DOE SBIR/STTR SUCCESS

RESERVOIR LABS INC.

Reservoir Labs is a great example of a small business that was able to develop and manufacture a complete product and to achieve significant sales to a diverse clientele by leveraging SBIR grants, without additional 3rd party private investment. Such an achievement "required bootstrapping and use of internal resources", Dr. Richard Lethin, President of Reservoir Labs explains. Nevertheless, Reservoir Labs' example shows that in certain cases SBIR grants alone, together with the small business' determination, can succeed in bringing a new product to the market.

FACTS

PHASE III SUCCESS
One year after product's launch in 2016, Reservoir Labs has achieved millions of dollars in sales, equal to approximately 2× the SBIR investment. Projected sales for 2018 add up to several times today's revenues.

IMPACT
Reservoir Labs' devices provide unprecedented cybersecurity to high-speed computer networks experiencing flows of data up to 1000 Gb/s at Government Facilities and private enterprises.

DOE PROGRAM
Advanced Scientific Computing Research (ASCR)

The core of one of [Reservoir Labs](#)' devices, [R-Scope](#), is a technology that provides cybersecurity to high-speed computer networks, which connect high-performance computing (HPC) centers at many DOE National Laboratories, and also many enterprise servers operating in private businesses such as finance, manufacturing companies, and other Federal Government Institutions. R-Scope was developed leveraging three Phase II SBIR grants from the Department of Energy (DOE) and other funding from the Department of Defense (DOD). The DOE grants were funded by the [Advanced Scientific Computing Research (ASCR)](#) Program within the Office of Science, which operates HPC facilities including the Leadership Computing Facility at Oak Ridge National Laboratory (OLCF), the Leadership Computing Facility at Argonne National Laboratory (ALCF), and the National Energy Research Scientific Computing Center (NERSC) at Lawrence Berkeley National Laboratory (LBNL). The supercomputing facilities are connected by a high speed network infrastructure named [ESnet](#) for Energy Science Network. ESnet faces a growing need for advanced tools and services to manage the increasing amounts of data being generated. Protecting the vast technological infrastructure in our modern society has become a fundamental process for information systems globally. On the other hand, providing cybersecurity on networks like ESnet and other private networks producing a fast flow of data of 100 Gb/s to 1000 Gb/s is a complex task. For this reason, each year [ASCR posts SBIR grant calls](#) with topics aimed at developing new technologies and tools to face rapidly evolving cyber threats at scale, and in real time.

Launching a tool for effectively monitoring high-speed data traffic required Reservoir Labs to develop both new mathematical algorithms and to employ high speed networking hardware. The major innovation introduced by Reservoir Labs, which ultimately provided the company an edge over its competition, involves new and powerful mathematical queuing algorithms developed within the DOE SBIRs. "The algorithms enable our device to perform both at a higher rate and to handle large bursts of traffic robustly, offering performance and resilience at the same time", explains Dr. Lethin. These algorithms were also implemented on high performance networking interfaces, in the form of heterogeneous computing, to meet the overall throughput requirement.   These innovations are reflected in [10 research papers](#) and 8 patent applications ([4 issued so far](#)).

However, algorithms and high performance hardware, albeit powerful, are only the beginning when it comes to bringing a real product to market. Firstly, a user interface (UI) needs to be developed and the system hardened to protect itself so that it would not add to the attack surface. Hardening activities include closing down open ports, segregating processes, and having in place the means for providing patches and security updates to customers, in a secure manner, as they become available. This patch and upgrade capability is an essential route for new features to be provided to customers. Integration with modern enterprise infrastructure, such as IT automation Security Information and Event Managers or SIEMS, are also needed. Reservoir Labs put substantial effort into providing these capabilities. Furthermore, assuring that the product meets its specifications and is of high quality is a substantial amount of work. Proper engineering processes, such as unit testing and code reviews, need to be followed diligently. A proper procedure for testing software releases, from manually working every UI feature to testing under diverse conditions needs to be developed and diligently followed at each release. Experienced Reservoir staff put these engineering disciplines in place early, so that the R-Scope product would be built on a solid foundation.

To assure performance in high speed networks, Reservoir developed an advanced testing system within the company's lab. The latter aspect is not trivial, considering the need to assure that R-Scope clusters could effectively meet 1000 Gb/s performance. Reservoir Labs' team created their own testing lab with a mix of commercial and homegrown technology, writing necessary software and assembling hardware components, to generate model network traffic patterns and project it at the product at very high rates. "It was a big learning curve", Dr. Lethin explains, "but we now have a reliable and consistent source of test traffic that allows us to experiment and develop new optimizations. We can see how a new software release performs, measure client's performance, and reproduce any customer's problem in our lab." Reservoir Labs also benefitted from being able to place R-Scope prototypes within the ESnet research testbed, where it was subjected to HPC facilities traffic and ESnet researchers could provide evaluations and feedback.

Having a product also means being there with support. While the majority of installations of Reservoir Labs' technology work flawlessly, occasionally problems happen. To make sure every customer's demand gets addressed efficiently, Reservoir Labs developed a web portal where customers report any problem they experience, and receive a ticket for processing. Solving a customer's problem can sometimes be a very intensive activity; customers cannot simply hand over their sensitive traffic for others to review and experiment with. From the beginning, the R-Scope product has had deep and extensive self-monitoring and reporting features. This enabled Reservoir Labs to develop an iterative process in which the parameters and metrics are initially gathered from the client and the traffic is then synthetically modeled, and iteratively refined, in order to reproduce the traffic that the customer experienced and diagnose and fix the problem. Reservoir Labs' customers have said that the team's ability to drill down rapidly and willingness to "stick with it" is one of the main reasons for the company's success and its customer's loyalty. "Through responsive, hard work and diligent communication, we get to the bottom of problems and solve them", Dr. Lethin adds. "R-Scope is unequaled in the market in terms of capability, performance, robustness, quality, and return on investment. So customers stick with us and work with us on the occasional challenge. We are very grateful for that."

Working with a contract manufacturer and managing the inventory are additional, equally important aspects to consider before a product can be finally introduced into the market. Every component of the technology needs to be precisely specified to the manufacturer, including providing the software and instructions on how to install it and assemble it, with a testing procedure. The branding aspect also needs to be developed with logo and labels designed and produced. Sales projections need to accurately reflect demand, so that the product can be assembled without delays and overproduction is kept to a minimum. Financial discipline is required with respect to credit and cash flow.

Although the majority of product testing, customer support, and quality assurance was done using the small business' own resources, the effort is now paying off as Reservoir Labs has achieved millions of dollars in sales, multiples of the original SBIR investment, with projected sales for 2018 adding up to several times today's revenues.

"The SBIR grants were very useful to us", Dr. Lethin stated "because we could combine a couple of Phase II DOE SBIR awards with resources generated by our general services business, to put a complete product in reach." Leveraging the research conducted through the SBIR awards, Reservoir Labs was able to

develop the key technologies to the point that they could merge with the business aspects of integration, hardening, support, quality, and manufacturing. The result is a fine product, which Reservoir Labs is now shipping to real-world customers including government facilities, consulting, manufacturing, and financial companies, to meet strategic cybersecurity needs. "At the end of the day", Dr. Lethin added, "it was the SBIR/STTR program that enabled the launch of R-Scope, and exceptional client collaborations that ensured commercial success."

Dr. Lethin joined Reservoir in 1997, when he completed his Ph.D. in computer science and electrical engineering at MIT. The company had been formed in 1989 to develop advanced compilers for high performance computers, but after joining, Dr. Lethin has broadened Reservoir Labs into an advanced research and products company with synergistic specialties building on the compiler expertise, including high performance networking, cybersecurity, algorithms, and sensing. Dr. Lethin stated: "We are fortunate at Reservoir to have a team for R-Scope that includes very experienced research engineers and business executives with decades of industry experience in high performance computing. This allowed us to take the innovations developed in the DOE ASCR SBIR project and bring them to market in an enterprise-class performance and quality product. This has generated revenue for Reservoir and enabled rewarding careers for our employees, but the most important result to come from this SBIR project is clearly the invaluable cyber security protections that R-Scope brings to our industry and government clients."

Written By Claudia Cantoni, Commercialization Program Manager, DOE SBIR/STTR, January 2018.

Publications:

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[RES17a] Jordi Ros-Giralt, Alan Commike, Peter Cullen, Jeff Lucovsky, Dilip Madathil, Richard Lethin, "Multiresolution Priority Queues," IEEE High Performance Extreme Computing, Waltham, MA, USA, Sept 2017.

[RES16] J. Ros-Giralt, A. Commike, R. Lethin, S. Maji, M. Veeraraghavan, "High Performance Systems And Methods To Catch Elephant Flows," IEEE High Performance Extreme Computing,Waltham, MA, USA, Sept 2016.

[RES15] Jordi Ros-Giralt, Alan Commike, Dan Honey, Richard Lethin, "High-Performance Many-Core Networking: Design and Implementation," INDIS 2015, November 15-20, 2015, Austin, TX,USA.

[RES14] Jordi Ros-Giralt, Alan Commike, Robert Rotsted, Patrick Clancy, Ann Johnson, Richard Lethin, "Lockless Hash Tables with Low False Negatives," IEEE High Performance Extreme Computing Conference (HPEC), Boston, MA, September 2014.

[RES13] Jordi Ros-Giralt, Bob Rotsted, Alan Commike, "Overcoming Performance Collapse for 100Gbps Cyber Security," ACM Changing Landscapes in HPC Security 2013, New York City,NY, USA 2013.

[RES12] Jordi Ros-Giralt, Richard Lethin, "Scalable Cyber-Security for Terabit Cloud Computing," IEEE High-Performance Computing, Boston, USA 2012.

[RES10a] Jordi Ros-Giralt, Pete Szilagyi, Richard Lethin, "Accelerating Regular Expression Processing Using Hardware DFA Engines," poster presented at ACSAC, Austin, USA 2010.

[RES10b] Jordi Ros-Giralt, Pete Szilagyi, James Ezick, David Wohlford, Richard Lethin, "Generation of High-Performance Protocol-Aware Analyzers with Applications in Intrusion Detection Systems," SPIE 2010, Orlando, USA.

[RES09] Jordi Ros-Giralt, James Ezick, Peter Szilagyi, Richard Lethin, "High-Speed Parallel Processing of Protocol-Aware Signatures," HPEC 2009, Boston, USA.