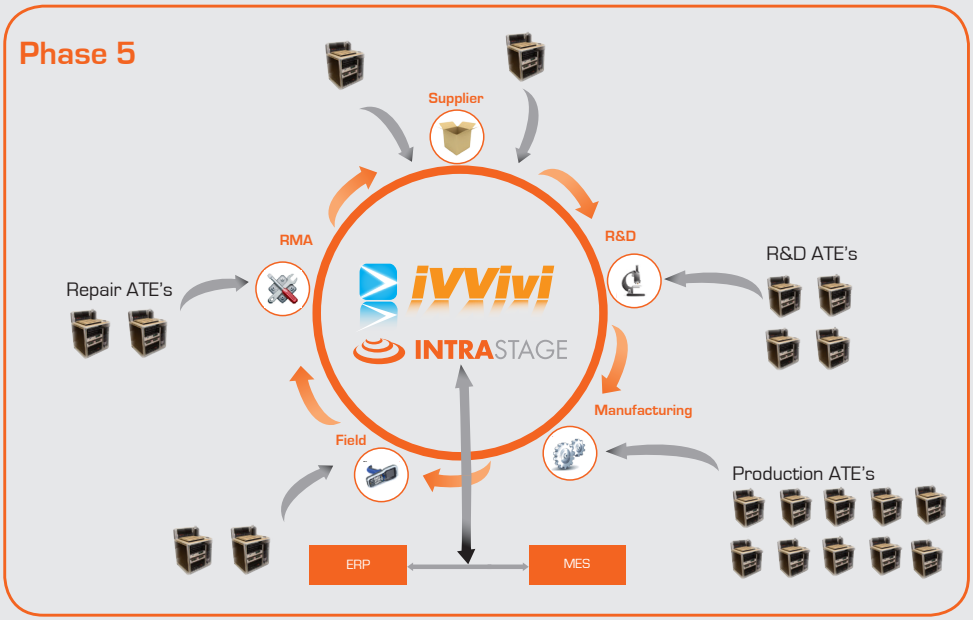
In addition to the integration with ERP/MES, this phase is also where we can link with Repair ATE's in the Enterprise. This allows for Repair engineers to easily check a part's history and compare the failures at the Repair depot with test performance at production. Since the entire Enterprise is now connected, the R/D manager can compare repair data pareto charts and failures with R/D Life Test results. This information can then be fed into the R/D department to improve design and DVT test coverage requirements.

When all of the company stakeholders can easily access quality information and share it, development times are improved and product quality increases.

Phase 4



Phase 5: Integrating with Supply Chain ATE's



Now we address the final challenge – going outside of the corporate intranet and synchronizing this information with supplier ATE's, contract manufacturer ATE's, and field ATE's (which may be at your customer's site).

For this solution, we again use our IntraStage Server, which has mechanisms for coexisting both inside and outside the firewall.

IntraStage can talk over the Internet to outside ATE's. Any outside ATE that is iVVivi-compliant or uses TestStand can be configured easily to communicate with the IntraStage Server. For those ATE's that are not TestStand or iVVivi-compliant, an adapter can be written (often for less than $2000) so that IntraStage can pull in the test data from the outside ATE, and transform that ATE's format into IntraStage's database.

IntraStage handles the secure communication and synchronization between both sides of your company's firewall. Once configured, it can bring in all data that the Supply Chain ATE's are responsible for sharing (and have agreed to contractually). Having this data gives you real-time access to Yield charts, Pareto's, Cp/Cpk, and much more. You can have much more visibility into the supply chain quality metrics – critical for your company's product quality.

Get more visibility into the supply chain quality metrics – in real time and on your web browser!

Summary: Scalable ATE Work-Flow Process

In this short paper, we have described a scalable roadmap for ATE software development that maximizes product quality intelligence. We have seen that the return on investment for an architecture like this is astronomical - certainly less than six months. These ideas and architectures are considered a best practice today, giving companies who embrace them a competitive advantage. However, we believe that the ROI and trends are strong enough that all OEM's will have a system like this in five years, giving a significant disadvantage to companies who continue developing in the traditional way.

"iVVivi and IntraStage offer a scalable roadmap for ATE software development that maximizes product quality intelligence"

iVVivi and IntraStage are not the only plug-in architectures on the market, so it is possible to achieve this vision with a different design. That being said, at the time of this writing, iVVivi and IntraStage are the lowest cost solutions for every single phase listed, and iVVivi is the only commercially available LabVIEW-based solution.

Additional Resources

About IntraStage

IntraStage is an enterprise software provider for companies who design and manufacture electronic products. Our software automates the retrieval, storage, mining and visualization of R&D, supplier and production test data. Our clients choose us because we seamlessly integrate test data from different sources, lower their product design, manufacture and return costs by finding quality trends more quickly and accurately. Fortune 1000 companies rely on us to keep them competitive when product quality and customer satisfaction are key differentiators.

About Cal-Bay Systems

Cal-Bay Systems is a recognized leader for test and measurement solutions when product quality is critical. Our global offices serve medical device and aerospace electronics manufacturers with functional test and DVT solutions for R/D and production. We serve power generation companies with Vibration Monitoring and Analysis.

Online Flash Demos (video and audio presentations):

IntraStage Overview	15 min	http://intrastage.com/flash-demonstrations.php
Cal-Bay Services Overview	4 min	http://calbay.com/flashdemos/1.html
Medical Device Solutions	7 min	http://www.calbay.com/flashdemos/biomedical.html
FlexATE Overview	10 min	http://calbay.com/flashdemos/FlexATE.html
Solid Software Design for Test	17 min	http://calbay.com/flashdemos/sw_design.html

Articles, White Papers and Brochures:

Article: “Three Trends That Could Make Your Test Data a Big Problem”
http://zone.ni.com/devzone/cda/pub/p/id/552

Why Sweat the Small Stuff in Functional Test?
7 Best Practices for Low-to-Mid Volume / High Mix production:
http://www.calbay.com/pdf/FlexATE_WP.pdf

IntraStage Brochure:
http://www.intrastage.com/brochure/2/INTRASTAGE_Brochure.pdf

The 10 Things to Consider When Choosing an Outsourced Vendor
http://labviewexpert.com/resources/whitepapers/10thingstoconsider.asp

Virginia Panel Mass Interconnect used with Cal-Bay FlexATE (formerly FTS-200):
http://www.vpc.com/products/applications/application_articles.cfm?ArticleID=5