

ASM – Innovation Project

The way to ASM

Due to the high competition in the PCB manufacturing market, ASM needs to lead with innovative solutions aiming to be the first industrial provider of Industry 4.0 solutions.

The customer has to improve the efficiency of assembly lines by reducing machine maintenance and outage time. The R&D department had already spent some time attempting to solve this scenario and had built a showcase for an industrial fair, displaying and processing alarm messages and material management on a smartwatch based on Android Wear in conjunction with an Android based mobile phone.

First Contact with ASM happened after the fair-show and the first version of the showcase and Marco Richardson (Technical Evangelist) was asked to make a pitch for the Microsoft Band2.

The apparent EOL of Microsoft Band and revisiting the scenario in more detail together with Juergen Schwertl (Technical Evangelist, App Development and IoT) it became obvious that the Operator app itself would be only a small scenario within a much bigger opportunity for an IoT solution leading ASM into the world of Industry 4.0 and preparing the Azure platform to in future also allow for Machine Learning and Predictive Maintenance.

Customer profile

ASM is a global provider based in Munich offering complete electronics production chain solutions ranging from wafers to chip and module production to SMT placement process. Industry: Discrete Manufacturing, Vertical: High Tech and Electronics

The Project - Team

Product Owner Cord Burmeister (ASM) Scrum Master Thomas Priegl (ASM)

Development

- Joachim Broeckl (ASM)
- Michael Koenig (ASM)
- Guenter Rall (ASM)
- Alexander Ostrovsky (MK) (ASM)
- Rupert Schauer (in-tech) (ASM)

Architecture

- Axel Schroepfel (ASM)
- Marco Richardson (Microsoft)
- Juergen Schwertl (Microsoft)
- Julia Jauss (Microsoft)

Problem statement

At this point, ASM was looking for alternatives to the Android smartwatch they were using in the showcase described above, which should have more industry-oriented features like water and acid resistance. In addition, the model used in the showcase did not have any user management or device management capabilities through existing management systems. But also the Microsoft Band2 is not capable for the use at a production site and there are currently no suitable devices in

the existing market. Through contacts with one of our ODMs, which were working on an industry smartwatch based on Windows 10 IoT Core, we were able to win the trust of ASM.

ASM got convinced that a transformation from the existing on-premises environment into an IoT based hybrid cloud environment is a necessary and reasonable step especially since it would be a door opener for much broader IoT solutions including predictive maintenance scenarios.

Proposed solution

The aim of the proposed solution is to ensure efficient assembly structures by reducing the amount of machine down time. Adding and removing supplies such as tapes with electronic components, maintenance and outages might cause the stop of machines. Within this IoT & wearable scenario, Microsoft technologies will enable the assembly line operators to be immediately informed about changes in the machine status via their wearables. This will streamline the manufacturing process to achieve a more efficient machine utilization by reducing e.g. walking distances for supply restocking. End-to-end messages of the PCB assembly machines will be transferred via IoT Hub to the wearable of the factory worker closest to the machine.

Goal Definition

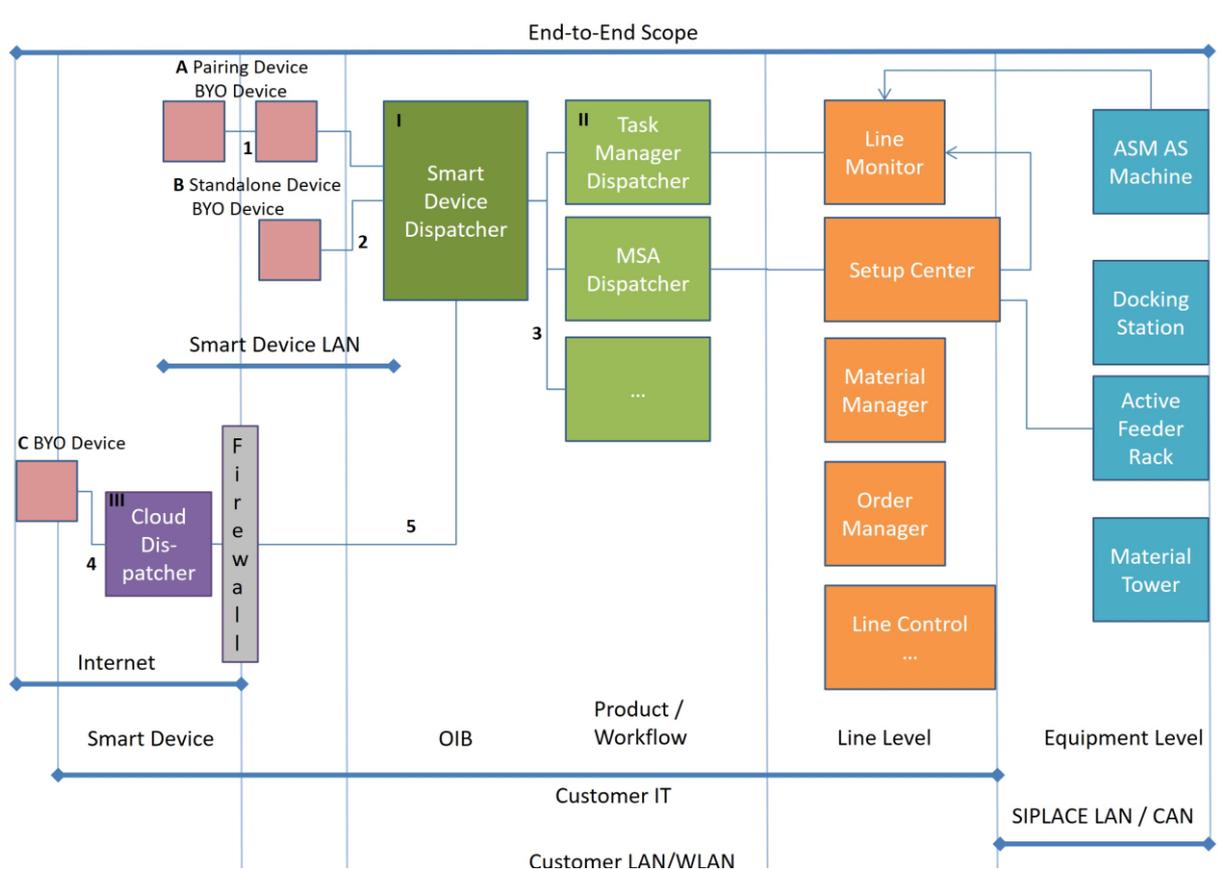
- Support Windows 10 IoT Core as client/wearable device
- Manage the integration of Smart Devices into the existing IT infrastructure:
 - Position of the devices
 - Guarantee constant actuality of the device's software
 - Ensure secure communication between wearable devices, assembly systems and backend infrastructure.
 - Applicability in industrial environments
- Integration of ASM AS SW portfolio with SmartDevices on-premises and via cloud
- Enhance ASM AS product portfolio with Smart Device support
- Develop a reference implementation for the use of Microsoft technologies in an industrial production environment

Further: use the hybrid infrastructure to collect, analyse and store the log data of their machines for predictive maintenance and remote services.

Key Technologies

- Device: ARM based smartwatch with Windows 10 IoT Core
- Ingestion: IoT Hub
- Compute: Azure Stream Analytics
- Storage: Azure SQL, Azure Storage
- DevOps: Visual Studio Team Services
- Coding-Lang: C# (Xamarin for extended scenario for line manager mobile dashboard app)
- App Plattform: UWP

In a first kick-off meeting the agenda was focused on the outlined conceptions of ASM as well as the architecture of the existing software components of the solutions in use.



Implementation

Juergen Schwertl and Marco Richardson provided a sample implementation of the following components with a [reference implementation](#) during the implementation phase to ASM:

- UWP Smartwatch Client, which is able to run on a Windows IoT core instance. It can receive and approve messages from Azure IoT Hub. The app has a message listener, who can receive the messages directly with low latency.
- UWP app "ServerView" for early testing and learning purposes, which retrieves the current status of the devices that have been made known to the IoT hub (with provisioning information like DeviceID and online / offline state visualisation). It is also possible in the ServerView to send messages directly to any of the known devices.
- UWP App "Machine Simulator" which is able to send faked alarm messages to the IoT Hub with the DeviceID of the target wearable on the shop floor. The Machine Simulator uses the Azure API App as the interface in the web, which will also use the existing onPrem backend of the ASM machine solutions in the industry environment. The simulator send data in the same data structure, that should come from the prod systems as well.
- Azure API App which is the interface between the Azure IoT Hub and the onPrem systems of the existing ASM solutions on the factory floor. ASM has a task to implement the security and user management on their side of the project team.

Device, data & communications security

TPM chip of the smartwatch is used to register at IoT Hub Ensure secure communication:

```
private string GetUniqueId()
{
```

```

    var hwToken =
Windows.System.Profile.HardwareIdentification.GetPackageSpecificToken(null);
    var hardwareId = hwToken.Id;
    var dataReader = Windows.Storage.Streams.DataReader.FromBuffer(hardwareId);
    var bytes = new byte[hardwareId.Length];
    dataReader.ReadBytes(bytes);
    return Convert.ToBase64String(bytes);
}

```

Registers device with IoT hub or gets device registration if device already exists:

```

internal static async Task<DeviceParams> RegisterDeviceAsync(string uniqueId)
{
    DeviceParams result = null;
    Device device = null;
    try
    {
        device = new Device(uniqueId);
        device = await RegMgr.AddDeviceAsync(device);
    }
    catch (DeviceAlreadyExistsException)
    {
        device = await RegMgr.GetDeviceAsync(uniqueId);
    }
    if( device != null )
    {
        result = new DeviceParams() { Id = device.Id, Key =
device.Authentication.SymmetricKey.PrimaryKey };
    }
    return result;
}

```

And this is how a typical message looks like:

```

public class MessageModel
{
    public long MessageID { get; set; }
    public string DeviceID { get; set; }
    public DateTime TimeStamp { get; set; }
    public enum MessageActions { Create, Update, Delete}
    public MessageActions MessageAction { get; set; }
    public enum MessageTypes { Alarm, Warning, Info}
    public MessageTypes MessageType { get; set; }
    public string MessageString { get; set; }
}

```

This is how messages are sent to the devices:

```

public static Task<bool> SendMessageToDevice(string deviceId, string message)
{
    return Task.Run(async () =>
    {
        try
        {
            Debug.WriteLine("IoTServerService::SendMessageToDevice(): Sending to DeviceID
"+deviceId+" with message:"+message);
            var msg = new Message(Encoding.UTF8.GetBytes(message));
            await Service.SendAsync(deviceId, msg);
            return true;
        }
        catch(Exception ex)
        {
            Debug.WriteLine(ex.Message);
        }
        return false;
    });
}

```

Current status

ASM is using the reference components to drive the development of all the parts of the solution. We currently support them with open questions regarding UWP on Windows IoT Core, usage of ports and protocols, consumption of Azure API Apps in a client applications. The implementation of the reference components is still in progress.

Smartwatch Prototype

Together with the delivery of our reference components for this project, we were also able to send a prototype of the Smartwatch from our ODM to ASM. Since then, ASM was able to test the reference app on the target device directly. ASM can push ahead with its own development. With the power of the final device factor for the major release, the responsible R&D department was able to achieve very good results during the coordination sessions with company management.







Conclusion & Feedback

What was going well

- Achieved and learned a lot, especially regarding industry specific requirements
 - Dived deep into specific problems
 - Developed solutions for upcoming challenges
- Gained experience with different new technologies
- Experienced an excellent cross-team collaboration (Breadth & Depth ISV, PBE & Account Team) to enable the customer the transformation to Industry 4.0 scenarios.

Challenges

- Factory floor internet connectivity at manufacturer sites => potential on-premises fallback solution with Azure Stack required.
- Availability of industry grade wearables (and potentially HoloLens devices).
- We need to be part of internal conversations very early (conversations about “use the cloud and how to make money with it”) to save a lot of time and effort. It's imperative to the succes of industry projects with cloud enablement to build trust with and provide answers to product management, sales force and the marketing staff directly.

Opportunities going forward

- Enable predictive maintenance