Visible Things™
THE EDGE TO ENTERPRISE IOT PLATFORM
Visible Things simplifies the complexity of secure edge to enterprise IoT technology. It delivers a complete evaluation and reference platform to connect smart devices right through to the cloud and enterprise software. Avnet supports an ever increasing range of sensors, connectivity, gateway and security technologies, together with cloud, analytics, mobile and enterprise integration services. We regularly add new features, provide updates and deliver training on our Visible Things platform.

Visible Things is delivered in the form of many different boards which can be taken depending on the functionality required. The very nature of IoT technology requires the features delivered by these boards to be pre-integrated and tested end to end wherever possible. This fundamental principle of Visible Things allows the users to concentrate on their applications to deliver the target IoT business outcomes.

This product brief aims to describe the features delivered and provide guidance to the most appropriate board or kit to use.

**Key Features**
- Sensor to server security layer on top of network security
- Quick evaluation of end application
- Highest degree of flexibility
- Reduces development time significantly – time saving
- Optimized power consumption
- Integrated and tested communication path from Edge to Enterprise
- Cloud ready

**Examples of Target Applications**
- Remote monitoring
- Predictive maintenance of motors and drives
- Room control in homes and buildings
- Lighting and shading (indoor & outdoor)
- Security and surveillance
- Home appliances
- Smart energy (metering & in home displays)
- Health care & infrastructure
- Industrial automation, inspection, drives monitoring, sensor hub

**More information and support:**
avnet.me/visiblethings
#VisibleThings
SCOPE OF THE VISIBLE THINGS PLATFORM

Environment
- LPWAN (LoRaWAN, Sigfox)
- Cellular (3G, 4G)
- GW/Fog (BLE, Thread, ZigBee, WBUSB, 6LoWPAN, WiFi)
- ETH, KNX, BACnet

Motion
- Sensors
  - Bluetooth Smart
  - Temperature
  - Proximity/gesture
  - Accelerometer
  - Gyro
  - Compass
  - Humidity
  - 3-Axis + temperature
  - Pressure
  - MEMS microphone
  - Ambient light
  - Energy harvesting
  - Secure element
  - Image

HMI

Vision
- Connected Actuator
- Data Generation
- Quantity of Data

Drive
- Connected Actuator
- Data Generation
- Quantity of Data

Motor
- Connected Actuator
- Data Generation
- Quantity of Data

Valve
- Connected Actuator
- Data Generation
- Quantity of Data

Light

Edge (Avnet & Partner)

Cloud Infrastructure & Platform
- LPWAN
- Cellular
- IoT Gateway

Enterprise
- Remote Monitoring
- Natural User I/F
- Mobile I/F (for Control)
- Predictive Analytics
- Prescriptive Analytics
- Automation

Building Blocks
- Generation
- Communication
- Storage
- Analytics
- Presentation
- Action


VISIBLE THINGS – FEATURES SUPPORTED

Sensors
- Bluetooth Smart
- Temperature
- Proximity/gesture
- Accelerometer
- Gyro
- Compass
- Humidity
- 3-Axis + temperature
- Pressure
- MEMS microphone
- Ambient light
- Energy harvesting
- Secure element
- Image

Gateway Functions
- Bluetooth
- WiFi
- 3G, 4G
- MCUs based on ARM Cortex™-M cores
- Camera module 1.26Mp
- 1x QVGA TFT display with touchscreen
- Audio – microphone and speaker
- NFC
- 1x PoE PD
- 2x Ethernet IEEE1588v2
- 2x USB (1x HS, 1x FS)
- 1x CAN 2.0B
- 32MB SPI flash
- 32MB SDRAM
- MicroSD card
- Secure element

- UbiquiOS™ gateway embedded software:

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>WiFi</td>
<td>Complete SoftMAC WLAN stack</td>
</tr>
<tr>
<td></td>
<td>SME/APME and WPA supplicant</td>
</tr>
<tr>
<td></td>
<td>WiFi Protected Setup (WPS)</td>
</tr>
<tr>
<td></td>
<td>Multiple roles including STA, AP</td>
</tr>
<tr>
<td>Bluetooth</td>
<td>Dual-mode HCI host stack</td>
</tr>
<tr>
<td></td>
<td>Serial Port Profile (SPP) over BR/EDR</td>
</tr>
<tr>
<td></td>
<td>BTLE GATT profiles as broadcaster, observer, peripheral and central</td>
</tr>
<tr>
<td>Networking</td>
<td>Compact TCP/IP stack with all auxiliary protocols</td>
</tr>
<tr>
<td></td>
<td>HTTP/HTTPS client and server</td>
</tr>
<tr>
<td></td>
<td>TLS v1.2 with OCSP</td>
</tr>
<tr>
<td></td>
<td>MQTT, WebSocket</td>
</tr>
<tr>
<td>Crypto</td>
<td>Universal Plug and Play (UPnP/PoE, mDNS/DNS-SD)</td>
</tr>
<tr>
<td></td>
<td>Diffie-Hellman, RSA, and ECC key management</td>
</tr>
<tr>
<td></td>
<td>AES, RC4 ciphers</td>
</tr>
<tr>
<td></td>
<td>SHA-1, SHA-265, SHA-512 and MD5 hashes</td>
</tr>
<tr>
<td>Other</td>
<td>Tiny OS layer enables minimum footprint on bare metal</td>
</tr>
<tr>
<td></td>
<td>Supports integration into third party RTOS</td>
</tr>
<tr>
<td></td>
<td>UbiquiOS Test Engine (UTE) enables automated production/</td>
</tr>
<tr>
<td></td>
<td>certification test (WFA CAPI-compliant)</td>
</tr>
</tbody>
</table>
**CLOUD SERVICES**

Demonstrator cloud platforms are built into the Visible Things starter kits. On top of this sits a whole range of services to develop a deployed solution.

- **Evaluation** – Visible Things cloud starter kit instances.
- **Manage** – Provision, deployment, and management of the cloud service.
- **Build** – Building the Software as a Service (SaaS) specific to customer application - mobile and cloud application development, device management, security, analytics.
- **Enterprise** – Integration of new cloud based and existing systems together – API architecture, industrial use case implementation, enterprise security.

**BUILD SERVICES**

Avnet and eco system services capabilities to create specific solutions to business issues.

- Mobile and cloud application development
- Device management and end to end security
- Cognitive and predictive analytics
- Advanced visualisation
- Managed services

**ENTERPRISE INTEGRATION**

Transform clients business models bringing new and existing systems together by working with our services capabilities and partner eco system.

- API architecture
- Industry demonstrators – use cases
- Enterprise class security
### STARTER KIT COMPARISON TABLE

<table>
<thead>
<tr>
<th>Order Codes</th>
<th>VT-SK-001-A01 Entry Starter Kit</th>
<th>VT-SK-002-A01 Industrial Starter Kit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gateway</td>
<td></td>
<td></td>
</tr>
<tr>
<td>WiFi</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Bluetooth Classic</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Bluetooth Smart</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>NFC</td>
<td>X</td>
<td>✓</td>
</tr>
<tr>
<td>Ethernet</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>CAN</td>
<td>X</td>
<td>✓</td>
</tr>
<tr>
<td>Embedded Vision</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Audio</td>
<td>X</td>
<td>✓</td>
</tr>
<tr>
<td>Power Supply</td>
<td>USB</td>
<td>PoE and DC Jack</td>
</tr>
<tr>
<td>Smart Sensor</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bluetooth</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Motion</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Ambient Light</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Proximity Detection</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>3D-Gesture</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Temperature</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Humidity</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Pressure</td>
<td>X</td>
<td>✓</td>
</tr>
</tbody>
</table>

### SK001 – ENTRY LEVEL STARTER KIT

#### Smart Sensor

- **Expansion connector**: BGM111 Bluetooth Smart module with ARM Cortex-M4
- **Memory**: Silicon Labs
- **MPU9250**: InvenSense
- **Si7021**: Sensirion
- **TO136**: Trust controller
  - **Trusted Objects**
- **CR2032 Battery**
- **TO136**: Trust controller
  - **Trusted Objects**

#### Gateway

- **Bluetooth Smart**: (●)

#### Expansion Connector

- **PMOD (I²C)**: STM32F746 ARM M7 microcontroller
- **PMOD (UART/SPI)**: STMPS2141 USB device
- **BGM111**: Bluetooth Smart with ARM Cortex-M4
- **MPU9250**: InvenSense
- **Si7021**: Sensirion
- **TO136**: Trust controller
  - **Trusted Objects**
- **CR2032 Battery**
- **TO136**: Trust controller
  - **Trusted Objects**

#### Visible Things Deliverables

The Visible Things starter kits consist of a smart sensor with Bluetooth connectivity through to a gateway. The gateway then manages connectivity through the cloud services where sensor data can be visualised and managed with simple tools. A mobile app is delivered to the boards and also directly visualise sensor data.

Both kits are designed to work together with quick start guides to quickly get up and running with a proof of concept. Technical documentation and design files are then available once development and integration of the technology into products starts.

Further smart sensors and PMODs are then available and described below to evaluate further connectivity such as GSM and LPWAN.

An Avnet mobile application for iOS and Android is provided for configuration of the devices locally and to support connections to the cloud service. The application is fully integrated with a quick start guide to make it easy to connect the system from edge to enterprise.
## SK002 - INDUSTRIAL STARTER KIT

Industrial Gateway with Energy Harvesting Environmental Sensor

### Smart Sensor

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
<th>Manufacturer</th>
</tr>
</thead>
<tbody>
<tr>
<td>DPS310</td>
<td>Pressure sensor</td>
<td>Infineon</td>
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<tr>
<td>SI1143A</td>
<td>Ambient light sensor</td>
<td>Silicon Labs</td>
</tr>
<tr>
<td>TO136</td>
<td>Secure element</td>
<td>Trusted Objects</td>
</tr>
<tr>
<td>DPS310</td>
<td>Pressure sensor</td>
<td>Infineon</td>
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<tr>
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<tr>
<td>TO136</td>
<td>Secure element</td>
<td>Trusted Objects</td>
</tr>
<tr>
<td>BGM111</td>
<td>Bluetooth Smart module with ARM Cortex-M4</td>
<td>Silicon Labs</td>
</tr>
<tr>
<td>SI7021</td>
<td>Temperature/Humidity sensor</td>
<td>Silicon Labs</td>
</tr>
</tbody>
</table>

### Gateway

<table>
<thead>
<tr>
<th></th>
<th>Description</th>
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</tr>
</thead>
<tbody>
<tr>
<td>SI3402</td>
<td>Power over Ethernet</td>
<td>Silicon Labs</td>
</tr>
<tr>
<td>TJA1042T</td>
<td>CAN</td>
<td>NXP</td>
</tr>
<tr>
<td>LSR4500152R</td>
<td>Bluetooth WiFi</td>
<td>Laird/LSR</td>
</tr>
<tr>
<td>Camera Module</td>
<td>Display</td>
<td></td>
</tr>
<tr>
<td>PN5180</td>
<td>NFC reader</td>
<td>NXP</td>
</tr>
<tr>
<td>LAN9353TI/ML</td>
<td>3x3 fast Ethernet</td>
<td>Microchip</td>
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<tr>
<td>S7G2-FBGA224</td>
<td>Synergy platform CM4</td>
<td>Renesas</td>
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<tr>
<td>SLS32AIA020A2</td>
<td>Secure element</td>
<td>Infineon</td>
</tr>
<tr>
<td>TJA1042T</td>
<td>CAN</td>
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</tr>
</tbody>
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### Cloud Services

- Microsoft Azure
- IBM Bluemix

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**Bluetooth Smart**

**WiFi**
**SIGFOX SMART SENSOR**

The Sigfox Smart Sensor, together with local sensors, is managed by an NXP Cortex-M0 microcontroller. Messages are sent directly to a Sigfox server and then Devicepoint™ manages them into the cloud service.

<table>
<thead>
<tr>
<th>Module</th>
<th>FXOS8700</th>
<th>MK20DX128</th>
<th>TO136</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sigfox</td>
<td>Motion sensor</td>
<td>Embed sim option</td>
<td>Trusted Objects</td>
</tr>
<tr>
<td>MKL26Z128</td>
<td>Low power microcontroller</td>
<td>NXP</td>
<td>NXP</td>
</tr>
</tbody>
</table>

- Switch Led
- TO136 Secure element
- TRusted Objects
- Li 1/2 AA Battery

Sigfox base stations and network server

**Devicepoint™**

**Cloud Service**

**LORAWAN SMART SENSOR**

The LoRaWAN Smart sensor, together with local sensors, is managed by an NXP Cortex-M0 microcontroller. Whether a private or public LoRaWAN network is being used, Avnet Silica can support the integration between the network server and a cloud service such as Devicepoint.

<table>
<thead>
<tr>
<th>Module</th>
<th>FXOS8700</th>
<th>MK20DX128</th>
<th>TO136</th>
</tr>
</thead>
<tbody>
<tr>
<td>FXOS8700</td>
<td>Motion sensor</td>
<td>Embed sim option</td>
<td>Trusted Objects</td>
</tr>
<tr>
<td>MKL26Z128</td>
<td>Low power microcontroller</td>
<td>NXP</td>
<td>NXP</td>
</tr>
</tbody>
</table>

- Switch Led
- TO136 Secure element
- Trusted Objects
- Li 1/2 AA Battery

LoRaWAN base stations and network server

**Devicepoint™**

**Cloud Service**

**ORDER CODES**

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>VT-SK-004-A</td>
<td>Entry starter kit</td>
<td>Includes:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Bluetooth Smart sensor board</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Gateway board</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Mini USB cable</td>
</tr>
<tr>
<td>VT-SK-004-A01-LAI</td>
<td>Industrial starter kit</td>
<td>Includes:</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Sensor board</td>
</tr>
<tr>
<td></td>
<td></td>
<td>- Industrial gateway</td>
</tr>
<tr>
<td>VT-SS-004-A01</td>
<td>Bluetooth Smart sensor</td>
<td>To connect additional sensors through gateway boards</td>
</tr>
<tr>
<td>VT-SS-004-A01S-INF</td>
<td>Gen 2 Bluetooth Smart Sensor</td>
<td>To connect additional sensors through gateway boards</td>
</tr>
</tbody>
</table>
DESIGN CHAIN SERVICES®

Avnet offers engineers a host of services from any point in the design cycle from concept to architectural design to new product introduction and on through next generation modification or end-of-life. Avnet has the technical products, services and tools to accelerate design cycles — including ASIC and programmable logic engineering services, IP cores and more. With offerings that run the gamut from Web seminars to connector assembly, Avnet offers it all.

Assembly and Programming
- Commercial and military interconnect assembly
- Custom cable assembly
- Device programming
- Motor modification
- ElectroAir™ avionic components
- Power supply modification
- Thermal management

Design Tools
- Design Resource Center
- Development and evaluation kits
- Embedded OS solutions
- IP cores

Engineering Services
- ASIC design/FPGA design
- Systems design
- Design service partners

Technical Education
- SpeedWay Design Workshops™
- On-Ramp Technical Sessions™
- Seminars/Webinars

SUPPLY CHAIN SERVICES®

Avnet optimizes supply chains by providing end-to-end supply chain services to electronic original equipment manufacturers (EOEMs), Electronic Manufacturing Services (EMS) providers and electronic component manufacturers. By combining internal competencies of global warehousing and logistics, finance, information technology and asset management with objective, external industry-wide data, Avnet’s supply chain services allow customers to increase their overall business knowledge — enabling more informed decisions.

Component Intelligence
- Bill of material (BOM) analysis
- Inventory optimization services
- Green initiative programs

Supply Chain Assessment
- Discovery and logistical analysis
- Financial analysis
- Project implementation

Inventory Management Solutions
- Bonded inventory programs
- EDI Point-of-Use Replenishment Systems (POURS)
- Vendor-managed inventory
- In-plant stores
- New product introduction (NPI) program support
- Pipeline inventory from forecasts
- Inventory ownership programs