THE LAB OF THE FUTURE, TODAY.
THE TRANSCRIPTIC COMMON LAB ENVIRONMENT (TCLE)

Benjamin Miles[1], Jimmy Sastra[1], Matthew Wong[1]

OVERVIEW

Transcriptic is turning biology into an information technology driven by data, computation, and high-throughput robotics with the goal of substantially advancing drug discovery and synthetic biology. We have implemented a *Lab of the Future* by creating a deeply integrated stack of hardware and software driven by automation. The Transcriptic platform is accessible from anywhere in the world through our Transcriptic WebApp, with every instrument connected via the cloud. This allows for the ability to monitor the lab and instrument environment in real time as well as collect metadata to allow experimental optimization and troubleshooting, ensuring the quality of experimental design and execution has never been easier. Data is transferred in real-time to the app via our API to allow for immediate downstream analysis of results.

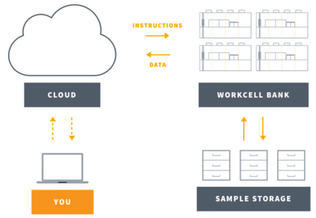

Figure 1. *Transcriptic's user workflow.*

ASSAY PROTOCOLS AS SOFTWARE: AUTOPROTOCOL

Autoprotocol is a language for specifying experimental protocols for biological research in a way that is precise, unambiguous, and understandable by both humans and computers. Autoprotocol is developed and used day to day at Transcriptic to define experiments. In this way protocols are versioned and sharable units of software. Our protocols have been open sourced on Github. Autoprotocol is submitted over the WebApp, where it gets compiled to commands. The Scheduler conducts when these commands get executed and on what device. Any data that comes from that device is then loaded into the WebApp.

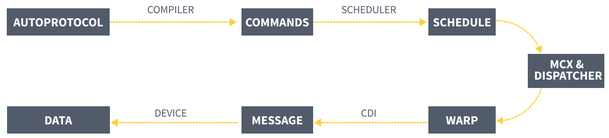

Figure 2. *The Autoprotocol execution workflow.*

THE TCLE (TRANSCRIPTIC COMMON LAB ENVIRONMENT) STACK

The front end: Provides a TCLE dashboard to display information about the Workcell, including the current schedule, resource amounts, and sensing data to highlight any errors that have occurred, and more.

The MCX: Stores the world state, and contains the current schedule, device set, volume information, and more.

The Dispatcher: Executes a schedule; it executes tasks by sending commands to devices.

Devices: Contain one node each, and each of these nodes listens for commands from the dispatcher and then sends the command to the biological device; devices also send analytical and monitoring data to the data node for collection and processing.

Data: Collects and processes analytical and monitoring data.

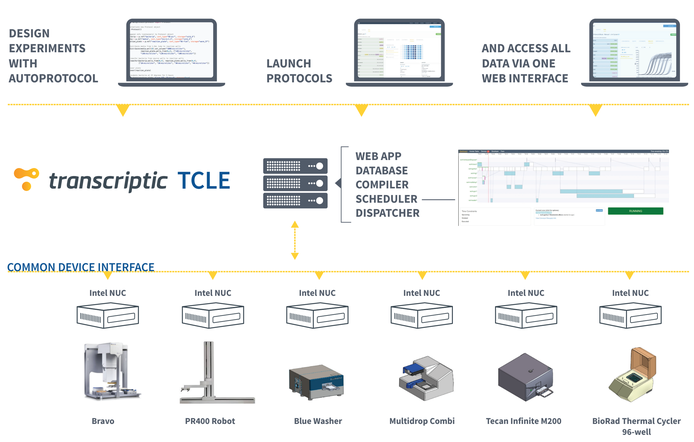

Figure 3. *The flow and transfer of data from assay execution through TCLE to the CDI (Common Device Interface).*

ASSAY EXECUTION

Assays are typically executed on our automated Workcells, however some steps are still manually run by human operators in a traditional wet lab. Whether run manually or on the Workcells, source code is hidden to the scientist who designs protocols through an Autoprotocol layer of abstraction within the WebApp. This interface allows for the selection of various assays, as well as parameterization of protocols **(Figure 4)**. The interface for both operators and assay designers is via TCLE. All data is stored in the WebApp so no data can get lost.

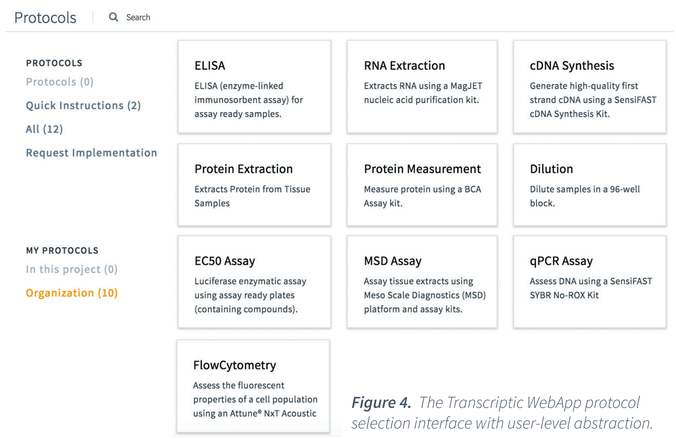

Figure 4. *The Transcriptic WebApp protocol selection interface with user-level abstraction.*

EXPERIMENT TRACKING AND REPRODUCIBILITY

Each experiment is tracked down to the instruction, and provides data collected from instruments involved, samples, and storage environments to ensure that you can fully trace necessary data for a particular experiment **(Figure 5)**. This data is accessible in real-time while the run is being executed, providing information that can be immediately actioned and used in the design of the next experiment quickly and seamlessly.

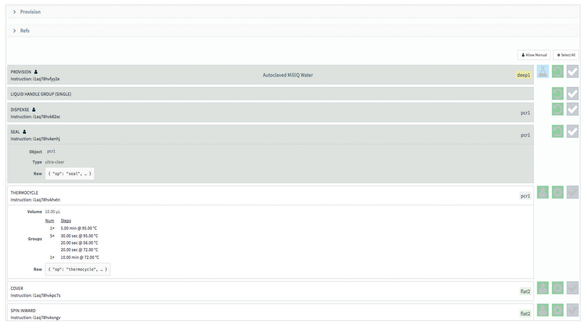

Figure 5*. Real-time monitoring through the Transcriptic WebApp.*

REAL-TIME CLOUD-BASED RESULTS TRANSFER AND ANALYSIS

With experimental metadata as well as results available in real-time via the API, the use of tools like Jupyter notebooks, Prism, or Spotfire has never been easier. You can either download the data via the cloud, or use our built-in Jupyter notebooks for immediate analysis **(Figure 6)**.

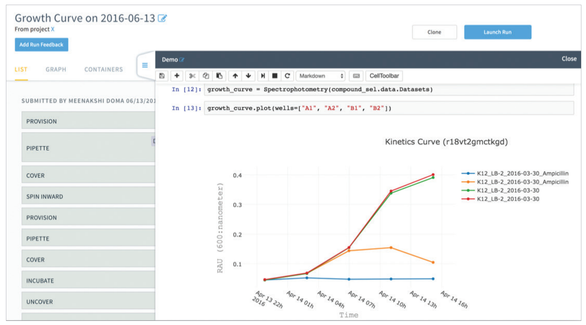

Figure 6. *In-app data analysis of an experiment using Transcriptic's built-in Jupyter notebooks.*

CONCLUSION

TCLE and the Transcriptic platform have changed the way pharmaceutical and synthetic biology companies carry out research, and will continue to utilize IoT as a means of bringing innovation to the industry.

[1] **Transcriptic, Inc.** 3565 Haven Avenue, Suite 3, Menlo Park, CA 94025

www.transcriptic.com
support@transcriptic.com / (650) 763-8432