**Project Title:** IBM Cloud Orchestrator Ecosystem for CAMSS (Cloud, Analytics, Mobile, Social, Security) Applications

**Overview: project research and goals**

The proposed research program will investigate the architecture, design, and deployment of cloud computing environments, specifically integration of IBM Cloud Orchestrator (ICO) with data center applications for CAMSS (Cloud, Analytics, Mobile, Social, and Security). These applications will include virtual container solutions based on the Docker open standard, enablement of BlueMix apps for cloud network management and software defined data centers, and cybersecurity solutions intended to combat emerging threats to SoftLayer cloud environments. This project will result in the creation of open source software to drive key IBM partner integration with the IBM cloud ecosystem, and development of a first-of-a-kind ICO environment, suitable for demonstrations with IBM clients. This research will be conducted at the New York State Cloud Computing and Analytics Center (CCAC) at Marist College; this facility will be able to serve as an IBM client reference and host briefings for the resulting solutions. The CCAC hosts a wide range of cloud computing clients (including hospitals, financial institutions, and local/state/federal government agencies) who will also have an opportunity to benefit from the results of this project.

The results of this work will directly benefit the IBM CAMSS strategy and SoftLayer cloud environment by providing differentiation and sustainable competitive advantage. The scope of this work has been reviewed with several IBM business units, and the resulting research effort is intended to close gaps and reduce risks in IBM business unit and research strategies. This work will include contributions to various open source software development efforts approved by IBM. As with prior engagements, results of this proof-of-concept deployment (subject to IBM approval) will be published or presented at leading industry technical conferences and trade shows in support of IBM’s marketing efforts. Finally, students engaged in this program will provide a pipeline of critical skills available to IBM, key business partners, and clients adopting this technology; in particular, this work will help address significant skills shortages in cybersecurity, Docker, and cloud architecture.

This work builds on existing infrastructure and research projects in the CCAC at Marist College. In 2014, Marist conducted extensive work with SDN VE, service chaining with virtual appliances, energy savings resulting from virtual appliances, live VM migration (within and between data centers) to maintain application performance and resiliency requirements; bandwidth calendaring (scheduling automated configuration changes in the data center, for example to test disaster recovery or verify regulatory compliance); and hybrid cloud bursting (enabling clients to “burst” excess workload into a public cloud during periods of high demand). The existing environment will be leveraged for creating and testing new CAMSS projects and demonstrating new apps developed with BlueMix as required to facilitate remote system management and security.

This work is expected to compliment existing IBM SUR grant programs, including those related to Power ISVs and Power Cloud. In particular, Marist College has access to IBM Power blade servers as part of their cloud environment, enabling the college to study cloud workloads for Power and compare their performance with the same workload run on other platforms. This adds
value for clients who want to use Power as the preferred workload platform. IBM has recently implemented Docker on the Open Power platform, and has significant cybersecurity initiatives under way using Power systems. Further, this approach makes it possible for application developers to either create new Power workload patterns using the Marist environment, or leverage existing patterns developed at Marist when they are writing new apps for Power systems. In these ways, Marist will support the Power ecosystem being developed by IBM.

What is the project?

There are several specific goals for the proposed research. First, we will demonstrate the benefits of IBM Cloud Orchestrator (ICO) in cloud computing environments based on OpenStack, KVM, and other cloud middleware solutions. We will create a multi-vendor environment using ICO to provide automated orchestration services to OpenStack APIs such as Neutron (software defined network (SDN) controllers and Network Function Virtualization (NFV) appliances). Other OpenStack APIs used in this project will include Congress (management and incident reporting), Keystone (authentication and security), Nova (server, virtual machine, and software containers), and Cinder (storage). Current partners in the Marist CCAC include Adva, BigSwitch, Brocade, Ciena, IBM, Lenovo, LightTower, NEC, Plexxi, and Vyatta, while current academic partners include Columbia University, CERN research labs in Switzerland, the City University of New York (CUNY), the State University of New York (SUNY), and the California Institute of Technology (Cal Tech). The Marist CCAC is also collaborating with cloud users including Fortune 500 companies (Goldman Sachs, Morgan Stanley), Vassar Hospital, and several local/state/federal government agencies (Marist is always open to inviting additional research partners to join this effort). Marist will create software to integrate ICO with these and other partners (for example, Brocade and Vyatta virtual routers and security appliances, or Adva and Ciena optical packet transport equipment). Marist will also provide a client showcase to demonstrate the results of this work and explain the design decisions undertaken in this effort. Specific projects will include the following:

- Enablement of multi-vendor ICO cloud ecosystems. IBM has a strategic interest in expanding the ICO partner ecosystem; Marist will create and test software to integrate ICO with third party equipment, potentially including certification testing. Software development based on APIs to the ICO management plane will be investigated, and linkages to management dashboards in ICO and open source management tools will be created. ICO is also strategic to the IBM SoftLayer Cloud, which recently announced an investment in four new global data centers. Since SDN VE will be incorporated into the SoftLayer cloud infrastructure, Marist’s experience with SDN VE will be valuable when integrating this code with ICO. SoftLayer is the world’s largest user of Brocade/Vyatta virtual security appliances, so ICO integration with Brocade/Vyatta is a key initiative. SoftLayer is also a major user of Adva optical technology, so Marist will leverage prior experience with Adva packet optical virtualization and ICO integration. Finally, IBM has more people contributing to Docker open source virtual containers than any other company; Marist will investigate virtual container migration and security issues in a hybrid environment. If requested by the cloud development team, Marist has the capability to compare workload performance on different types of platforms (Power, x86,
and System Z). As required, students will develop enabling applications using IBM BlueMix development platform.

- Cloud environments and Analytics using Docker virtual containers. IBM announced a significant focus on Docker at InterConnect in February 2015, claiming to have the largest number of contributors to this open virtual container standard and plans to announce new Docker prototypes in 2Q15. Further, IBM’s announcement that the company will be joining a cloud exchange service with Equinex (available in 2015) will benefit from both ICO integration and extension of the virtual slicing and service chain technology developed previously by Marist. Marist will develop Docker applications for the cloud, and investigate virtual machine and virtual container migration in cloud exchanges, as well as the novel security issues posed by these environments. Results will be aligned with IBM’s “unified network architecture”. Marist will use analytics to optimize virtual container migration and placement in the cloud.

- Cybersecurity for cloud: The recently formed IBM Security group is currently drafting a global strategy within Systems Group. Marist will contribute cloud use cases including automated ICO security policies, detection and handling of specific traffic flows, quarantine of suspect data center resources, and multi-component threat vectors (for example, DDoS attacks masking malware incursion). Marist will also investigate use of tools such as AppScan and Metasploit to enhance visibility to cloud security threats and reduce false positives from intrusion detection systems. Security impacts on virtual container migration using Docker open standards will also be investigated, including BlueMix apps for security system management. Marist is uniquely qualified in this area, having launched a new cybersecurity curriculum (supporting ISC2 industry certifications) which includes collaboration with the Dean and faculty of the School of Criminal Justice supporting cybersecurity compliance, governance, and related issues. Marist is already engaged with IBM security executives who are helping craft NSF/NIST initiatives in this area.

- Mobile computing initiatives: There is interest from IBM Telecommunications (formerly S& D Comm Sector) in developing rapid provisioning of virtual cloud applications (for example, secure virtual evolved packet core (vEPC) and intercloud wide area network (WAN) provisioning). This is an enabler for the emerging Internet of Things (IoT). Lightweight containers would enable fault tolerant, hyperscale environments with significant cost advantages, including integration of ICO with billing and OSS/BSS services. Marist will investigate cloud provisioning of these virtual applications, including working with IBM preferred virtual appliance partners. System Z has also announced a mobile back end initiative, which could be addressed by the enterprise development lab at Marist. Marist will investigate the impacts of this technology on multisite orchestration, administration, and management (OAM). Marist will collaborate as required with the IBM Telecom Solutions Lab (TSL) in LaGaude and Dallas on this work, and take direction from these groups regarding integration with SoftLayer and BlueMix application development platforms.

- Global Services. According to IBM, services is the fastest rising cost component for cloud, and the largest skill gap in the industry relates to security service practitioners. IBM asserts that 70% of the software market today is Software-as-a-Service (SaaS) in the cloud, however the scale of cloud applications requires automation of key tasks and
specialized services training for the remaining tasks. IBM is an executive sponsor and board member of ISSIP, the international society of service industry professionals; the Marist faculty serving as principle investigator for this work is also leading the ISSIP SDN Working Group. Marist will implement ICO automation of security features required for large scale cloud deployment, and integrate this effort with the Marist curriculum for cybersecurity certification. Marist will also help develop reusable service offerings for IBM Global Services related to cloud, virtualization, and security.