OVERVIEW

Banyan Hills Technologies (Banyan) provides technology services in combination with Canopy™ our Internet of Things (IoT) platform to support companies taking large networks of devices to market. Using a phased approach that is effectively aligned with go-to-market business objectives, we gain a complete understanding of the market and can refine the long-term technology road map. A typical Banyan engagement involving the deployment of Canopy includes the following key objectives:

ANALYSIS AND ASSESSMENT

Analysis & Strategy: Partner with the customer to analyze strategic business objectives, and establish a technology road map that enables operational efficiency and growth.
Assess: Identify key pain points within an existing solution set, should one exist, that are preventing the customer from obtaining their business objectives.

STABILIZATION OF EXISTING TECHNOLOGY ECOSYSTEM

Stabilize existing technology solutions and processes: Resolve all open issues that are preventing pre-existing technology solutions from maintaining high availability for the customer.
Optimize partner relationships: Enhance relationships with third-party technologies providing services such as payments, cellular, software, and hardware in order to rationalize costs and centralize accountability.

CANOPY DEPLOYMENT

Introduction and deployment of Canopy: Migrate to a single software management platform that supports the end-to-end business.
Leaf Implementation: Implement and configure Canopy’s Leaf end-point agent to listen and understand the customer’s unique business environment.

MAINTENANCE AND SUPPORT

Road map execution: Execute technology road map that aligns with and achieves strategic business objectives.
Canopy Optimization: Continuous optimization of the Canopy implementation, to fine tune Canopy in a manner that ensures delivery on key performance metrics.
Scale and maintenance: Further establish a deep partnership with the customer to drive scale in the deployment, and maintain high availability of the network for ongoing growth.
Introduction

The introduction of Canopy will be a key strategic component of the technology road map. Canopy provides the business with all of the tools necessary to run a network of devices at scale from a single centralized management platform. We use the phrase “One time, real-time" to describe what Canopy does, as it perfectly summarizes the fact that Canopy takes real-time data from a network and centralizes it into a single management platform to support operations. Key components of the platform include:

**DEVICE ENDPOINT**

- **Device Instrumentation**: Secure device instrumentation through an easily extensible software agent (Leaf), that runs on any base operating system / device hardware platform.
- **Software Distribution and Management**: Canopy’s Software Distribution service is coupled with Leaf so that it can be leveraged to centrally manage the distribution of software updates out to the Leaf agents that reside on the network of device endpoints.
- **Secure Remote Command Execution**: Leaf allows an operator to securely and safely execute defined commands on the device endpoints. This allows the operator to recover devices in error states or otherwise quickly trigger behaviors across their fleet.

**ENTERPRISE SERVICES**

- **Event Processing**: The Canopy “Event Pipeline” is the heart of the solution, providing the centralized processing engine for data coming in at scale from the network of devices. It also supports the real-time decision making engine that allows for rapid response to complex events.
- **Integration Services**: Canopy maintains an integration platform that easily allows third-party software solutions to integrate into the platform. This helps operators leverage technology investments that have already been made within their existing IT infrastructure.

**MANAGEMENT PORTAL AND BUSINESS APPLICATIONS**

- **Operational Web Portal**: A multi-tenant based web portal provides centralized access of available Canopy modules to a network operator, the operator’s customers, as well as an operator’s integration partners.
- **Location & Device Management**: The Location and Device Management modules manage the entire life cycle of a device, from initial procurement to provisioning and field deployment to device retirement. Nodes can be established to allow the operator to view their devices like they view their business.
- **Customer Management**: The Customer Management module allows an operator to track, manage, and communicate to customers that are interacting with the device.

Canopy takes real-time data from a network and centralizes it into a single management platform to support operations.
Leaf is a software agent that is installed on the client device, and is responsible for capturing and delivering event data to the enterprise. Leaf is currently designed to run on both Windows and Linux operating systems, with the goal of providing a software agent that can be agnostic to the hardware device in which it is installed.

Upon installation, Leaf automatically begins sending common device/machine data attributes (available memory, CPU temperature, available physical disc space, etc…) to the Canopy Enterprise. Leaf can then be easily extended through the build out of plugins, to obtain additional attributes. Examples include: network connectively health, fraud detection events, credit card reader, device health, retail transaction events, and customer information.

The following diagram illustrates how Leaf is architected on the device, and how it communicates to the Canopy Enterprise.
Leaf can be agnostic to the hardware device in which it is installed.

**LEAF AGENT – KEY FEATURES:**

**Message Delivery:** The core process of the Leaf Agent is the reception and delivery of messages from the device to the enterprise.

**Queuing:** If necessary or desired, the Leaf Agent is capable of queuing messages for later delivery. This might be used if network availability is uncertain or artificially constrained.

**Buffering:** The Leaf Agent is capable of buffering and aggregating messages if desired. This feature is useful when bandwidth is at a premium and real-time statistics are not required.

**Filtering:** The Leaf Agent is capable of filtering messages, if desired or necessary. This feature is useful when plugins or other processing are causing noise in the messaging stream.

**Remote Command Execution:** The Leaf Agent can be sent commands to execute by the Enterprise. Commands are pre-built and tamper proof. The Enterprise notifies the Leaf Agent that a command is ready during the response to normal communication.

**Software Distribution / Upgrade:** The Leaf agent is capable of receiving, facilitating, and reporting software update status from and to the enterprise.

**LEAF AGENT TO SERVER COMMUNICATION:**

The communication from the Leaf Agent to the Leaf Server is authorized and secured. The communication protocol is flexible given the type of implementation being required, however the following are the most frequently utilized.

- **HTTPS:** The Leaf Agent can communicate to the Leaf Server over HTTPS so that messages in flight cannot be intercepted by a third party.

- **MQTT:** The Leaf Agent can communicate to the Leaf Server via MQTT, a lightweight publish/subscribe messaging transport, that is optimized for IoT use cases.

**LEAF AGENT SECURITY:**

**Client Certificate Authentication:** The Leaf Agent is authenticated to the Enterprise via the use of a Client Certificate.

**Client Initiated Communication:** All communication between the Agent and the Server is initiated by the Agent, so no third party can inject commands into the Agent maliciously.
The Event Pipeline is responsible for receiving events from all Leaf agents that are deployed across the device network. The Event Pipeline receives these events, interprets the data, evaluates the data for subsequent event/notification handling, transforms as applicable, and ultimately persisting into the Canopy data repositories. The Event pipeline is designed to process data at scale through dynamic vertical and horizontal scaling capabilities, a key requirement for large IoT device networks.

The following provides a view as to the architecture of the Event Pipeline:

**EVENT PIPELINE – KEY FEATURES:**

**Dynamic Scaling:** The Event Pipeline can scale up or down as needed and on demand.

**Resilient:** The Event Pipeline responds to failure in event generators, event consumers, and the pipeline itself in a graceful and lossless fashion.

**Extensible:** It is simple to create a service to plug in to the Event Pipeline and begin consuming events. Such services can be registered at run-time, so that new functionality can be added on the fly. An example of an extending the event pipeline would be to add complex event processing for predictive analytics on data flowing through the platform. Examples might be to use this kind of capability for predictive maintenance scenarios, and/or financial retail transaction forecasting.

**Configurable:** Adding new data sinks to the Event Pipeline can be done on the fly, which means raw data is always available for analysis, even before you know what you would like to do with it.
CORE EVENT PIPELINE ARCHITECTURE OVERVIEW:

- The entry point of the event pipeline can be configured to be any number of inputs, such as message queue, FTP listener, file folder, TCP listener. All messages are expected in JSON format.
- The core processing engine of the Event Pipeline is built on Apache Flume, which allows for the simple digestion of events and storage of those events in various data sinks (Mongo, RDBMS, Hadoop, etc.) Custom sinks can be written simply by implementing the provided interface.
- The Core Event Processing that occurs in the Event Pipeline is built via Apache Camel and Spring Cloud.
- Creating a service to register for events simply consists of creating a Spring Boot application and including annotations for registering the event listener for the required JSON path. Events will be distributed either via RESTful Web Service (synchronous) or JMS Queue (asynchronous).
- Zero message loss is guaranteed by queuing messages separately for each event target, such that failures in one system will not impact other systems.
- Event Pipeline service discovery is facilitated via Eureka and Ribbon with customized registration and heartbeats for health monitoring.
Canopy aims to greatly simplify the management devices by providing an operator with a single centralized web portal containing everything required for the full operation of the network. It is essential that the operator has real-time visibility into the status of their network, and that all information is tied together and presented through a single, intuitive user interface.

The portal is designed to be multi-tenant, allowing for the operator to setup and manage security credentials and associated security access for internal team members, internal operators (e.g. franchisees), external customers, and external partners.

**CANOPY WEB PORTAL KEY FEATURES:**

**Multi-Tenant & Security Management:** Canopy is multi-tenant and has a flexible hierarchy management security architecture. This allows for the operator to setup and manage security credentials that can restrict accessibility (Canopy modules and/or data within the modules) at any level within their organization.

**Internal and External Access:** The security requirements extend to external users of the operator’s organization as well, allowing an operator to grant access to external customers or partners so they log into the solution and access information specific to their environment.

**Modular:** The Canopy solution groups related functionality into modules. This allows an operator to “opt-in” for particular modules that are required for their business, and “opt-out” of modules that are not applicable.
Run Your Entire Business With Canopy

Go beyond basic device management. With Canopy’s custom KPI’s, you gain real-time visibility into the health of your devices and, with a custom dashboard, you can track performance and measure business impact. Manage all of your devices, locations, customers, transactions and other aspects that may be unique to your business.

Easy and Intuitive
Canopy is designed with the user in mind, providing a clean, modern, and intuitive user interface.

Customized Branding
Allows the operator to brand the portal with their look and feel or that of the various tenants within their organization.
Canopy Functional Modules

Canopy provides the operator the full set of products ("Canopy Modules") needed to run their business. These modules can be enabled and disabled as needed per the particular business problem being supported. The data between modules is seamlessly integrated so an operator never needs to leave the Canopy portal to have a sound understanding of what’s occurring within their device network. Correlating data across modules is essential in making sure the operator has an accurate and complete view of their business.

DEVICE & LOCATION MANAGEMENT

The device and location management modules of Canopy allows the operator to maintain an up to date inventory of all devices and associated locations within their network. This allows for the full life cycle of a device to be tracked and reported on from a status perspective, which is imperative in realizing cost and operational efficiencies.

Key features include the following:

- Device procurement / ordering platform
- Device provisioning
- Device assignment to location hierarchy
- Location assignment and hierarchy management
- Status tracking and reporting
- Relocation / reassignment management
- Device Retirement

CUSTOMER MANAGEMENT

The customer management module within Canopy provides customer relationship management (CRM) capabilities directly through the Canopy solution. This allows for the operator to keep track (if applicable) to customers transacting at the devices, and then to manage the ongoing relationship through Canopy.

Key features of the Customer Management module include:

- Customer Repository, containing customer attributes to be used for reporting, analytics, and segmentation.
- Customer management, including the ability to edit/add attributes for customers within the operator’s network, or even transact on their behalf.
- Customer segmentation, providing the ability to segment customers into groups based on stored attributes. This allows for the segmentation to be leveraged within the other Canopy modules (example: Marketing and Promotions).
- Seamless cross module integration, providing the ability to view how customers are engaged with other functionality within the solution.
Examples could include:

**Transaction Integration:** View what transactions a customer has completed.

**Marketing and Promotions Integration:** Include customers as a part of a digital marketing campaign.

**Incident Management Integration:** Create, track, and manage incidents for a particular customer.

**Location Management:** View devices across all your locations.

**TRANSACTION MANAGEMENT**

Canopy gives operators the ability to monitor and manage device transactions and revenue.

- Real-time visibility to transactions and revenue at the device level.
- Payment Management capability to find, edit and reverse payments as necessary.
- Predictive analysis of transactions and revenue, enabling an operator to take corrective action before an undesirable event.
- Seamless cross module integration provides the ability to see how transactions impact other modules within the solution. Examples could include:
  - **Customers:** See which customers drive the most revenue and which customers do not.
  - **Inventory:** See the impact of transactions on inventory levels.
  - **Marketing & Promotion:** Assess the revenue impact of promotional offers.
Operations – Monitoring & Notification

Canopy will provide the ability to monitor every facet of the kiosk solution, providing centralized visibility and notification to the operator. As an example, monitoring capabilities that could be provided to an operator of unattended kiosks might be:

**Hardware monitoring:** All hardware instrumented with real-time visibility into the health of the kiosk. This includes the monitoring of robotics within the machine, the kiosk peripherals. (credit card readers, screens, etc.)

**Network monitoring:** Monitoring of the network to ensure availability and real-time visibility into the health and performance of the kiosk. In an environment where machines are supported by a cellular network, this is important to ensure accounts are managed correctly to prevent overage charges to the business.

**Software monitoring:** Monitoring of the kiosk user experience software to ensure that all issues are seen at the time of failure to help prevent customer outages and continuously improve the solution.

**Customer transaction monitoring:** Real-time monitoring of transactions to provide the business centralized visibility into transactions as they occur, helping to identify issues as soon as they occur.

**Inventory:** Providing real-time visibility into inventory levels refining the distribution process to maximize revenue and help protect from possible misappropriation and improve operational efficiency.
The platform allows for metrics to be configured into Canopy as “Key Performance Indicators” (KPIs) that are specific for their business. This helps the operator to maintain a close view into the overall health of their business. These KPIs can then be easily reported on within the Canopy system, helping the business further optimize their operation.

The operations team will have centralized access to all capabilities through the Canopy portal’s rich monitoring, reporting, and analytics application suite.

As these monitoring alerts and events are processed, Canopy has the capability to provide:

- **Real-time notification:** Access to email, SMS, and push notification alerts.
- **Automated dispatch:** Configurable triggers to alert operators about common failures so that technicians can be dispatched.
- **Predictive analytics:** Using machine learning the system can detect failures and self-diagnose and heal through predictive maintenance.
- **Portal dashboard:** Configure dashboards to view the overall health of your fleet and the health of individual units within the fleet. This allows the operator to quickly understand their general health and to isolate problems.
Incident Management

Canopy provides an integrated incident management solution for all customer, partner and system generated issues that might arise during operations. The solution is configurable such that it can be mapped to an organization’s incident management organizational structure, allowing for an end-to-end ticketing platform that is tightly integrated with the device network being supported.

The following high-level features are included:

• Configurable incident management system that maps to an operator’s organizational structure.
• Ability to have tickets manually created by team members within the organization’s support organization.
• Ability for automatic system generated tickets to be created and assigned based on alarms within the network.
• Ability to manage incident tickets through the entire incident management life cycle.
• Integration to other modules within Canopy, providing a seamless view of the data to the operator.

Examples might include:

• Reporting integration for full view of incident management metrics for the business
• Location integration, such that metrics can be driven on how many incidents are being created by device/location
• Customer integration, such that the operator can maintain a complete understanding the customer experience

INVENTORY MANAGEMENT

From unattended retail to digital screen media to complex rental businesses, Canopy gives operators visibility into their inventory levels and the power to optimize their inventory across the network.

• Real-time view of inventory levels by device.
• Monitor key inventory metrics like turns, shrink, returns, markdowns, utilization, etc. to optimize inventory investment and allocation.
• Reorder, remove or re-locate inventory.
Canopy provides the ability for the operator to create rich marketing campaigns that deliver targeted advertising and promotional content to its customers. This feature introduces new advertising-based revenue streams for the business, and provides the business with a channel to personalize and enhance the customer experience.

Key features of the Marketing and Promotions Module Include:

- **Ad integration and management**: Ability to integrate with third-party ad providers, for the purpose of distribution to the available channels via marketing campaigns.

- **Channel management**: Ability for marketers to select multiple channels to communicate to their customers through kiosk digital signage, the primary kiosk user interface, email, SMS and more.

- **Customer and location segmenting capabilities**: Ability for operators to segment lists of customers to drive a personalized advertising experience.

- **Promotion and offer management**: Ability to create a wide range of promotional content, such as one-time use promotion codes to a customer base.

- **Campaign management**: Ability to create marketing campaigns that tie everything together into a defined marketing activity. The campaign can then be distributed out to the customer base, and tracked via reporting and analytics accessible through the Canopy portal.
Canopy provides the operator and its customers with canned and analytic reporting capabilities. This provides the ability to bring all of the cross functional data together into a single user interface, that a user of the solution can then leverage for ongoing management of reporting capabilities.

**Key features included within the reporting module include:**

- Ability for users to easily create and manage their group of reports ("My Reports")
- Ability for users to run reports and dynamically change report parameters via run-time for increased analytic capabilities.
- Ability to export reports in a variety of formats allowing for integration to other systems, or export to formats that might help drive further analysis.
- Ability for customers to subscribe to reports that are automatically delivered to themselves and others via email attachment or link to a file server.
Ready to make “things” happen?

Contact us at

770-615-2528
info@banyanhills.com