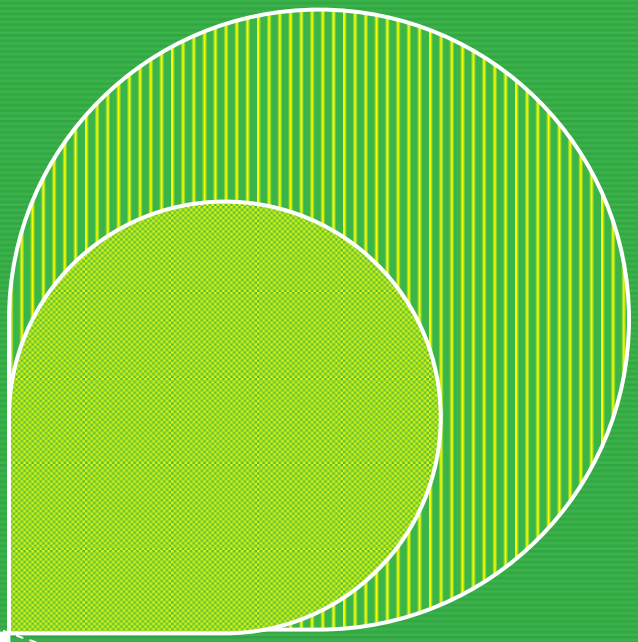
March 2014, HAPPIEST MINDS TECHNOLOGIES

Simplifying Data Center Network Management Leveraging SDN

Author

Srinivas Jakkam Shivaji



Copyright Information

This document is an exclusive property of Happiest Minds Technologies. It is intended for limited circulation.

Table of Contents

Introduction

The traditional networks that have been built within the global enterprises over the years are inflexible, very cumbersome to change, not easily scalable and need highly skilled and experienced network architects and engineers to administer and manage its complexity.

External programming or automation is an issue with traditional networking devices due to their usage of vendor dependent proprietary management system, protocols and lack of reliable APIs. The networking industry has been slow to evolve due to the concept of “Black Boxes”; many enterprise customers perceive it as the primary inhibitor to agility and innovation.

Enterprises are driving data center consolidation, maximizing ROI through robust technologies such as server and storage virtualizations and private/hybrid cloud implementations, to support the agility demands by the business. Enterprise Data Network, however has been a major impediment to agile changes; therefore enthusiasm dampener for the business and IT. This has made networks in Datacenter appear as “antiquated and error prone component.”

Software Defined Networking (SDN) is the new norm for networks that enables network operators to have programmatic control over the entire network from a single logical/virtual point. SDN offers the vision of real-time control of the behavior of parts or all of network by centralized software (Control Plane) which was not possible in traditional networking approaches.

This whitepaper gives a brief overview of one of the critical use cases which Happiest Minds can demonstrate as an innovative solution that enhances field engineer’s experience in managing/configuring/debugging all levels of networks in datacenters leveraging Software Defined Networking Technology (SDN).

The Drivers for Simplifying Network Management

A typical Enterprise Data Center is an ever-changing system consisting of thousands of IT and Infrastructure assets with very complex relationships between Data Center network elements often spanning multiple data centers across locations and geographic boundaries. There are a wide range of tools available for data center network management. Data center management remains to be intimidating despite the deployment of tools such as asset management, real-time monitoring of network element's availability, Service chain provisioning and Workflow/Automation management.

With Internet of Things taking shape, where the number of things connected to internet would increase exponentially and Cloud Computing making huge impact in a positive way, the enterprise Data Center architecture and design is getting more complex. Data Centers need to handle explosive data growth, very large volume of concurrent transactions at extreme responses, deep data analysis using complex algorithms and ability to recover from failures and restore large volumes of data, in short period, in a federated compute environment.

This necessarily means that it would require, besides highly efficient and improved planning, Data Centers to be consolidated and managed for massive scale and very high performance.

Changes with minimal downtime must be made seamlessly to production business applications, the network elements monitoring and management simplified, and maintenance process reliable.

THE COST OF GETTING IT WRONG

Average cost of data center downtime per minute	$ 7,900
Average reported downtime	86 minutes
Average cost of incident	$ 690,000
For a total data center outage, average recovery time is 119 minutes, costing approx.	$ 901,500
For partial data center outage, average recovery time is 56 minutes, costing approx.	$ 350,000

Ponemon Institute

Traditional Enterprise Data Center Network management can be extremely challenging, requiring painstaking analysis which is error prone, and potentially very expensive to business due to any network downtime and inadvertent exposure to attacks. Often successful break-fixes, minor changes or enhancements to network elements and most definitely all major upgrades and/or implementations requires significant coordination between field engineers and remote network architects, managers or administrators operating from global network management centers. The enterprise network management process today is a serious impediment to the promise of agile application development and continuous deployment even as the server and storage virtualization, and private/hybrid/public cloud solutions have come of age.

The management/configuration/debugging procedures remain a daunting task in data centers mainly because of multiple vendor-specific proprietary assets such as switches/routers requiring their own proprietary procedures rather than simple and unified process. The data center network management challenges as above have found answers in the latest technology advances such as Software Defined Network (SDN) where the control panel is abstracted from the network devices. However, all these future technology adoption will be possible only if and when the point of adoption is strong.

Challenges Faced by Field Engineers towards Data Center Network Management - A Deep Dive

Challenging economic climate is driving businesses to reduce or at-best maintain flat budgets without impacting performance. Meeting current market needs is impossible with traditional network management approaches in data centers. However, data center consolidation to service oriented architecture is enabling organizations, an opportunity to implement advanced network virtualization technologies that are application aware, and management strategies that maximize network bandwidth utilization and ensure superior application performance.

Enterprise Network Management challenges are multi-fold and some of these are described below:

- Lot of challenges are faced by Field Engineers to add or move any device in data centers, as they have to touch upon multiple switches, routers etc. using vendor dependent device level management tools.

- For a simple network-wide policy to be implemented, Field Engineers (of Data Center) may have to configure multiple devices and mechanisms. For example, every time a new Policy is to be added, it can take hours/days, for field Engineers to reconfigure policies across the entire network.

- As capacity, performance and availability demands on the data center rapidly grow, so must the network grow. This requires an efficient and better management of network in data centers. The traditional network management tools used by Field Engineers are not designed to support analysis and changes according to the growing business demands with service level expectations in hours or days.

- Enterprise datacenters would need to deploy new capabilities and services in response to changing business needs and user demands. But, provisioning such new capabilities in enterprise datacenters is hindered by vendors' equipment product cycles with respect to Management Tools.

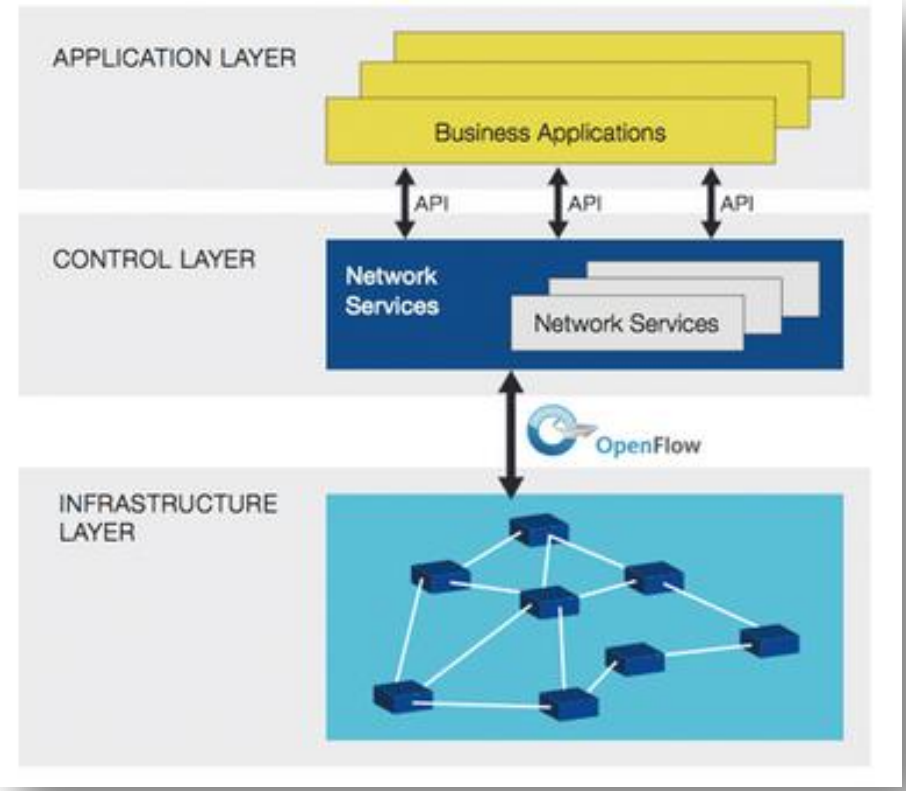
- Ability of network operators/Field Engineers to tailor the network to their individual environments is hindered due to lack of standard, open interfaces.

All these above described challenges act as negative catalysts that result in exponential increase of Operational expenditures at Data Centers. The number of interfaces that requires human touch starting from extensive planning and using unwieldy network diagrams make the whole process error prone. In effect, traditional enterprise network management methods are increasingly proving expensive to the business, both in terms of maintenance and ability to introduce changes to the network at speeds, which can make business agile in the market place.

SDN (Software Defined Networking) plays an integral role in transforming most of the network management issues and is promising to be a key differentiator in bringing down the Operational expenditure (OPEX), therefore needs serious consideration by Network Managers.

SDN Overview

Software Defined Networking is a new architecture that has been designed to enable more agile and cost effective networks which enables simpler and innovative management approaches that introduces consistency, reliability and performance into today's complex Data Center's environment. The Open Networking Foundation (ONF) has defined an SDN architecture model as depicted below.



Software Defined Networking (SDN), the emerging new network architecture primarily does two things: (a) decouple network control functions from simple network forwarding functions and (b) make networking functions programmable via APIs to applications. This migration of control, from individual network devices, enables the underlying network to appear like a logical entity for applications and network services.

Network intelligence that was distributed in traditional networking architecture is now logically centralized in a controller that enables one to have an entire view of the network. With SDN, enterprise data centers can now have vendor independent control over the entire network infrastructure from a centralized logical point, which further simplifies the network operation and its management. Network administrators/Field engineers can now through standard, open-interfaces (using automated scripts/programs) debug/configure this simplified network abstraction, rather than feeding in thousands of lines of configuration distributed among multiple devices.

Network managers get the flexibility to organize, manage, secure and improve network resources by automated SDN programs. SDN enables field engineers to manage the entire network infrastructure at Data centers through intelligent orchestration, and provisioning systems that can be built as business applications at the Application layer of SDN architecture, custom tailored to meet business objectives.

Solution: Network Management Simplified

Implementation:

The following illustrates the transformation by the SDN architecture on implementation of management function developed by Happiest Minds.

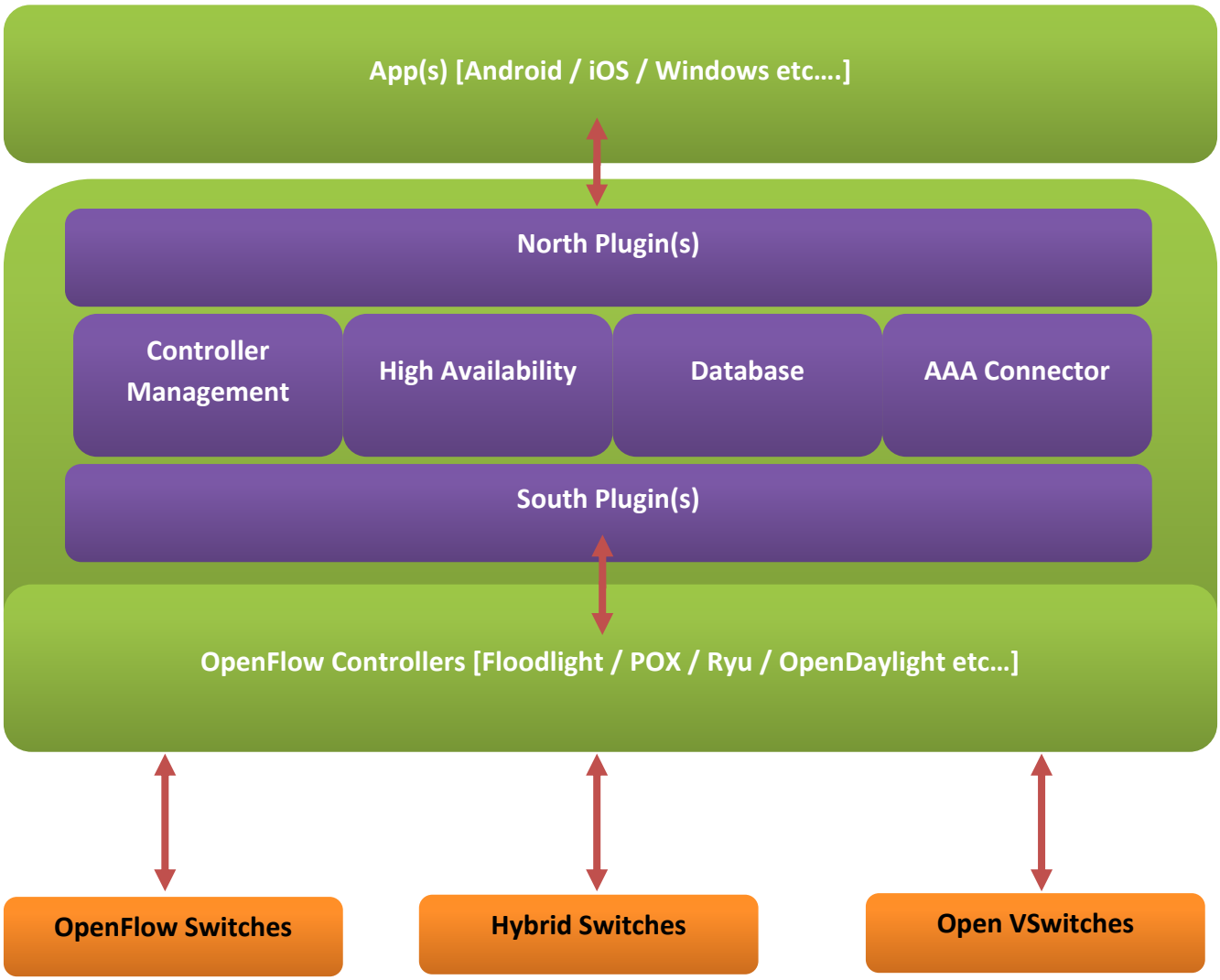
1) **QR (Quick Response) Code**: QR Code would be present on each and every network element. Using this, the field engineer would retrieve all the dynamic statistics information (such as Current traffic at its ports, Flow tables, ACLs, etc.) pertaining to the scanned network element.

We could have various implementations of QR codes as shown above on each and every network element in a data center.

2) **Central Server**: Helps in establishing and maintaining connection between itself and SDN Controllers present at the Datacenter. It also helps in establishing connection between itself and the App running on a tablet/phone. It forms a bridge between the Response and the Query between App and SDN Controllers.

3) **Android app**: Runs on a tablet/phone, and enables the field engineer to perform required operations on the network element in an Enterprise Datacenter.

Architecture



Brief Overview of Central Server

North Plugin(s): This component provides compatibility and acts as a translator between various Platform Apps (such as Windows, Android, iOS etc.), to communicate with the central server.

Controller Management: This Module is mainly responsible for acquiring and storing all the information about a controller such as its IPv4 address, so that the controller can get attached to the central server.

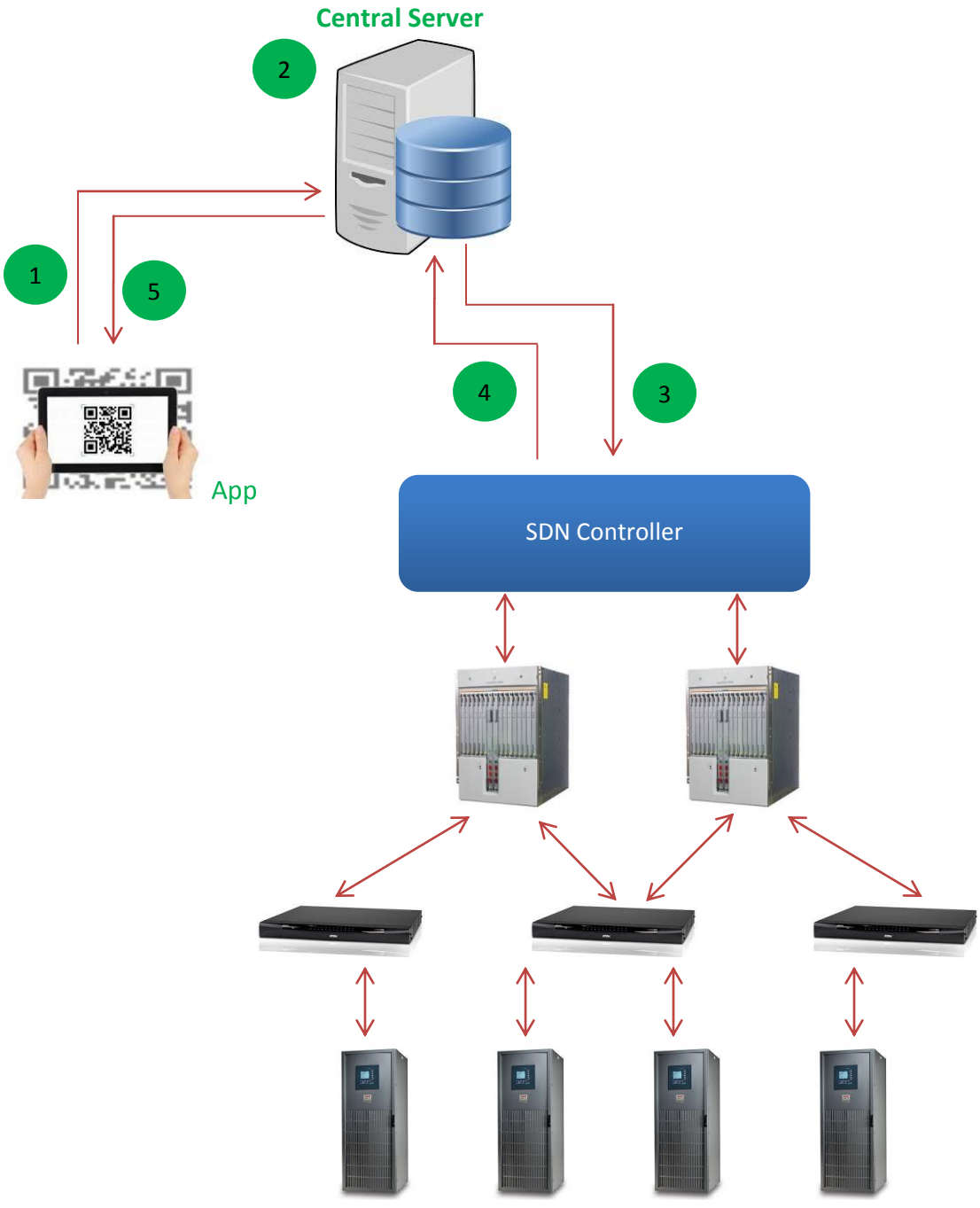
High Availability: As we know the outside world is very uncertain, this module helps in having Distributed Server approach. When a server is down due to uncertain events, then this module can automatically sense this state and transfer all the fragile information (such as the table information) and its contents to a Standby server, which would automatically take over the work.

Database: This module is liable or causative for updating the basic Network Element Information (such as MAC Address) at the central server.

AAA Connector (Authentication Module): This module authenticates each and every valid Controller registrations. The network administrator can also determine which of the controllers can gain access to the server and which cannot.

South Plugin(s): As we know there are many types of SDN Controllers available that are unique in their own ways in terms of Programming language that was used to build them (or) Policies/Standards that were used to build them. So south plugin(s) provide a medium through which various SDN controllers could communicate with the central server.

Implementation Overview



1. Field Engineer scans the QR Code present on the network element (Switch/Router) and the MAC address is sent to the Central Server.
2. The Hash Table maintained by the Central Server is scanned for the IP address of the SDN Controller, with received MAC address.
3. Central Server establishes connection with the retrieved IP address of the Controller and sends the Query received from the App to the SDN Controller.
4. SDN Controller searches for the network element information maintained by it and send back the queried result to the Controller.
5. The Central Server sends the result to the App and the App displays all the Queried information on the screen.

Using the retrieved information, Field engineer can either decide to debug (or) configure the network element from the App itself.

Benefits

- The solution has been designed to cater to future needs of Data Centers, arising out of Data Center consolidations and transformation to hybrid or completely Software Defined Data Centers (SDDC). In such scenario, the Network Management such as configuring/monitoring/debugging its assets must also transform.
- Centralized Management and networking control devices from multiple vendors with a single application, increases the productivity of a Field Engineer during downtime by just relying on single Management Application rather than Multi-Vendor specific Management tools, which directly translates to Datacenter Agility.
- Rapid Innovation has the ability to deliver new network capabilities and services, without the need to configure individual devices or wait for vendor releases that enables one to design their datacenter networks, according to their business needs, thus having an Competitive edge.
- More granular network control with the capability to apply comprehensive and wide-ranging policies, at the device level enables to introduce new services in matter of minutes compared to hours/days using traditional approaches.

- Eliminates the need to individually configure network devices each time an end point, application or service is added or moved, or a policy changes, which reduces error prone environments at data centers caused due to configuration or policy inconsistencies.
- Because SDN controllers provide comprehensive visibility and control over the network, it could be ensured that access control, quality of service, security and other policies are enforced consistently across the network infrastructure of enterprise data centers.
- With Happiest Minds Datacenter network management solution, enterprises and carriers benefit from reduced operational costs, more dynamic configuration abilities, less errors and consistent configuration and policy implementation.

Conclusion

The main aim of this solution is to have a Unified Debugging/Configuring/Monitoring tool, rather than having individual vendor specific Configuring/Debugging procedures for each and every different vendor specific switches, in a Datacenter with the help of SDN Technology. It also eliminates the use of CAT cable techniques and has an entire Network Infrastructure Intelligence in a Tablet/phone, through which Debugging/Configuration/Monitoring can be done on the fly. This solution along with SDN enables Field Engineer to install the Flows (Flow tables) in the switches on the fly from any device, thus transforming the network from “STATIC” networks to “DYNAMIC” networks. SDN technology enables “Traditional Data Center” to be transformed to “Software Defined Data Center, where everything is determined in terms of software rather than relying on CLI’s and Closed Proprietary Technologies, Tools and Devices. So, are we ready to cater to the needs of future applications that utilize Data Centers, such as Internet of Things (IoT), Cloud, Big Data, M2M, Intelligent and smart Devices, Software Defined Data Centers (SDDC), Intelligent Networking Infrastructures etc?

References

Causes of downtime study – Emerson Network Power
www.opennetworking.org
www.sdncentral.com
Software Defined Networks by Thomas D Nadeau & Ken Gray from O'REILLY

About Happiest Minds Technologies:

Happiest Minds, the Mindful IT Company, applies agile methodologies to enable digital transformation for enterprises and technology providers by delivering seamless customer experience, business efficiency and actionable insights. We leverage a spectrum of disruptive technologies such as: Big Data Analytics, AI & Cognitive Computing, Internet of Things, Cloud, Security, SDN-NFV, RPA, Blockchain, etc. Positioned as "Born Digital . Born Agile", our capabilities spans across product engineering, digital business solutions, infrastructure management and security services. We deliver these services across industry sectors such as retail, consumer packaged goods, edutech, e-commerce, banking, insurance, hi-tech, engineering R&D, manufacturing, automotive and travel/transportation/hospitality.

Headquartered in Bangalore, India; Happiest Minds has operations in USA, UK, The Netherlands, Australia and Middle East.

To know more about our offerings. Please write to us at **business@happiestminds.com**