On Using Intelligent Composable Fabrics for Superior Results in Digital Enablement

Business and technology leaders globally are all in on the idea that digital enablement of their operations is critical for their success.[1] Although projects focused on these goals are generally promising, an attribute they tend to share is that they focus on relatively narrow, often isolated areas of operation. For example, a particular type of robot may be deployed in a factory to perform a given task; a family of drones can be put to work in a logistics company's distribution hub, hopefully in sync with its other elements; analytics and artificial intelligence (AI) can be applied to understanding a particular disease and improve the care provided in one portion of a medical practice. The predominant state of play has been that progress can be achieved in silos.

Although it is important to appreciate this progress, it's also important to note that each step takes us only a part of the way toward achieving the pervasive digital enablement that leaders and strategists want. Is there a path to a more unified and impactful outcome? Fortunately, to complement these frequently silo-based initiatives, we have made broad-based progress as a collection of industries in applying ICT[2] innovations to expanding the capabilities we have at our disposal for achieving digital enablement on a broader level. We are building the capabilities to develop and run fully connected intent-based digital operations.

What is bringing such expanded levels of digital enablement within reach? Overall, it is by leveraging advances being made concurrently in a range of related disciplines, ranging from computing capabilities we can apply to the analytics we can bring to bear on operations.

[1] For examples of the breadth of these initiatives, see the World Economic Forum's summary of its Digital Transformation Initiative, 2018 (http://reports.weforum.org/digital-transformation/) and McKinsey's report, 'Unlocking Success in Digital Tranformations', 2018 ((https://www.mckinsey.com/~/media/McKinsey/Business%20Functions/Organization/Our%20Insights/Unlocking%20success%20in%20digital%20transformations/Unlocking-success-in-digital-transformations.ashx)

[2] Information and communications technology.

Let's have a look at the most important of these and how they are contributing to progress.

First, dramatic innovations in computing silicon and hardware design are delivering new functionality in multiple categories of operation, in a variety of form factors, and at a scale not achievable before. New chip and system designs are expanding capabilities in telemetry, machine learning, analytics, artificial intelligence, vehicle and machine controls, computer vision, digital simulation, cloud computing, and other functions. In hand-held systems and connected vehicles; enhanced machinery production and control systems; and in robust, distributed clouds, we are achieving a level of computer-aided operations that we have never had at our disposal before.

To harness this power we have made corresponding significant advances in software designs to make operations simpler and allow us to integrate systems more straightforwardly into our work. With broad industry collaboration on open system architectures we have made it possible to support diverse hardware elements into coordinated solution deployments. Innovations have made development of more modular and adaptive software possible, usable in many types of platforms and at a wide variety of scales. Cloud computing has made the availability and extensibility of applications pervasive and in fact an expected element of operation.

Making all of this functionality accessible and supporting the collaboration that information-driven operations need, significant advances in networking have also been achieved. These are extending the reach of applications to devices and locations not previously possible to include. They increase the throughput and performance of our infrastructures, allowing richer sets of information at higher volumes to be shared and increasing the amount of work that can be accomplished in a given unit of time. Newer, more robust networks deliver a wider range of qualities of service for an increased number of applications. They incorporate important security mechanisms to ensure the integrity of our connected infrastructures. These innovations have occurred in both wireless and wired networks and in both local and wide-area environments.

Beyond these underpinnings, innovative new techniques for harvesting insights from our systems and their operations have been developed. These run in both hardware and software. They provide telemetry, machine learning, analytics, and artificial intelligence to extract deeper insights and increase the effectiveness of operations. They serve to elevate levels of performance on every dimension, from local machine and site, to department and business unit, to entire organizations and ecosystems.

In one final category, the capabilities of our widely available cloud computing platforms have continued to advance, extending now in an elastic continuum of functionality accessible from edge to core in both private and public clouds and in distributed implementations.

As a group, this collection of advances has brought us to the threshold of operating at significantly enhanced levels of effectiveness in fully connected digital infrastructures, compared with models used to date. We can unify operations more and make enhanced levels of achievement possible in virtually every sector using a model ACG Research describes as an Intelligent Composable Fabric or ICF.

Understanding Intelligent Composable Fabrics

What exactly is an intelligent composable fabric (ICF) and how is it different from methods already in use?

At the highest level an ICF is an intent-based, AI powered, highly distributed yet logically unified platform that works continuously to deliver the maximum possible achievement of an organization's goals. ICFs are built from a heterogeneous mix of elements at every site and in every domain. Their operation is unified by analytics, AI, automation, and software control at every level. ICFs are usable in a wide variety of industry sectors, use cases and applications. They are an extension of the principles of software-defined, cloud-native operations prevalent in ICT over the past five years into new spheres of operations (such as factories and distribution hubs and hospital operating rooms.) They are a union of the profound expertise present in diverse sectors and areas of specialization with performance improving enhancements available from well-designed digital innovations. ICFs provide a versatile reference model and platform to use in pursuit of digital enablement and business excellence.

With that said at a high level, let's look at each major attribute of an ICF in a bit more detail and explore how each helps move the state of the digital enablement art forward.

Infrastructure Composability

First, ICFs leverage composability. Composability is an approach to automating operations that has gained strong traction in ICT and cloud computing over the past four to five years. In those environments, modularity in open system architectures, microservices software design, clearly specified data models, and application programming interfaces (APIs), along with software-driven management platforms have produced a degree of flexibility in solution implementations that has gained significant, and in all probability, irreversible momentum.

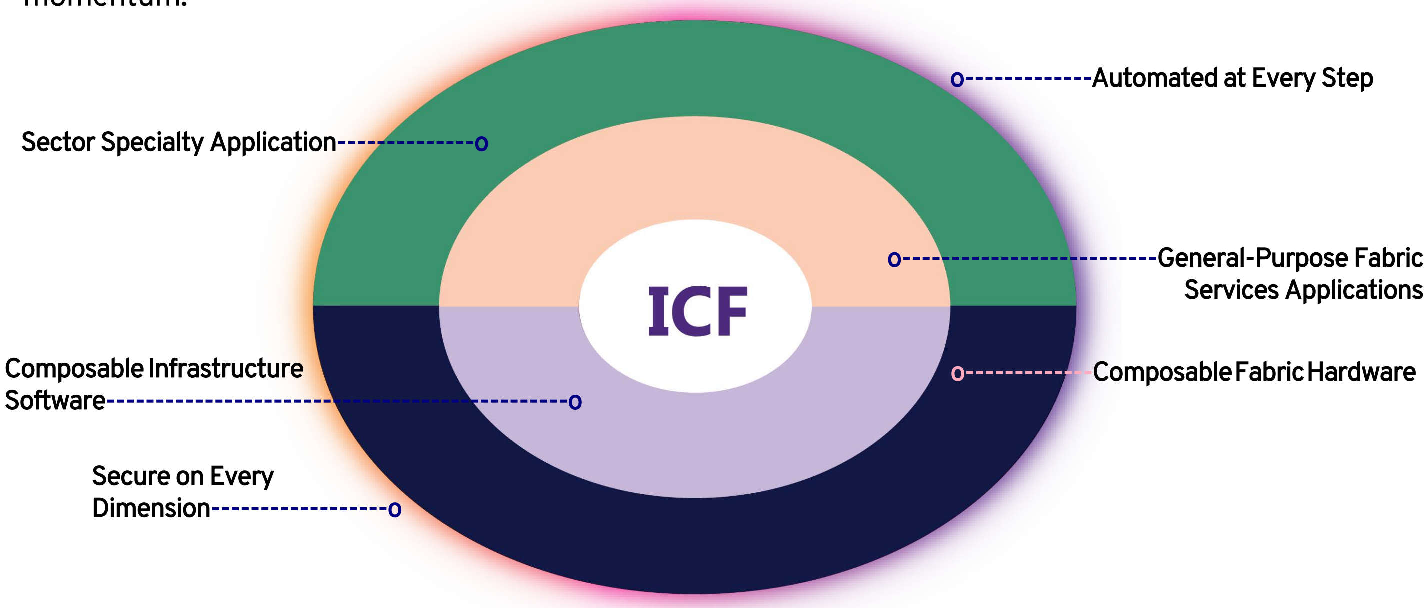

Figure 1. ICF Conceptual Model

Although composability is popular in ICT, it has been less achievable in other operating domains, where technologies (generally called operations technologies or OTs) are in comparatively earlier stages of evolution toward similar levels of modularity. Given the pace at which general-purpose computer capabilities are being embedded into a range of OT solutions, composability will become an increasingly important element of solutions in these areas of operation as well.

In the diagram of our ICF conceptual model (Figure 1), we see the four levels of infrastructure in which this characteristic is used in ways appropriate to each one's scope of operation (underlying hardware, such as PLCs, CPUs, and GPUs; infrastructure software, such as operating systems and containers; general-purpose fabric services software, such as machine learning, analytics, and blockchain; and industry-specific applications for operations in sectors such as manufacturing, health care, energy, and others.) Each has a role to play in achieving more unified digital operations.

Fabrics

If an ICF uses composable infrastructures, how does the fabric concept apply?

Technically, fabrics are platforms that include a set of nodes connected to each other over a well-defined, reliable communication path; are integrally related to each other in terms of the functions they perform; and are bound to produce a known set of results in line the goals of an overall system. Fabrics can operate in support of a localized goal (such as in converting the format of a packet from one type to another in a network node) or they can work in support of the broader business intent of an organization (as in holding a piece of information for no longer than a specified length of time before forwarding it to its next step so the goals of an organization in a given area of application can be achieved). Examples of fabrics that illustrate these concepts include a nonblocking CLOS fabrics used in network designs[3] and collections of nodes deployed in the forwarding domain of a network as in an IP or an Ethernet deployment.

Expanding this paradigm to all of the elements used in the digitally enabled OT and IT environment of a company produces a powerful model for unifying the company's operations in the service of its goals. ICFs are composed not only of locally connected digital infrastructures (as in a factory area network) but also (as implied by the elements in the model in Figure 2) of elements in a distributed infrastructure stretching across numerous locations, clouds, and organizations. The intelligence being harnessed throughout the ICF is used to achieve an organization's most important goals and to measure performance in achieving them using indicators that have both local and global significance.

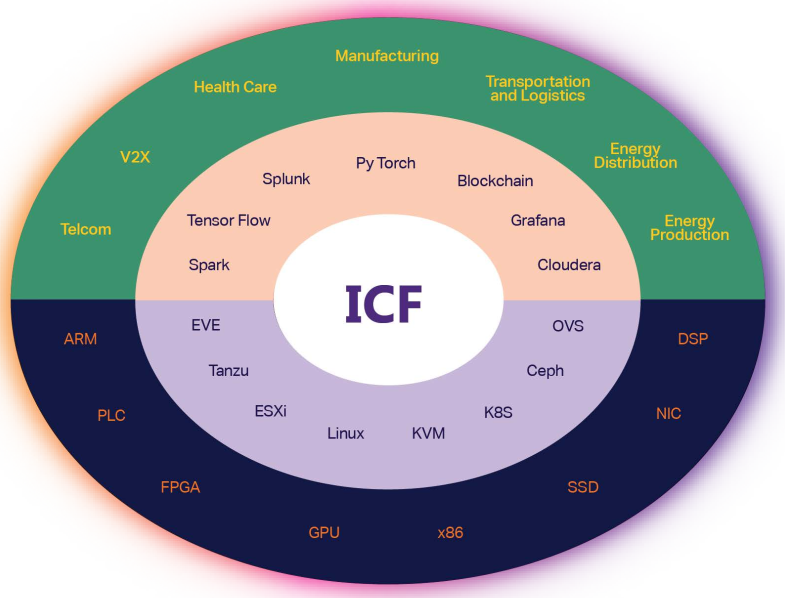

Figure 2. Elements in Each Layer of an ICF

[3] For some general perspective on nonblocking CLOS fabric designs, see https://en.wikipedia.org/wiki/Clos_network.

Intelligence in the ICF

Understanding that ICFs are composable and that they operate using a fabric model, what gives ICF its distinct intelligence? How is it an intelligent composable fabric?

Existing platforms in many areas already include a degree of embedded intelligence to enhance their operations. Robots, connected vehicles, smart cameras, and GPUs accessible as a service in cloud computing pools are examples. The intelligence in an ICF is distinct from these in its support of pervasively linked machine learning, analytics, and artificial intelligence (AI) at every level to achieve an organization's goals. The ICF's fusion of analytics and AI into operations is not a one and done proposition. It is an ongoing integration of functionality that continues over time. An ICF's network of analytics and AI is the engine that creates its overall agility and makes it distinct from pre-existing silo'd operations.

Analytics and AI in an ICF get their focus by integrating the business intent of an organization into its design. and a subsystems are deployed using cloud-native software, rich processing capabilities, ubiquitous reach, pervasive security, and programmable intelligence at every level. As a result, ICFs are intelligent, composable, and self-optimizing operational fabrics. They provide an adaptable framework for achieving superior results in digital enablement.

How large are the improvements that can be achieved? At a macro level, several analyses have shown that dramatic contributions can be made to global GDP from such pervasive use of AI.[4] At a more granular level the results will be specific to the implementations of each organization (and will be the focus of detailed research moving forward. As one point of reference, when improvements in productivity or reductions in costs on the order of 10% (or more at an organizational level are made from a given implementation, its contribution to both savings and return on investment is well worth evaluating.

How much of an acceleration in results can be achieved? This again will be unique to each sector and organization.

[4] Assessing the Economic Impact of Artificial Intelligence, ITU and McKinsey Global Institute, September 2018, projects a 1.2 % per year contribution to global GDPs from the use of AI by 2030.

Ongoing Research into Digital Enablement and the Use of ICFs

ICFs clearly have great promise in advancing the state of the art in digital enablement in many sectors. Where do we go from here? ACG will publish two additional papers exploring key characteristics of ICFs in more depth, as companions to this initial document. First we will consider ICFs' main architectural components, what they include, how they contribute to enhanced operations. The second will explore the economics of ICFs more, examining how ICFs generate results, how they differ from alternative approaches.

In addition to these, ACG will analyze how ICFs can be used in a variety of industry sectors and use cases. Sectors include manufacturing, supply chains and logistics, health care, energy production/distribution, and cloud and telecommunication service providers. We will also explore the impact of ICFs on the categories of infrastructure in which we do ongoing research. These include wireless and mobile networks, edge computing and edge applications, network automation, hybrid/multicloud deployments, and developments in analytics and AI.

Periodically, this will result in podcasts and publications on notable innovations, solutions, and technological developments. We will also publish economic analyses on the impact of digital enablement and ICFs in the sectors we are researching and primary research on the perspectives of industry stakeholders on the digital enablement journeys on which they have embarked.

About the Author

Paul Parker-Johnson is ACG's chief analyst and practice lead for research on hybrid, multi-cloud technologies and their use in private, edge and public clouds. His current work is focused on use cases in industry 4.0 and vertical segments in which it is gaining uptake, including the use of machine learning and AI in distributed operations models. pj@acgcc.com