Smart Shop

VeeaHub Platform

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SMART RETAIL

APPLYING ARTIFICIAL INTELLIGENCE AND ADVANCED ANALYTICS

veea

INTELLIGENTLY CONNECTED

Background

VeeaHub Application Initially Proposed

Indoor navigation for passengers with proximal marketing using
 VeeaHub and Veea SDK for **Smart Shop** smartphone app

Smart Shop Additional Requirement for Crowd Analytics

- *Precision* – accurate crowd counting to within 5-10m accuracy
- *Output* – generate crowd density based heatmap of the **Smart Stores area**within deignated public environments to provide categorization of individual store spaces based on the level of crowd density ouside of each store

Veea Research

- *Technology Assessment* – Veea has invested time and effort to consider a wide range of different technical approaches – from capabilities inherent to WiFi through to the use of peripheral equipment

Veea Recommendation

- *Visual Computing* – based on the level of accuracy required combined with VeeaHub's capability to integrate and support additional technology and applications this approach offers the best means of meeting requirements

Visual Computing

Benefits
- *Lower data transport level & cost* - VeeaHub local video compression reduces the backhaul traffic requirement
- *Reduced technical complexity* – accurate count and demographics without face recognition techniques
- *Less equipment* - multiple zones covered from single camera feed
- *Works with the environment* - some flexibility of positioning of Camera in the deployment
- *Adaptable use* - data can be exported

Features
- Video based solution
- People counting in/out of configured zone
- Dwell times
- Daily heatmaps
- Demographics (age, sex)
- Video analysis and dashboard in Cloud
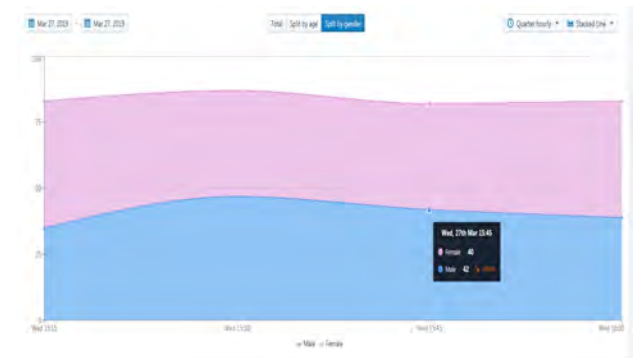
Smart Retail and Security

Smart AI camera technology is well suited for the high demand needs of the smart retail space. Solving problems unique to the sector including heightened security requirements as well as advanced AI capabilities and reporting functionality.

Capabilities:

- People Counting
- Heat Maps
- Gender
- Age
- Mood Analysis

- Facial Recognition
- Dwell Time
- Zone Counter
- Data Analytics
- Open APIs for Full Customer Reporting

The Advantage – Key Points of Differentiation vs. Competition:

• Wider field of view (FOV) than push to zoom cameras, 360° coverage vs. narrow 60° FOV of competitors

   - Facilitates broader coverage with dramatically fewer cameras and associated costs

   - Provides for a more flexible implementation that allows cameras to be mounted in various configurations (e.g., ceiling, counter top etc.)

• Higher resolution at distance that allows tracking at a 4x distance vs. traditional fisheyes (e.g., 20 meters vs. 5 meters for fisheye)

   - Provides more reliable analytics and tracking at distance

   - Provides greater coverage (larger zone areas) and requires fewer cameras to cover similar area

• Powerful edge processing with VeeaHub provides for full wireless connectivity and edge processing where needed

   - Allows more processing to be performed on camera and minimizes server/PC requirements

Smart AI Technology

Technology in action. Note the advanced AI technology's ability to identify key personal attributes:

- Gender

- Age

- Mood

- Unique Identifier

Key Features Delivered with VeeaHub – Camera Solution supported by Third Party Cloud-Based Analytics Platform (Vendor Options)

① **People Counting**

Provide optimized marketing information based on comparative analysis between walk-in customers and purchasers

② **Zone counting & Heat Map**

Optimize product placement and customer experience through in-store customer behavior pattern analysis

③ **Face Analysis**

Identify age, gender and sentiments information of each visitors

Behavior Sensing Report provides retail customers with end-to-end insights to support marketing activities

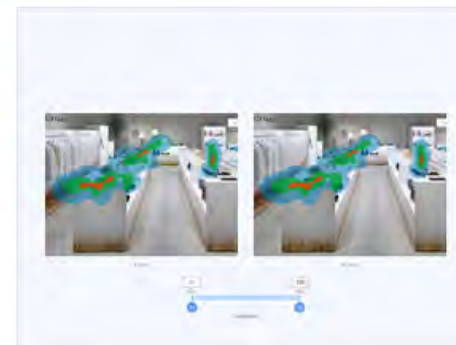Customer   Store

Foot Traffic
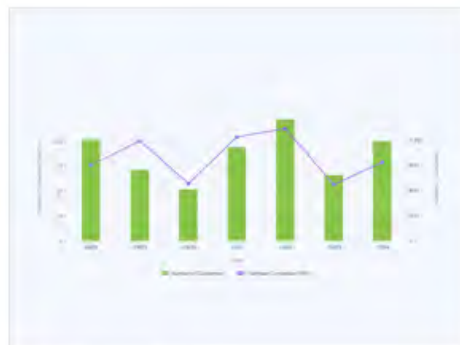People Count

Visitor Ratio
People Count

Time Range
Heat Map

Time Compare
Heat Map

Zone Count
Zone Count

Popularity
Zone Count
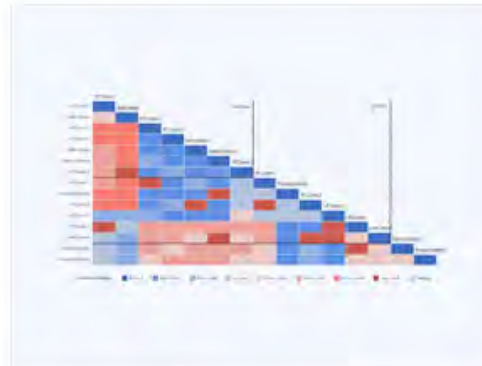
Zone Count Heat Map
Zone Count

Zone Analysis Graph
Zone Count

Behavior Sensing Report provides retail customers with end-to-end insights to support marketing activities
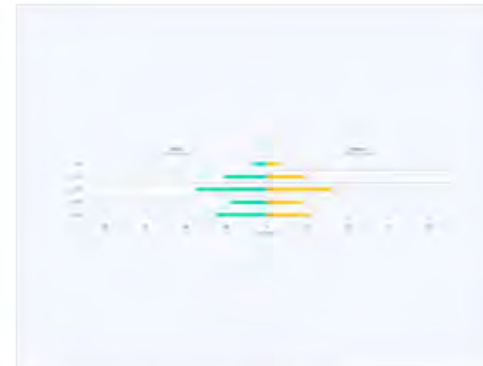
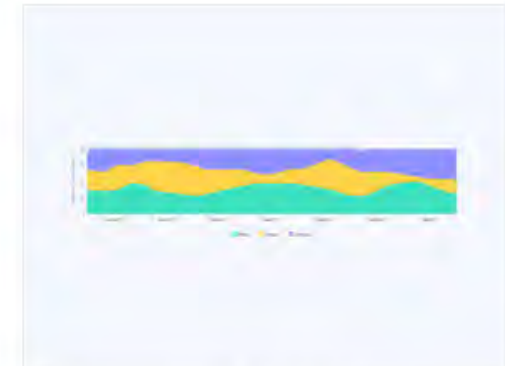## Applications of VeeaHub Platform for the Smart Shop Pilot

- Highly accurate Indoor Positioning System (IPS) with Veea SDK

- Music streaming and Public Announcement (PA) system by zone

- IoT device management, monitoring & data collection (energy management, lighting control, safety applications, etc...)

- Security camera monitoring with event notification

- Private messaging (voice, video and text)

- Automated Workflows & Tasking

- Secure guest WiFi

- 4G SD-WAN with failover in case of ISP service interruption

- Virtual wait-lists

- Cash register / payment counter queue time management

- Blockchain-based inventory (asset management)

Appendix

Veea Inc. Corporate Snapshot

Our Team's Background

Veea Inc. is a Platform as a Services (PaaS) company providing Edge computing & communications solutions that substantially improves operational efficiencies and reliability of service while reducing complexity and costs of computing, communications, transaction processing and value-added applications for consumer, enterprises, manufacturers, utilities, service providers, public service & government users, and partners

Formed in 2014

Wholly Owned Subsidiaries
- VeeaSystems (US/UK)
- VeeaSolutions (US)

120+ Employees

85 Engineers

31 Patent Applications (key patents granted)

Major Shareholders
- NLabs Inc.
- EdgeWater Investments Co
- Korea Information & Communications Co. (KICC)
- Sony Corporation

Headquarters: Manhattan   **Satellite Offices:** Atlanta, San Diego, Paris, Geneva, Seoul   **Major Operations:** Bath, UK & Metropark, NJ

Retail Vertical Pain Points Demanding New Solutions Today

» Numerous single point solutions for communications and utility applications require investments in installation, integration, management and maintenance of devices, sensors and stand-alone networks with a wide variety of wired and wireless protocols

  ▪ significant amount of structured cables in many cases

» Mission critical applications relying on the Cloud services are vulnerable to ISP service interruptions or communications latency

» Data collected at the Edge for many applications, such as for machine learning, AI or latency-sensitive applications, has value only for a short period of time and Cloud communications limits the utility of such applications due to the round trip delay

» Wireless connectivity by mobile and fixed devices and sensors in the local networks create major security challenges

» Growing risk of service disruption & network outages now require many businesses to subscribe to redundant ISP connections

» Costs of Cloud computing are rising and require certain applications and services to run more efficiently either partially or completely at the Edge

  ▪ Bandwidth intensive applications, such as video analytics, can be more cost effectively managed at the Edge

** The **Edge** is a physical and logical space from a few to hundreds of feet where people's devices and "things" directly connect to each other and the network(s). For example, the area that a laptop, tablet or a sensor connects to a WiFi Access Point.*

Legacy Wi-Fi	Mesh Wi-Fi	"Smart Wi-Fi" Hubs

VeeaHub Intelligent Edge Server Product Types

- veea Hub **PRO** — Indoor – Enterprise (VHE09 & VHE10)
- veea Hub I — Indoor – SMB/Consumer (VHC05)
- veea Hub **PRO OUTDOOR** — Outdoor – Enterprise & Smart City Applications (VHH10)
- Smart Rail & Other Smart Transportation (VHHR06)

Legacy Wi-Fi
- ✓ Coverage
- ✓ Installation via browser
- ✓ Expansion thru repeaters
- ✓ Multiple SSIDs

Mesh Wi-Fi
- ✓ Capacity and coverage
- ✓ Installation via Mobile App
- ✓ Expansion thru limited Mesh
- ✓ Multiple SSIDs
- ✓ Family usage monitoring
- ✓ Guest Wi-Fi

"Smart Wi-Fi" Hubs
- ✓ High capacity and coverage
- ✓ Pro versions with Quad-radio WiFi solutions with 2X concurrent 4X4 802.11ac Wave 2
- ✓ Installation via Mobile App
- ✓ Expansion through Unlimited Mesh
- ✓ Significant savings in cabling costs
- ✓ Multiple SSIDs
- ✓ Guest Wi-Fi (optional auto-login with retailer's or enterprise app)
- ✓ Cost competitive - one of the lowest TCO

- ✓ Applications Sever - Edge Computing
- ✓ Bluetooth/Beacon
- ✓ IoT Gateway
- ✓ AppStore
- ✓ SD-WAN with 4G failover
- ✓ Advertising Platform
- ✓ Machine Learning & AI
- ✓ VeeaFi (Wi-Fi HotSpot with advertising)
- ✓ Many more applications

VeeaHub Platform's Intelligent Edge Server Solutions

- Edge computing "micro-Cloud" created by VeeaHub platform devices - extending the Cloud to the edge
- Converged platform providing a highly integrated compute, storage and connectivity
- Consumer/SMB, enterprise & industrial product line supported by a complete range of indoor/outdoor/ruggedized products
- VeeaHub Pro version with quad-core 64-bit 1.5 GHz ARM architecture (2-4 GB SDRAM)
- 32 GB eMMC flash storage with an SDXC card slot (512 GB SD cards available – 2 TB format)
- Wi-Fi APs, Bluetooth, Zigbee or 6LoWPAN, Thread (i.e., 802.15.4 protocols), Eddystone Beacon, optional 4G with global eSIM, Ethernet, USB and other connectivity options such as LoRa for wide-area coverage
- Supports network segmentation with IPv6 and IPv4 connectivity to external devices
- Supports a wide-range of IoT devices
- Lowest Total Cost of Ownership (TCO) compared to equivalent solutions with combination of single- or multi-point solutions


veeaHub™ PRO

veeaHub™ I

veeaHub™ PRO OUTDOOR

Edge computing powered through all-in-one "VeeaHub" intelligent wireless servers delivering wireless micro-clouds connecting wireless and wired devices and sensors, running applications where deployed with high security on an end-to-end basis, while minimizing the typical cabling requirements more than any other WiFi-only or server solution, at the lowest Total Cost of Ownership (TCO)
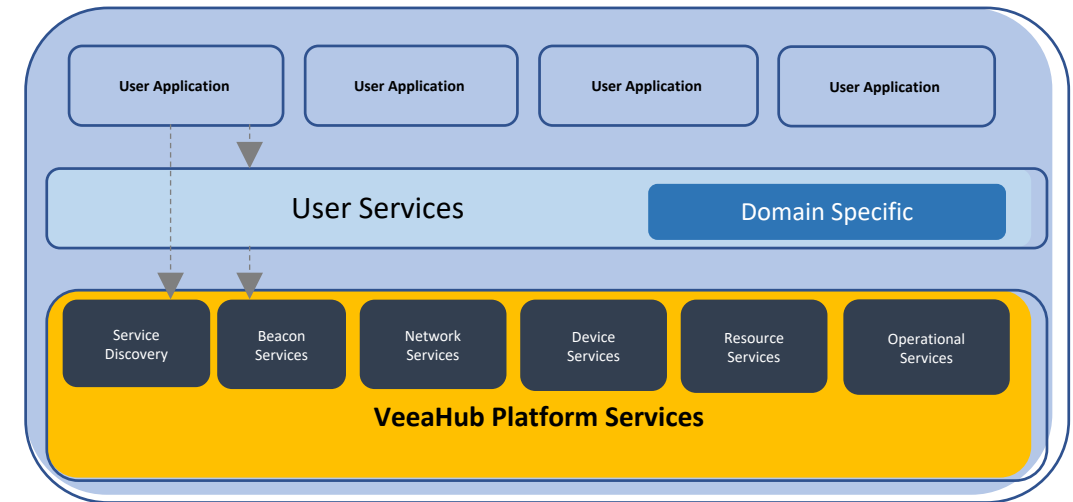
Wireless Network Installation and Management Simplified!

» vMesh provides for a unique communications fabric for seamless connection of devices and IoT sensors supported by VeeaHub within the coverage area providing for the most robust, complete wireless mesh solution - well beyond the typical WiFi mesh solutions in the market

» Number of hops over all wireless and wired nodes only limited by link- and application-level performance requirements - an "industry first" for Edge-maintenance of QoS for running applications at the Edge

» <u>Significant reduction in requirements for structured cabling</u> - Ideal for smart cities, campuses, shopping malls, large commercial buildings, hospitals, stadiums, arenas, festivals, older homes and venues where running structured cables is difficult or costly (i.e., in many cases cabling costs are several factors more than the cost of equipment)

» Creates a self-healing, self-organizing network of VeeaHub nodes with backhaul Redundancy

» Enrollment server for secure wired and wireless network access for all VeeaHub nodes as well as devices and sensors on the network based on highest level of secure access standards in the commercial industry
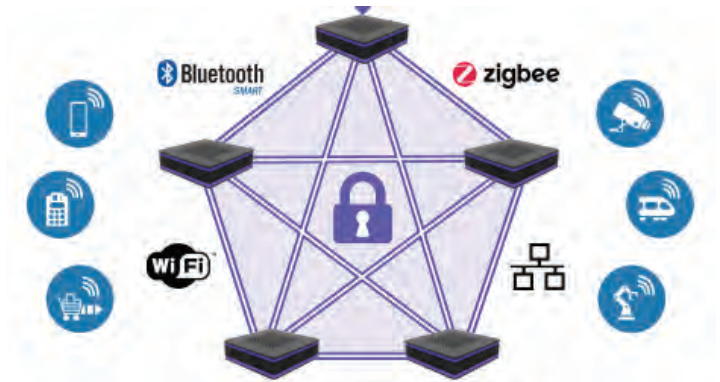
vMesh™ is a hybrid multi-protocol wired & wireless mesh based on <u>a novel network layer routing protocol</u> that is *transport agnostic* supporting WiFi, Bluetooth, 802.15.4 (e.g., Zigbee, 6LoWPAN/Thread and other IoT protocols), 4G, 5G and others over a cluster of VeeaHub nodes

Cutting Edge Network Management and Transaction Processing

» Cloud-based Management and Authentication Services (MAS) with NOC capabilities

» Platform provides for Cloud-based and local management of VeeaHubs and vMesh networks, with an API to optionally integrate with 3rd party dashboards, along with central deployment of applications through the VeeaHub App Store

» Link- and application-level performance monitoring, management, fault reporting, alarms & event handling

» Remote configuration & OTA upgrades of VeeaHubs individually, in groups or mesh clusters

» Support for cloud-based IoT platforms such as AWS Greengrass, Google Cloud IoT, Microsoft Azure IoT Hub, IBM Watson IoT and others with MQTT, CoAP, AMQP protocol adapters

» Centralized fulfillment of products and managed services offered by network owners to their customers for free or as an App-as-a-Service (AaaS) at the edge (e.g., turn-key services for pop-up stores, concession stands, mobile vendors, MDUs or commercial tenants, rental applications)

» Order processing, onboarding, activations, inventory management, provisioning of access, CRM

» All forms of payments, billing, risk management, transaction monitoring, settlements, trouble ticketing

User Application | User Application | User Application | User Application

User Services — Domain Specific

Service Discovery | Beacon Services | Network Services | Device Services | Resource Services | Operational Services

VeeaHub Platform Services

Management and Authentication Center

Image
App
Group
Mesh
Node
Service
Dashboard
Hierarchy by Node
Hierarchy by Service
Settings

Search:

Name	SSID	Mesh ID	Group Name	Healthy Nodes	Last Mesh Post	Last Mesh Poll	Created
ies0500055 vmesh (59)	ies0500055 vmesh	n4molk0hcgq0	Transportation (19)	1/1	A few seconds ago	A few seconds ago	May 10th '18, 9:25:11pm

Node Name	CPU Serial	Unit Serial	Node ID	Manager	Host	Last Seen in Post	Last Seen in Poll	Error Message	Agent Status
ies0000055 (127)	00000000ba0d4dbd	135050000055	7kgl2opucti	Yes	10.84.64.1	A few seconds ago	ready (A few seconds ago)		Up (a day)

Show 25 ▾ entries   Showing 1 to 1 of 1 entries   Previous 1 Next

VeeaHub App Store Supporting Highly Unique Edge Applications Developed by Veea, 3rd Parties and You!

- VeeaHub provides for a server function with the ability to run applications supported by a Cloud-based app store to host applications
  - VeeaHub's Linux OS-based server function enables an open software development stack
  - VeeaHub units, as edge computing platform devices, create a wireless and wired "micro-Cloud" for data-center like operations to run all edge applications with ease and flexibility
  - Combination of central and local orchestration and management of applications ensures that applications continue to run even when backhaul becomes unreliable or broken
- Highly secure containerization ensures isolation between apps and secure from attacks
- Robust processing of services and applications with fault tolerance given that every VeeaHub deployed for WiFi coverage can run the same applications on a stand-by basis
- Redundancy and backup for services & mission critical applications made easy through servers in multiple VeeaHubs that are primarily deployed for wireless coverage
  - VeeaHub's lightweight virtualization technology allows multiple applications to run simultaneously on one or more VeeaHub servers
  - VeeaHub App Store simplifies app selection & download of apps on a selective basis for VeeaHubs on one or multiple clusters
  - 3rd party developers can easily develop apps using VeeaHub's Edge Development Kit (EDK) with software development tools and APIs with apps distributed through the app store
- To dynamically run applications either at the edge or in the Cloud, rule-based dynamic assignment of applications between VeeaHubs and the Cloud resources is established based on a number of criterion such as communications latency, bandwidth consumption, backhaul resilience, privacy requirements, service availability for mission critical applications at the edge, and resource availability on various VeeaHub edge nodes versus those in the Cloud (e.g., CPU, storage, bandwidth requirements based on backhaul quality, power consumption, costs, etc.)
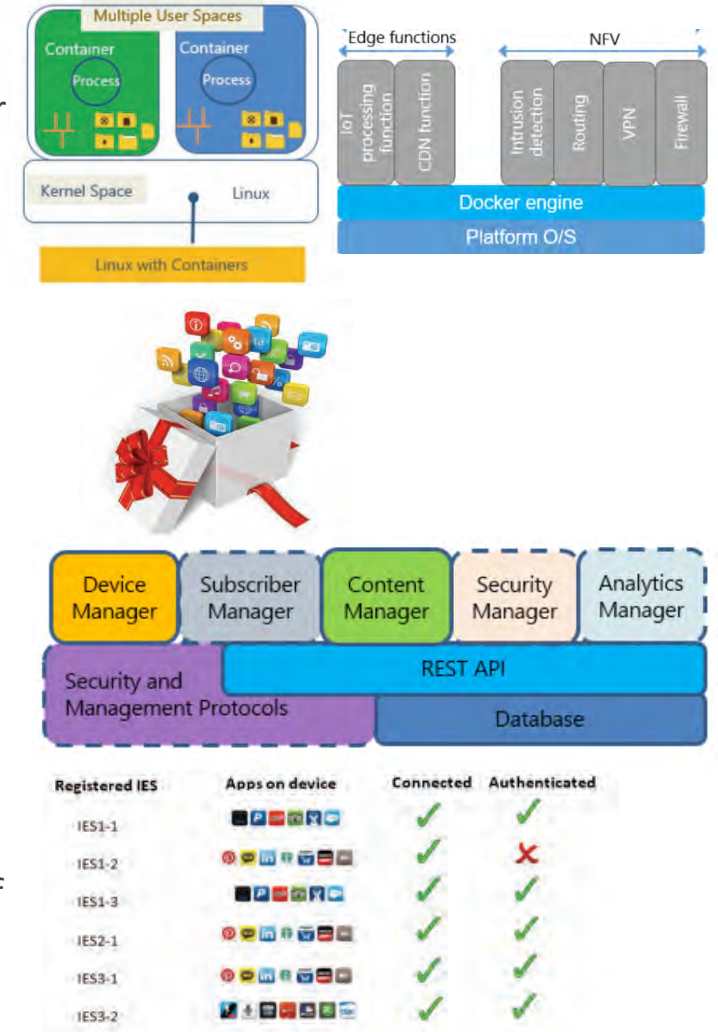
VeeaHub Platform Capabilities & Benefits at a Glance

The Lowest Total Cost of Ownership (TCO) and Business Operations for with much more Functionality at highest Quality and Security:

- o Every version of VeeaHub product pricing compares favorably to pricing of similar WiFi AP-only solutions while delivering significantly more functionality and value
- o Eliminates the majority of structured cable typically installed at several times the cost of equipment
- o Substantially improves the ease of installation (i.e., less labor), maintenance and operations at the edge
- o Raw data is pre-processed with only desired data forwarded to the Cloud thus reducing unnecessary edge data flow between the edge and the Cloud further reducing demand on network infrastructure and costs of Cloud computing including Cloud connection costs

Low-Latency: Reduces round-trip time to the Cloud for latency sensitive applications running at the Edge including those applications requiring real time processing/response and for context aware computing

Security & Privacy: Data collected at the network edge and records for communications applications can remain local to the source a) avoiding unnecessary access to data by third parties in the Cloud while b) providing an opportunity to sanitize data through VeeaHub applications in highly secure application containers before upload to the Cloud, and c) with a built-in industrial grade LAN firewall and a programable forward & reverse firewall for IoT connections.

Quality of Service: Applications can run at the network Edge with a high level of redundancy for uninterrupted operations with highly redundant resources at the Edge, optionally with Cloud resources on stand-by, minimizing impact of ISP service interruptions – a "must have" for mission critical applications

Improved Reliability for IOT Applications: Connectivity among all connected devices and sensors is highly reliable with redundant communications paths and the ability to monitor and maintain IOT applications, especially, for mission critical applications at the edge

Opportunity to Drive Substantial Revenue: VeeaHub platform offers the opportunity to offer a wide-range of value-added services such as digital signage advertising, proximal marketing, Edge-CDN content delivery, Multi-Tenant / Multi-Dwelling Units (MTU/MDU) and public WiFi hotspot and IoT monitoring services including Wi-Fi calling (VoWiFi),

Continuous operations with Distributed Computing from the Edge to the Cloud: With a highly flexible architecture and third-party software development tools, VeeaHub platform allows applications to run most efficiently and flexibly at the edge, the fog and/or the Cloud meeting customer requirements on an end-to-end basis

Data Lifetime Protection: VeeaHub platform facilitates many machine learning and AI applications where data collected at the network edge, which could amount to tens to hundreds of terabytes per day, has value only for a short period of time and must be processed at the edge

Apps Available thru VeeaHub App Store

» **IoT device management, monitoring & data collection:**
  - data collected from IoT sensors and devices can be pre-processed by VeeaHub applications such as from vibration sensors and industrial equipment predictive maintenance
  - support for cloud-based IoT platforms such as AWS Greengrass, Google Cloud IoT, Microsoft Azure IoT Hub, IBM Watson IoT and others with MQTT, CoAP, AMQP protocol adapters

» **LAN & IoT firewalls & router:**
  - stateful inspection firewall with Unified Threat Management (UTM) with Intrusion prevention
  - forward & reverse firewall for IoT applications
  - router (DHCP and other advance features) with VLAN support
  - web filtering (Web Titan, configurable by backend dashboard, which allows centralized management, records of sites visited, etc.)

» **4G SD-WAN with auto failover:**
  - backhaul connection can be primary connection or automatic failover for ISP connection based on customer configured rules with zero-touch deployments
  - Elastic Edge with software defined policy management with features such as traffic steering

» **Security camera monitoring with event notification:**
  – permission-based access to camera streams from mobiles, tablets or computers
  – organize streams with specific security algorithms
  – view NVR live stream or recorded video through VeeaHub Control Center
  – supports all IP-based cameras

» **Secure Local Area Network (LAN) private messaging:**
  – local messaging among employees and/or customers with ease, privacy and security
  – facilitates GDPR data management – ability to sanitize date uploaded to the Cloud
  – automated employee tracking and tasking capabilities
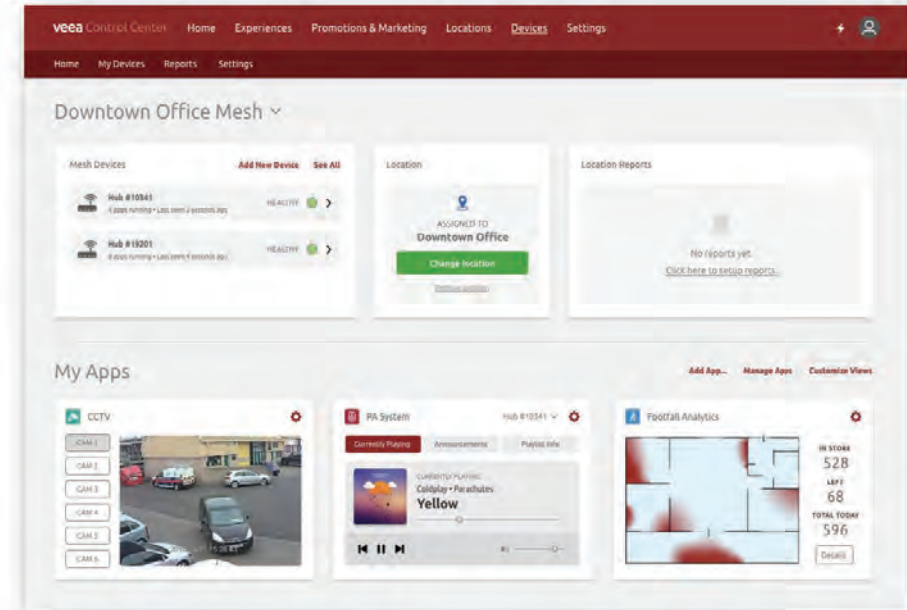
VeeaHub Customer Control Center

Locally Managed and Cloud Managed
➤ Configure & manage from one to thousands of VeeaHub units and the apps running on any one or a collection of units through the cloud
➤ VeeaHub mobile app (iOS & Android) for local management
➤ Applications can be managed through user customized cards, as shown in the example above, that are displayed on VeeaHub Control Center webpage

Apps Available through VeeaHub App Store

» **Secure Guest WiFi:**
- with or without a splash page; no need to give out passwords if splash page for customer login not desired
- easily create a brandable guest WiFi for customers that is secure & separate from business network
- auto login into guest WiFi is enabled with supplied app SDK & VeeaHub's built-in Eddystone beacon

» **Indoor Positioning System for Customer journey with footfall analytics:**
- novel method to locate people or objects to as low as 30 cm of accuracy indoors
- highly accurate real time & historical visitor and/or staff footfall analytics and heatmaps with individual dwell times with a supplied app SDK or even without using an app (i.e., a Veea proprietary solution)

» **Digital advertising through a variety of marketing surfaces:**
- targeted advertising, optionally supported by machine learning and AI, for example, using gender and demographic identification
- ability to dynamically change the signage for the nearby customers with a Veea supplied app SDK

» **Push deals & promotions:**
- push targeted promotions & deals to in-store customers
- enabled via combination of a) built-in Eddystone beacons in VeeaHub units, b) virtual beacons placed throughout the coverage area and c) high speed WiFi Direct
- promotional videos already cached on multiple VeeaHub units load on target devices instantaneously when within proximity of a virtual beacon
- additional storage for up to 512 Gb with currently available microSDXC memory cards (SDXC format supports up to 2 TB)

» **Music streaming & PA system:**
- public announcements or music streaming in one zone or multiple, separate zones
- supports fully licensed audio streaming services based on ASCAP, BMI, GMR, and SOCAN
- includes "dayparting" to schedule music by time, day of the week and by zone plus support for social playlists

» **Connected retail - 21 (CR-21):**
- hub application for communications & peripheral management for retailers (printers, scanners, display poles, cash drawers, etc.)
- substantially streamlines deployments/management & PCI compliance of peripherals for POS & payments

OPTIMIZE MARKETING CAMPAIGNS WITH AI

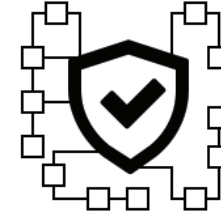# VeeaHub Applications Customized by Veea for Enterprise Customers

Machine Learning and AI

Indoor Positioning System, Automated Workflows & Tasking

Security System & Access Control with Notifications

Blockchain-based Inventory & Supply Chain Management

Industrial & Space Automation with Automated Workflows & Tasking

Bidirectional Omnichannel Retail Services

Object, Gender and Demographic Identification

Sensor Management for Electronic Shelf Labels & Product Packaging

VeeaHub applications shown above can be uniquely customized by Veea applications development team or through a 3rd party developer for VeeaHub enterprise customers

The Connected Store

An Open Platform & Solution

- No vendor or application lock-in

- Attract multiple vendors, agencies and brands

- Develop a COMPLETE advertising solution

    - Omni-channel to bridge digital and traditional

    - Control all touch-points; media sovereignty

    - Veea's micro-clouds facilitate localized content

- Non-intrusive

- Personalized ads will be opt-in

Tue July 31 2018 19:49:30
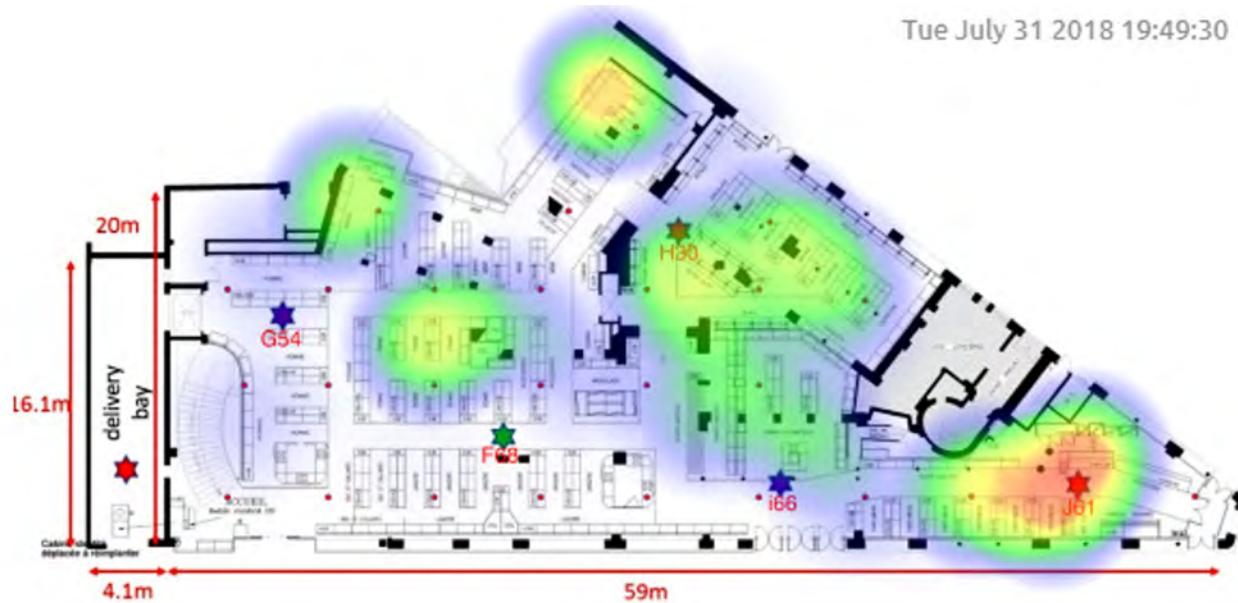
## Unique Platform Capabilities for Intelligent VeeaNet Advertising

- Indoor Positioning and Tracking
  - Optics: gender, age, race
  - RF: position, speed, dwell times
- Navigation, discovery
- Easy Installation
- Optional loyalty, payments, PoS integration
- Relevant, opt-in, non-intrusive advertising

Driving retail success and ad revenue through "webification"

- End-to-end observation with improved understanding and insights

- More options for permission-based interaction and engagement

- Ability to drive actions, observe outcomes, iterate and optimize (efficiently and confidently)

Physical

Digital

VeeaNet Intelligent Ads

Sessions

Interactions

Conversions
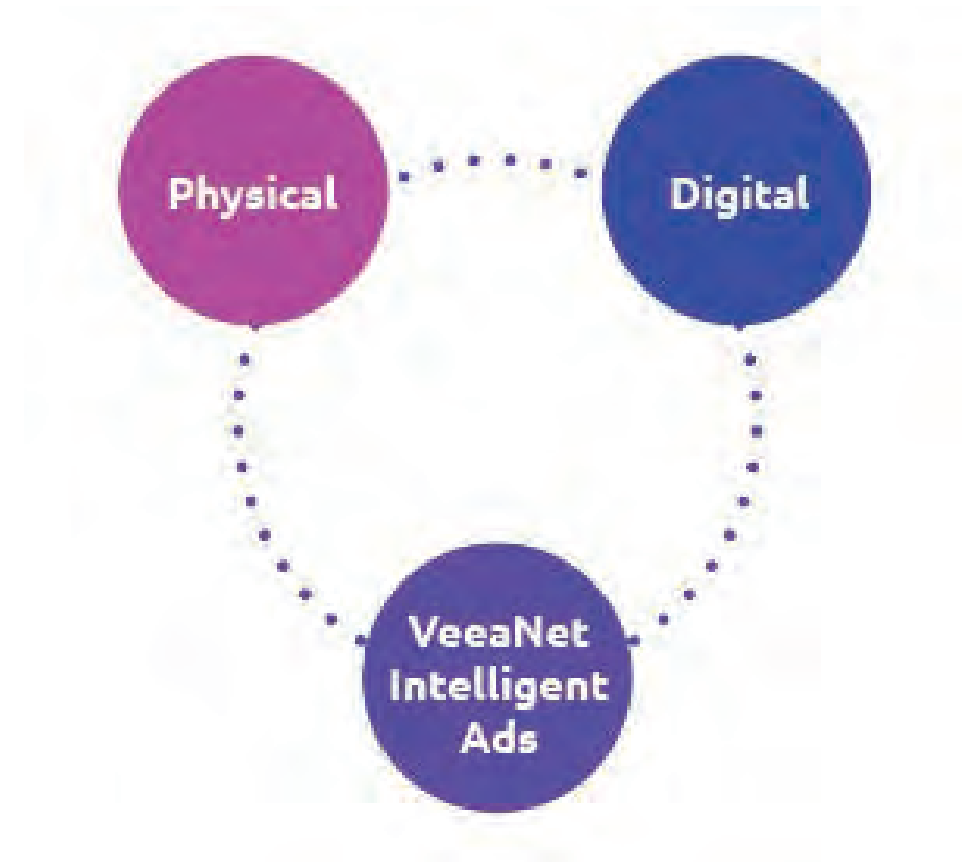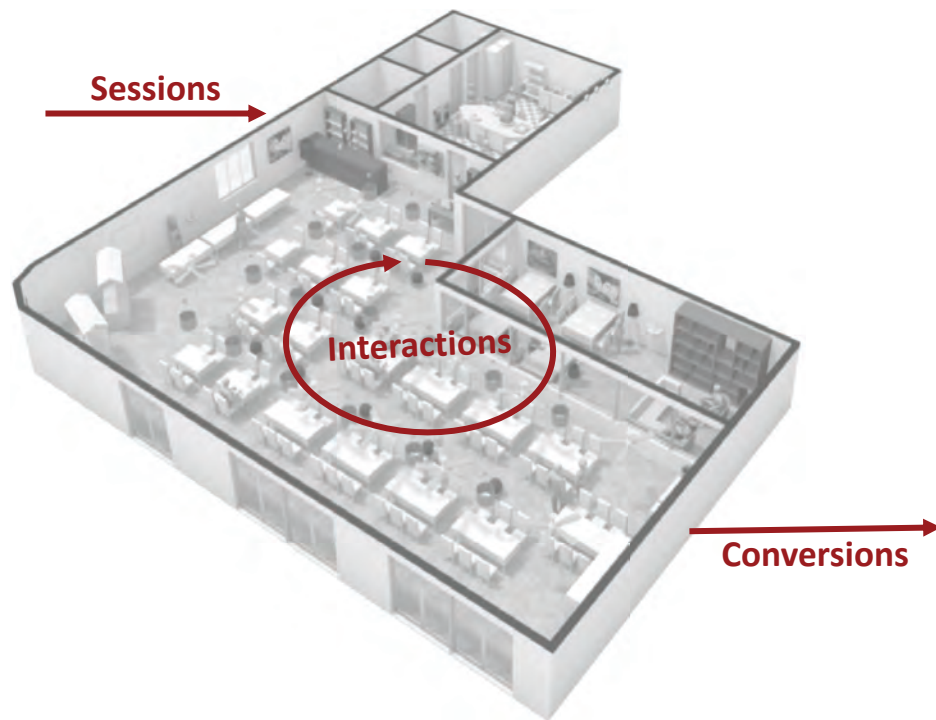
Re-imagining the physical location as a digital property

Veea optimizes:

- Localized Sensing

- Localized Processing

- Localized Action

- Agile Iteration

How does VeeaNet maximize ad-based revenue?

More effective promotions, more precise targeting, more powerful audience analytics resulting in **higher CPM and conversion rates.**

How is VeeaNet advertising different?

Hyper-personalized

Interactive

Gamified

Continuously Learning

Social Activation and Interaction

Privacy Enabled

Opt-In/Opt-Out

Audience Insights

Intelligently integrated omnichannel commerce
(interaction with online store or POS)

Physical-to-Digital Microtargeting

VeeaNet **enhances display media** with unique conversion links that can be triggered by QR code, NFC, Beacon or Virtual Beacon.

Augmented Reality
(Camera)

Gamification
(Smartphone)

VeeaNet enables **fully reactive and interactive advertising experiences** that connect to network devices such as cameras or smartphones.

VeeaNet processes real-time data from multiple sources to **provide holistic insights and deeper intelligence** about ad performance, viewer attentiveness and demographics.

Gender: Female
Likely Age: 25-30
Emotion: Happy
Glasses: No
Sunglasses: No

Media Player Analytics

Vison Analytics

WiFi Analytics

Profile Analytics

App Analytics

Conversion Tracking

Purchase Analytics

All-in-One Smart Retail Experience & Operations

- A complete digital solution for enhanced customer experiences and intelligent store operations

- Fully integrated WiFi & IoT connectivity and automation

- Secure, reliable and high speed business and guest WiFi

- 4G SD-WAN with auto failover

- Indoor GPS - highly accurate indoor positioning system (IPS)

- Proximal marketing

- Video and audio streaming applications

- CCTV monitoring, music streaming & PA by zone

- Opportunity to create new source of revenue through VeeaNet – intelligent "Digital Out of Home" (DOOH) advertising for digital signage and all marketing surfaces