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FULL-STACK OBSERVABILITY:
Expanding the Digital Experience and Impact with Advanced Business Context

RESEARCH BY:

Stephen Elliot
Group Vice President, I&O,
Cloud Operations, and DevOps, IDC

Mark Leary
Research Director,
Network Analytics and Automation, IDC

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Navigating this White Paper

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Introduction/ Executive Summary

Enterprise IT and business leadership teams now recognize the fact that their technology architecture is their business architecture.

As business executives attempt to expand their end-customer and business partner engagement models, accelerate innovation, bolster worker productivity, and improve the digital experience for all, applications and supporting network, compute, and cloud infrastructure have become the foundation for profitable revenue growth, worker and customer success, and competitive advantage.

Enterprise IT organizations are adopting multicloud strategies and cloud-native application architectures built on containers, Kubernetes, and microservices, while continuing to manage traditional application estates and an expanding array of infrastructure and endpoint devices. The rise in technology and business model innovation — and the dependency on technology to deliver high-performing applications and positive digital experiences — requires the ability to understand end-to-end core-to-client services capabilities and quality, and the business impact these services have on the end-customer journey that delivers revenue growth.

This paper outlines the critical aspects of full-stack observability: what it is, why it's different from traditional monitoring, and the value it can provide for DevOps efforts, development projects, site reliability engineers (SREs), network and IT operations, line-of-business managers, and cybersecurity groups. It empowers a deeper understanding of full-stack observability and its business implications for IT teams and the digital experience, and its applicability for modern system development, deployment, and management that can drive measurable business outcomes.

Situation Overview

As end customers demand new digital engagement models to acquire products and services, the supporting technology, organization, process, and tooling complexity is accelerating. The software development, deployment, and management life cycle utilizes manual and automated processes and various development methods (i.e., Agile, Waterfall, etc.) with large toolchains to create a vast web of complexity spanning applications, networks, core and edge computing, cloud services, and even smart devices. Each architectural layer is increasingly complex; for example, IDC research shows that a typical cloud-native application can have from five to 15 dependencies on other services, resources, or application programming interfaces (APIs) — each of which generates its own set of operational risks and associated metrics and data. In addition, over 80% of IT organizations are adopting some degree of agile DevOps methodologies, and many expect that within two years, close to 30% of production workloads will run in containers. Virtual machines (VMs) and bare metal platforms as well as public cloud infrastructure as a service (IaaS), software as a service (SaaS), and serverless solutions are also expected to be part of the mix. As complexity increases, so does the challenge of managing it to reduce business risks and improve revenue opportunities, customer satisfaction, and worker productivity. For most IT organizations, the adoption of cloud-native applications and container-based infrastructure, multiple clouds, and software-defined infrastructure creates a "complexity tipping point" for adopting full-stack observability solutions to manage the fast-moving, globally distributed environments that deliver the best possible digital experience and, ultimately, the most positive business impact.

But applications are just the start of the full-stack observability opportunity. The broader visibility requirements of infrastructure, runtime security, correlation dependency mapping, and active dashboards that collect, contextualize, analyze, and display vast troves of telemetry information (e.g., metrics, logs, traces, polls, events) from across multiple clouds and classic, mobile, and modern application environments is now required.

This complex map of resources and demands creates a system that has critical dependencies, all of which must be managed to prevent performance and security problems. In addition, the need to understand the digital experience for end users that use mobile and web-based applications is another critical part of full-stack observability. Most enterprises expect that this complex blend of infrastructure and application architectures, processes, and use of multiple clouds will remain for the foreseeable future. Traditional monitoring is no longer enough to manage the rising complexity, scale of change, and importance of speed in delivering high-impact and high-quality digital services.

FIGURE 1

Full-Stack Observability: Next-Level Performance Monitoring

Application monitoring is a core foundational element of full-stack observability … but it's just a start.

Classic Monitoring	Full-Stack Observability
Metrics, logs, traces, polls, and telemetry that support passive data collection and broad-based analysis	End-to-end active monitoring and in-depth analysis that boost resilience and responsiveness
Static, passive displays and interfaces	Exploratory, active role-based dashboards
IT Ops target role with emphasis on problem detection and resolution	From development to delivery to customer centric (SRE, Dev, DevOps, COEs, SOC product manager, and customer)
Segment, component, or application focus, static	Full-stack core-to-client visibility, dynamic
IT-centric	Business- and end user-centric
No security awareness	Security integration
Limited analytics	Intelligent broad-based analytics, AI/ML-enabled
Lack of automation, limited triggers and actions	Auto-remediation and -optimization enabled

Observability is for everyone: SREs, Ops, DevOps, development, security managers, platform teams

Source: IDC, 2021

As highlighted in **Figure 1**, the differences between classic monitoring and full-stack observability are striking. Maintaining the health, performance, and security of services requires tracking and correlating a wide range of infrastructure, application, and security operations data across exchanges, events, and conditions across critical portions of applications and infrastructure. Kubernetes, containers, and microservices also provide additional fast-moving infrastructure to support cloud-native applications but create further management complexity because

traditional monitoring approaches often have limited visibility, narrow views, change control mechanisms, and governance insights that can't keep up with the continuous fluctuations in resource usage and availability.

Finding the problem or root cause of a service issue before it impacts the digital experience is a difficult challenge when using traditional search tools, log-based alerts, and static graphical displays. Traditional IT monitoring tools are optimized to collect data about the state and health of individual systems and applications in a limited fashion or time frame for a small group of end users and specific technology domain(s). Full-stack observability solutions provide a common framework for collecting, normalizing, and analyzing performance and security data in context to drive rapid, actionable insight across a wide variety of applications, cloud services, and computing and networking infrastructure.

Managing and running modern cloud applications is a complicated task today, and will continue to increase in complexity, mainly due to the need to manage multiple cloud-based infrastructure and application services. Here, the natural diversity of different application architectures, the importance of mobile applications, the often-hidden internal operating conditions of cloud services, the cross-team adoption of polyglot microservices frameworks, and the rising importance of API-driven integration requirements all contribute to the increasing complexity of today's digital environments. In addition, enterprises typically have unique approaches to application and infrastructure security across different vendors and environments. In today's hyper-connected digital world, security threats raise the stakes dramatically in application and infrastructure management.

Many monitoring tools and processes operate for a specific IT silo, creating separate data pools that are fragmented and lacking business context. This makes it difficult to identify the root cause of a problem, and virtually impossible to map service problems back to the business impact. Many traditional monitoring tools rely on different teams to manually isolate data points and initiate manual, fragmented processes. As the volume and diversity of data, formats, and sources proliferate, these teams need an integrated approach driven by common data sources, core-to-client analysis, contextual smart dashboards, and artificial intelligence and machine learning (AI/ML) models to process deep and broad data pools, identify and solve problems rapidly, track usage and performance trends, and match service conditions and issues to their respective business metrics and outcomes. It's the combination of visibility, insights, and an ability to take actions based on business priorities that makes full-stack observability a potent reality.

Full-stack observability is a modern approach to gleaning insight into the performance of complex environments, applying analytics on deep and broad pools of telemetry data (metrics, events, logs, and traces) collected from an array of sources (applications, networks, internet, compute infrastructure, cloud

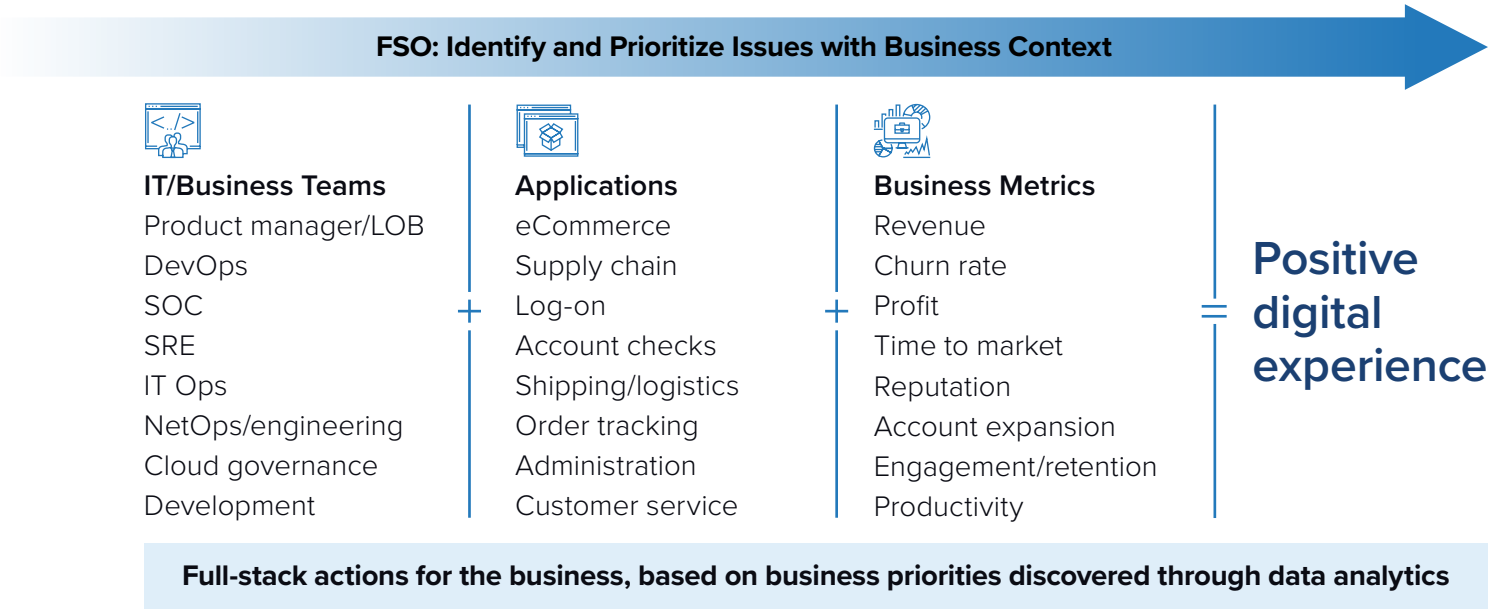
services, Kubernetes, service mesh, microservices, etc.). It incorporates the end-user experience and adds the business context to the performance analysis. Full-stack observability utilized with DevOps and SRE practices creates a platform to prevent and solve service problems before they cause end-user and business disruptions. Full-stack observability allows teams (e.g., NetOps, SecOps, DevOps, engineering) to collaborate and discover new business and customer insights, essential ingredients for success in a digital-first world.

Driving Business Context

To compete and drive sustainable competitive advantages, IT executives must consider the importance of gaining visibility, insight, and an actionable understanding of business context delivered with full-stack observability. Business context is the ability to map service capabilities and quality across digital applications and infrastructure, with insights to the real business impact experienced by the end user, whether internal worker, external partner, or end customer (see **Figure 2**) — for example, the ability to understand revenue flow or customer churn as it is impacted by the performance of digital services. The service visibility, insights, and analytics provide context that enables IT leadership to deliver high-quality digital experiences that create measurable business outcomes, in business — not only technical — terms.

FIGURE 2

Full-Stack Observability: Providing Business Context for Enterprises



Source: IDC, 2021

Full-Stack Observability Benefits

Full-stack observability solutions allow multiple IT (and business) teams to have a common end-to-end performance view of systems across applications, multiple clouds, infrastructure, and network segments, using advanced analytics models and automation capabilities to identify and solve problems, deliver consistent service levels, readily activate new service capabilities, and act in an automated and accurate fashion. In addition, there are many other benefits that full-stack observability can provide.

These include:

- Improving the overall digital experience for end users and smart end devices
- Targeting performance metrics and service levels based on business priorities/policies
- Heightening application health and availability measurement
- Reducing mean time to repair, operational incidents, and help desk calls
- Providing more timely, precise, and automated remediation
- Supporting reliable reporting with business context
- Bolstering IT cost control, containment, and staff productivity
- Improving development productivity and business agility
- Aligning IT teams via a shared common core-to-client context
- Enabling proactive management actions that head off digital experience impact
- Assuring and securing DevOps pipelines more effectively
- Accelerating innovation across the full software development life cycle and related operational teams from a single platform

What Questions Can Full-Stack Observability Answer?

Full-stack observability can help a plethora of IT teams answer several questions in their own context, using a singular, consolidated data set.

Some of the key question include:

- Why is the service broken, and where is the problem?
- What are the service dependencies, and can we visualize those dependencies?
- Is the performance problem in the network, infrastructure, security, or application stack?
- How are cloud services (IaaS or SaaS) affecting the digital experience, and what can we do to identify and remedy cloud service issues in partnership with the provider?
- Why has performance degraded over the past month?
- What logs, metrics, events, and traces should we look at right now that are relevant?
- How are digital experiences, resource usage, and system/service loads trending?
- Who is impacted by the downtime?
- Are we prioritizing business context for each service?
- What are the business priorities (and policies) we are mapping the service toward?
- What is system performance like for our most important customers?
- What service-level objectives should we set?
- Are we meeting our service-level objectives?
- Do we have the right service-level indicators?
- Do we have the right analytic models to apply to the data set for our defined outcomes?
- What can we auto-remediate, and can we predict problems before they impact end users?
- Do we have a handle on the performance and impact of our planned digital rollout?
- Have we mapped out the customer journey and do we understand the perception of customer value?

Essential Guidance

Based on IDC enterprise client conversations, full-stack observability capabilities are fully expected to benefit their overall organization and their IT teams. Some observability features — such as service mapping and transparency, problem detection, trend tracking, intelligent analytics, information visualization, and business context across a consolidated view of application and infrastructure (network, compute, cloud) — are in high demand. In addition, the need for existing toolchain integration continues to be a critical component for success.

As enterprises continue to consider their modern observability strategies, they should consider the following recommendations:

- Consider the implementation of a comprehensive data-driven strategy that utilizes a full-stack observability platform to rapidly ingest, normalize, analyze, and share insights from various analytic models.
- Road map opportunities to align observability data with automated actions and remediations for problem, change, and incident management processes.
- Consider the consolidation of tools and workflows as the strategy moves from monitoring to full-stack observability.
- Collaborate with the business to gain a mutual understanding of the goals, measurements, and intended end-user segments to define the business metrics that matter.
- Identify the data sets required to define key performance indicators (KPIs) for the business.

CISCO FULL-STACK OBSERVABILITY SOLUTION:

Focus on Performance, Optimization, and Security

As businesses evaluate the benefits that full-stack observability can bring to their people, processes, and technologies, they often start the discussion with the business outcomes they want to deliver for customers and the business. Full-stack observability enables alerts, reports, and recommendations that connect the availability of an application's system to a specific business metric — for example, providing the ability to identify and visualize data from a slow-performing application service, then mapping the relevant data to a geographic region and specific service component before it fails completely. By getting ahead of the failure, IT stakeholders can ensure the availability of the service, thus reducing customer impact, the potential loss of revenues, and a hit to a net promoter score. Increasingly, the successful delivery of business outcomes and great customer experiences are predicated on the performance, optimization, and security of applications and their associated services.

Cisco brings full-stack observability to customers through multiple use cases across performance, optimization, and security. It does so through a closed-loop, data-driven, real-time framework. This starts with full-stack visibility via an observable and optimizable technology stack, spanning data ingestion from application performance, internet, and hybrid infrastructure, including end-user experiences and business outcomes. Comprehensive visibility enables full-stack insights that provide application and business insights across the stack by building a shared common context. This includes operational issues and the end-to-end real-time correlation required to prioritize the resolution of issues with higher business and experience impact.

Whether these insights are associated with business transactions, security incidents, or other KPIs like service-level objectives, they can all trigger full-stack actions, the final part of Cisco's full-stack observability framework. This is where full-stack actions for the business are prioritized around remediations and optimizations across the stack, from applications to infrastructure performance and workloads, plus cost optimizations and application security detection and policy enforcement, from both development and runtime environments.

Building on the types of prioritizations done by many businesses, Cisco offers full-stack observability solutions across performance, optimization, and security use cases.

Performance Use Cases

Hybrid Application Monitoring: Performance monitoring of traditional and cloud-native applications

This is a very common yet challenging environment from a full-stack observability standpoint. Hybrid applications typically include technologies and services from on-premises and/or edge deployments, multiple public cloud services, and SaaS offerings. Many businesses need this flexibility to get to market faster and to scale to millions of users while still remaining agile.

KEY OPPORTUNITIES

- Visibility across all of these environments is critical to understanding every component the hybrid application is dependent on — even more so as businesses continue to accelerate their digital transformation journeys.
- True full-stack visibility allows teams to measure performance and establish KPIs and metrics while correlating data to provide insights. A typical example is faster root cause analysis (RCA) across distributed environments when there are issues affecting performance that ultimately impact business KPIs and revenues. Cisco leverages AppDynamics and its extended capabilities to deliver on these requirements.

Digital Experience Monitoring: Actionable, end-to-end insight into the application experience, its underlying dependencies, and associated business impact

Typically, the application experience is directly correlated to the end-user experience and is based on the performance of the business application and the end-user application that is consuming it, as well as many networks and services — mainly the internet and SaaS — that are in between and typically outside of IT operations teams' control. As such, Digital Experience Monitoring becomes even more important as many applications become mobile and hybrid work environments allow people to continue working from home.

KEY OPPORTUNITIES

- Enterprise operations teams are often responsible for application experience but have limited visibility into the external environments and dependencies that shape it, leading to longer resolution times, degraded user experience, and, in many cases, negative revenue impact and damaged brand reputation.
- There is a need for application and network teams that support user experience to come together and decide which issues should be prioritized based on the application experience and business impact. Cisco delivers that via ThousandEyes Internet and Cloud Intelligence integration with AppDynamics Dash Studio.

Optimization Use Case

Hybrid Cost Optimization: Only paying for what's needed in the public cloud and optimizing on-premises and edge assets

A frequent condition associated with IT infrastructure and workloads is overprovisioning. Both application operations and infrastructure operations teams usually have specific monitoring tools for historical and current demand as well as associated costs. Nevertheless, they typically do not have visibility into their real-time dependencies, inclusive of collateral cost impact, let alone insights that tell them how to optimize for performance and costs when looking at them together. Businesses spend too much time and money maintaining multiple non-integrated tools, each responsible for only one layer or aspect of potential optimization.

KEY OPPORTUNITIES

- When provisioning workloads, businesses overprovision computing instances and bandwidth reservations in the public cloud as a hedge to ensure application performance. They also allocate on-premise resources assuming peak application loads. Such overprovisioning leads to higher-than-necessary expenses.
- Cisco delivers on multicloud cost optimization and infrastructure rightsizing, in context with the business applications' impact via Cisco's Intersight platform integration with AppDynamics.

Security Use Case

Vulnerability: Providing the visibility needed to actively identify and block against vulnerabilities found in production applications

Many IT operations teams continue to struggle with pinpointing security incidents. They are often in reactive mode when it comes to security vulnerabilities and incidents, which is already too late. This situation happens due to the time it takes to diagnose what has been impacted, then determine how to fix it. The scenario becomes even more complex when multiple operations teams, beyond SecOps, must be involved. Applications, networking, infrastructure, cloud, and other teams find it challenging to understand the scope of security incidents, which ultimately makes it difficult to determine the impact and priority in relation to other alerts.

KEY OPPORTUNITIES

- There is a common lack of visibility into how security incidents actually impact production applications, end users, and the overall business.
- When considering production business applications, the AppOps and SecOps teams need to collaborate so that application security is not an afterthought, and they need to go even further when it comes to blocking vulnerabilities in runtime application environments. For that to happen, contextualization and correlation of ingested information plus real-time insights on incident mitigation is needed, which is provided by the Cisco Secure Applications solution.

Challenges and Opportunities

For many enterprises, organizational structure, established practices, and policy issues related to implementing full-stack observability capabilities may be more challenging than the technical considerations. Many organizations have strictly structured and siloed IT teams and processes, each supported by its own plethora of unique tools aimed at operational and performance management. Migrating to a full-stack observability solution requires significant process change, improved cross-IT collaboration, and forward-looking aspirations that transcend any one IT team or technology set. The opportunity exists for IT leadership to consider the growing role of in-depth end-to-end analytics in driving the best possible digital experience for workers, partners, and customers and the most efficient and effective use of increasingly complex core-to-client technology structure and highly valued IT staff. Here, improved system observability and control enable consistent service delivery, full resource utilization, a strong security posture, and digital readiness and innovation.

Tooling that is appealing to multiple IT teams and stakeholders — such as IT operations, SREs, networking and security teams, and application developers — is necessary to increase the adoption of full-stack observability and to enable effective collaboration across the enterprise, both within IT and between IT and business groups. Cisco will need to help organizations bring together diverse decision makers representing development, operations, engineering, security, and services oversight and provide ready integration (e.g., validated configurations, open APIs, and common data sets) across both Cisco and non-Cisco tools. The ability to balance further analytics models to accomplish different outcomes is another common observability challenge.

Finally, most IT organizations lack the ability to create unified visibility across all key services, covering application, network, compute, and cloud services components. This causes a slowdown in incident response, exposes the end user to a poor digital experience, and pulls IT staff away from innovation efforts. Cisco must continue to partner with enterprise organizations to implement an outcomes-focused approach that removes process and technology inhibitors while providing a runway to increase full-stack observability feature adoption across IT teams to expand platform adoption and impact.

Conclusion

IDC believes that observability solutions deployed consistently across organizations will be important in optimizing end-to-end service performance with visibility, insights, and analytics. By making systems observable, IT teams can move quickly from identifying the effect of a problem to the cause in a complex production system. Observability is about understanding that a performance problem is happening, having the transparency to communicate why and where it's happening, and empowering teams to go fix the problem, manually or automatically. The future will involve automated actions and processes dependent on full-stack observability capabilities that monitor, measure, and manage across application, network, compute, and cloud resources, using analytics and business priorities to adapt infrastructure in real time to drive operational simplicity and optimized digital experiences. Generally, the more that developers, SREs, and infrastructure and security teams are provided with unified visibility into the operating condition of an end-to-end digital system, the better the digital services will perform and, most importantly, serve the business.

About the Analysts

Stephen Elliot
Group Vice President, I&O, Cloud Operations, and DevOps, IDC

Stephen Elliot manages multiple programs spanning IT Operations, Enterprise Management, ITSM, Agile and DevOps, Application Performance, Virtualization, Multicloud Management and Automation, Log Analytics, Container Management, DaaS, and Software-Defined Compute. He advises senior IT, business, and investment executives globally in the creation of strategy and operational tactics that drive the execution of digital transformation and business growth.

More about Stephen Elliot

Mark Leary
Research Director, Network Analytics and Automation, IDC

Mark Leary is responsible for worldwide technology market research and analysis. Mark's core research coverage focuses on the advancement and adoption of network performance management solutions (both on-premises systems and cloud-based services) and the development of network automation capabilities by both technology suppliers and enterprise operators. Sample key areas of interest include end-to-end visibility, predictive analytics, AI/ML-driven insights, digital experience management, open source technologies, cloud service monitoring, and "programmed" automation as they apply to a secure, dynamic, and predictable network environment. Based on his current work and background, Mark's research also examines the evolution of enterprise and cloud network technologies, adoption of cloud services and software-defined systems, buildout of professional support services and partner ecosystems, fortification of network management best practices, and the reformation of IT staff roles and skills in this demanding hyper-connected digital era.

More about Mark Leary

Message from the Sponsor

Full-stack observability is an evolutionary step beyond traditional monitoring that's siloed by domains. Cisco's Full-Stack Observability solution provides full-stack visibility, insights, and actions from the API all the way to the bare metal and across all data types. This enables our customers to optimize for performance, cost, and security across hybrid and multicloud environments for traditional and cloud-native applications. Cisco's Full-Stack Observability solution also includes business context, so when a problem does occur, our customers not only know where the problem is, but they also know why it occurred and the actions they need to prioritize based on the impact to the business. Today, Cisco is breaking down the silos between teams and delivering full-stack observability through integrations across three SaaS services: AppDynamics (including Secure Application), ThousandEyes, and Intersight.

To learn more, please visit: **www.cisco.com**

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