Getting Started

DSH-PREDMNT

1. Look at overall status

Find the list of your devices in the map, their status and get control of all events.

2. Add your devices for live monitor

Create your dashboard and see live data real-time from the cloud, look at the trends and gain insights.

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Agenda

1. Architecture
2. Run the application
3. Get started with SL-PREDMNT-E2C
4. Get started with STEVAL-STWINKT1
STMicroelectronics wants to enable customers to fast implement Proof Of Concept on condition monitoring and predictive maintenance from an end to end perspective.

STMicroelectronics, on top of providing evaluation tools and software libraries, allows to connect its devices on a cloud application.

Predictive Maintenance Dashboard is a Cloud application based on AWS services that allows to collect, visualize and analyze data streamed by Sensor Units tailored for Vibration, Environmental and Ultrasound condition monitoring.
The Cloud Application collects data from IoT Node directly or from a Gateway.
Predictive Maintenance Dashboard

AWS services by class

- **Management and Governance**
  - Amazon CloudWatch
  - AWS CloudFormation

- **Application core modules:**
  - IoT, Compute, Database and Storage
    - AWS IoT Core
    - AWS IoT Greengrass
    - Kinesis
    - AWS Lambda
    - Amazon DynamoDB
    - Amazon Simple Storage Service (S3)

- **User identify and security**
  - Amazon Cognito
  - AWS Shield
  - AWS Identity and Access Management (IAM)
  - AWS WAF

- **Networking and Content Delivery**
  - Amazon CloudFront
  - Amazon API Gateway
Predictive Maintenance Dashboard

How can I access?


*regulated with terms of usage for free limited access
Run the application
Predictive Maintenance Dashboard
Run the Application in limited free usage

- ST.com/DSH-Predmnt
  - dsh-predmnt.st.com
  - Serverless deployment in customer’s account

Terms of usage:
- Max 5 devices
- Max 6 months from license agreement acceptance

When user runs out of conditions:
- user can download data
- decide whether or not open its own AWS account
- ask for additional free usage upon business case
Welcome back! Enter your e-mail address and password to login your ivyIT user.

E-mail address
Password

Remember me on this computer?

Login
Forgot password?

New user?
ivyIT brings you a set of personalized features:
- Participate to ST Events
- Stay informed with ST newsletters
- Get in touch with ST Online Support
- Connect to the ST Community
- Receive updates from our online training tools
- Use ST software
- Order free samples
- Manage your weekly product updates
- Buy ST products & tools
Create Account

Terms of Usage
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Login
Sign the Terms of Usage and go

Terms of Usage

Login and accept Terms of Usage
Redirect to the dashboard
Predictive Maintenance Dashboard

DSH-PREDMNT Features

- Device and AWS Greengrass Edge registration and configuration:
  - Provisioning
  - Association to assets
  - Streaming time

- Live data visualization
  - Add a device to live monitoring

- User login and data segregation

- English and Chinese

- Asset Health Monitoring
  - Collect data
  - Analyse Historical trends
  - Apply failure thresholds for alerts and warning

- Assets Map

- Monitor live events or check events history

- Download telemetry data sent filtering by device

- Info Panel for the user about its terms
Predictive Maintenance Dashboard
Register, add, remove and manage a device

1. Add new device

2. Compile form

3. Download device certificate and take note of IoT endpoint

Latitudes and longitudes coordinates
Predictive Maintenance Dashboard
Configure periodic update time

1. Configure transmission periods

2. Drag balloons

Streaming Time for Device: myDevice

- Environmental time domain period
  - Current value: 40s
- Inertial time domain period
  - Current value: 20s
- Inertial FFT time domain period
  - Current value: 50s
- Acoustic time domain period
  - Current value: 50s
Predictive Maintenance Dashboard
Configure measures and condition monitoring thresholds

1. Select cloud dashboard side event
2. Measures domains
3. Thresholds configuration
Predictive Maintenance Dashboard
Set Ultrasound FFT filter

1. No filters

2. Applying filters

3. Device ID: STWin_4356932

Edit Attributes: STWin_4356932

Frequency MIN (kHz): 15
Frequency MAX (kHz): 85

Alerts:
- Low threshold: 38 kHz to 40 kHz, -20 dB
- High threshold: 58 kHz to 62 kHz, -20 dB
Predictive Maintenance Dashboard
Register and manage an AWS Greengrass Group

1. Create new group…
2. …deploy it
The device, once connected for the first time, generates a *Hand Shaking Message* used to expose the measures (environmental, vibration, ultrasound) and Firmware Release.
The Dashboard recognizes the device, update the device shadow (that will be used for other purposes also) and adapt the visualization.

Environmental domain

Vibration (FFT) domain

Vibration Analysis: TD & FD results

Acoustic (FFT) domain
Predictive Maintenance Dashboard
Add a device to live monitoring

Select your device for live monitoring
Predictive Maintenance Dashboard

Assets Monitoring
User can downloads the raw telemetry data for his devices
- Choose device(s) and time period
- Choose device's domain(s)
- Download .zip package with all data in.
Devices selection

Time period selection

Domains selection for each device

Download button
Predictive Maintenance Dashboard

Folder structure downloaded

user-id
device-name
domains
...
...
year
month

Aggregated (by week) json file containing all data for the relative domain

```
{
  "Device_Id": "<device-name>",
  "timestamp": 1583943221725,
  "TTL": 1599495221,
  "Humidity": 34.97,
  "Pressure": 1018.92,
  "Temperature": 24.66,
  "UserId": "#\$\%\&\'\(\)\*\+\,\-\./\0\1\2\3\4\5\6\7\8\9\:\;<=>?@ABCDEFGHIJKLMNOPQRSTUVWXYZ[\]^_`abcdefghijklmnopqrstuvwxyz{|}\~\`
```

```
}]
```
Telemetry data (environmental)

Transmission time
Predictive Maintenance Dashboard

Events

User can retrieves historical events and:

- Filter by device name, date and severity using advanced panel
- Watch dynamic circular chart for global statistics
- Open event detail

This feature will be functional available from June 2020
**Predictive Maintenance Dashboard**

**Events**

**Filters for advanced searching**

**Global statistics**

**Fast event identification**

**Paginations**

---

### Events

<table>
<thead>
<tr>
<th>Timestamp</th>
<th>Severity</th>
<th>Device</th>
<th>Information</th>
</tr>
</thead>
<tbody>
<tr>
<td>2020 Feb 21</td>
<td>INFO</td>
<td>STWIN_CES20B1</td>
<td>STWIN low power mode On</td>
</tr>
<tr>
<td>2020 Feb 21</td>
<td>INFO</td>
<td>STWIN_CES20B1</td>
<td>Bearing status OK</td>
</tr>
<tr>
<td>2020 Feb 21</td>
<td>ALARM</td>
<td>STWIN_CES20B1</td>
<td>Bearing ALERT fault detected</td>
</tr>
<tr>
<td></td>
<td>WARNING</td>
<td>STWIN_CES20B1</td>
<td>Bearing WARNING fault detected</td>
</tr>
</tbody>
</table>

This feature will be functional available from June 2020
Get started with SL-PREDMNT-E2C
Predictive Maintenance Dashboard

how to start

- Google Chrome
- ST Evaluation Tools and SW Packages on your hand, you can combine both approach as you may need

Quick start

End to end architecture based on wired Smart Sensor Nodes and Gateway

STM32MP157C-DK2 rev. C01
X-LINUX-PREDMNT

STEVAL-IDP004V1/V2
STSW-IDP4PREDMNT

STEVAL-BFA001V1B
STSW-BFA001V1B
In this scenario, two motors are monitored by using two STEVAL-BFA001V1B provisioned as BoothDemo1 and BoothDemo2 connected via a Master STEVAL-IDP004V1 and a Gateway STM32MP157C-DK2 rev. C01 connected over WIFI. One of the motor is unbalanced (corresponding to BoothDemo2).

1. Get STEVAL-BFA001V1, STEVAL-IDP004V1, STM32MP157C-DK2 and Download the Software
2. Deploy the X-LINUX-PREMDNT on the STM32MP157C-DK2
3. Register the Edge and the devices
4. Start the application
Vibration and Environmental Monitoring

Get the Hardware's, Download the SW

Go to www.st.com/SL-PREDMNT-E2C

Buy the Hardware

Download all the SW

<table>
<thead>
<tr>
<th>Component</th>
<th>Order code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Smart Sensor Node</td>
<td>STEVAL-BFA001V1B</td>
<td>Predictive maintenance kit with sensors and IO-Link capability</td>
</tr>
<tr>
<td>Master</td>
<td>STEVAL-IDP004V1</td>
<td>IO-Link master multi-port evaluation board</td>
</tr>
<tr>
<td></td>
<td>STEVAL-IDP004V2</td>
<td></td>
</tr>
<tr>
<td>Gateway</td>
<td>STM32MP157C-DK2</td>
<td>Discovery kit with STM32MP157C MPU</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>SW Layer Mission</th>
<th>Software Code</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collect, Preprocess and communicate to the Master</td>
<td>STSW-BFA001PREDMNT.zip</td>
<td>Binary</td>
</tr>
<tr>
<td>Handle the communication with the Smart Sensor Node and with the gateway</td>
<td>STSW-IDP4PREMNT.zip</td>
<td>Binary</td>
</tr>
<tr>
<td>Handle the communication with the master, enable Edge processing and data injection in the Cloud</td>
<td>X-LINUX-PREDMNT</td>
<td>OpenSTLinux Expansion Pack in Source Code and with SD Card image</td>
</tr>
<tr>
<td>Visualize data</td>
<td>DSH-PREDMNT</td>
<td></td>
</tr>
</tbody>
</table>
Vibration Monitoring

deploy X-LINUX-PREDMNT

Go to
You can start the application after the configuration and deployment phases. Follow the procedure below to activate vibration and start the application on your setup with or without motors.

1. Connect the setup to the gateway via USB cable.
2. If you connect rotating motors, power on the setup.
3. Set the speed of the setup to the desired value.
4. Click “RUN APPLICATION” on the gateway GUI, or run “/home/root/start_pmp.sh” from a terminal:

Open the dashboard and log in: https://dsh-predmnt.st.com/
Click on [DASHBOARD]->[Add Device], and select the desired devices.
Get started with STEVAL-STWINKT1 and connectivity expansions
Predictive Maintenance Dashboard

how to start

- ST Evaluation Tools and SW Packages on your hand, you can combine both approach as you may need
- Google Chrome, view directly in your browser the data coming thanks to DSH-PREDMNT application

Quick start

End to end architecture based on Wireless Smart Sensor Nodes (WIFI – LPWAN)

STEVAL-STWINWFV1
STEVAL-STWINKT1
FP-IND-PREMNT1

STEVAL-STWINKT1

STMOD+ cellular add-on board coming from P-L496G-CELL02

STSW-STWINCELL
Vibration and Ultrasound Monitoring
Quick Start with WIFI expansion STEVAL-STWINWF1

In this scenario a motor is monitored by using an STEVAL-STWINKT1 as smart sensor node connected by using the WIFI expansion module (STEVAL-STWINWFV1) and the smart sensor node is provisioned.

1. Get STEVAL-STWINKT1 and STEVAL-STWINWFV1
2. Download the FP-IND-PREMNT1 and Flash it
3. Register your node at DSH-PREDMNT
4. Run the application
5. Monitor data on DSH-PREDMNT
6. Set Thresholds for events management
### Buy the Hardware

<table>
<thead>
<tr>
<th>Component</th>
<th>Order code</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>SensorTile Wireless Industrial Node (STWIN)</td>
<td>STEVAL-STWINKT1</td>
<td>Predictive maintenance kit with sensors</td>
</tr>
<tr>
<td>Expansion board</td>
<td>STEVAL-STWINWF1</td>
<td>WIFI Expansion</td>
</tr>
</tbody>
</table>

### Get the Software

<table>
<thead>
<tr>
<th>SW Layer Mission</th>
<th>Software Code</th>
<th>Online Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collect, Preprocess and communicate to the Cloud</td>
<td>FP-IND-PREDMNT</td>
<td>Source code available for STM32</td>
</tr>
<tr>
<td>Visualize data</td>
<td>DSH-PREDMNT</td>
<td>Web based application</td>
</tr>
</tbody>
</table>

Collect, Preprocess and communicate to the Cloud
FP-IND-PREDMNT
Source code available for STM32
Web based application
Power ON/OFF the STWIN

• Battery only (no USB cable):
  • Power ON
    • Long-press the PWR button until the red led turns off (~1 sec)
  • Power OFF
    • Press the PWR button

• Plugged mode (USB cable)
  • Power ON
    • When USB is plugged-in, the STWIN is always on. It doesn’t matter if the battery is present or not
  • Power OFF
    • Unplug the cable and, if the battery is connected, press the PWR button.
Download FP-IND-PREDMNT1 and Flash Predictive Maintenance Cloud Application (1/6)

1. Download FP-IND-PREDMNT1

2. Select FP-IND-PREDMNT1

3. Download & unpack

4. Compile/Flash and Run the project

5. Configure and Monitoring the application
   - TeraTerm (v. 4.97 or higher)
   - ST DSH-PREDMNT

6. FP-IND-PREDMNT1 package structure
   - Name
     - Docs
     - BSP, HAL and drivers
     - AWS, mbedTLS, Wifi, MotionSP
     - Application example
   - Projects
     - STM32L4R9ZI-STWIN
     - Demonstrations
     - Predictive_Maintenance_WIFI
   - Binary
     - STM32L4R9ZI-STWIN_PredictiveMaintenance_WIFI_v2.0.0.bin

Load the pre-compiled binary using STM32 ST-LINK Utility

www.st.com/stm32ode-fp

OR

\Projects\STM32L4R9ZI-STWIN\Demonstrations\Predictive_Maintenance_WIFI\AWS\Binary\STM32L4R9ZI-STWIN_PredictiveMaintenance_WIFI_v2.0.0.bin
Set up your network configuration
Predictive Maintenance Cloud Application (2/6)

- Connect STWIN to the PC using a micro-USB cable
- Open TeraTerm (v. 4.97 or higher)
- File-> NewConnection
  - Select the right COM port
- Setup-> Terminal
  - Set parameters as below
  - Press RESET button of STWIN.
To change Wi-Fi network follow the instructions on the console:

- Press the STWIN USR button within 5 seconds

- Provide new Wi-Fi credentials:
  - SSID
  - Security mode
  - Password
Register your node and inject data
Predictive Maintenance Cloud Application (4/6)

1. Register and provision the device by downloading the certificates

2. Configure AWS Credentials and load the certificates

   - Press the USR button within 5 seconds
   - Enter the AWS IoT Core endpoint
     - a1azohj3ky8ktj-ats.iot.eu-west-1.amazonaws.com (example for Predictive Maintenance Dashboard)
   - Send via terminal the certificates obtained from the dashboard when the device was created:
     - Directly drag and drop the file or copy and paste the text
Start the application
Predictive Maintenance Cloud Application (5/6)

1. Add to the dashboard

2. Experiment thresholds
Start the application – Thresholds and Events
Predictive Maintenance Cloud Application (6/6)

1. Add thresholds to device

2. View events coming

Telemetry

Set Thresholds

Anomaly events
Vibration, Ultrasound and Environmental Monitoring
Quick Start with STMOD+ cellular add-on of P-L496G-CELL02

In this scenario vibration, audio spectrum and environmental parameters such as temperature, humidity and pressure are monitored by using an STEVAL-STWINKT1 as smart sensor node connected by using a STMOD+ cellular add-on board based on Quectel BG96 modem, LTE Cat M1 / NB-IoT / 2G fallback, coming from P-L496G-CELL02.

1. Get STEVAL-STWINKT1 and STMOD+ cellular add-on board based on Quectel BG96 modem
2. Setup STEVAL-STWINKT1 and add-on board
3. Download the STSW-STWINCELL and download it into STEVAL-STWINKT1’s MCU
4. Register your node at DSH-PREDMNT
5. Set up your network configuration
6. Run the application
7. Monitor the data on DSH-PREDMNT
# Vibration, Ultrasound and Environmental Monitoring

## Get the Hardware, Download the Software

### Buy the Hardware

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<td>STEVAL-STWINKT1</td>
<td>Predictive maintenance kit with sensors</td>
</tr>
<tr>
<td>Expansion board</td>
<td>STMOD+ cellular add-on board based on Quectel BG96 modem coming from P-L496G-CELL02</td>
<td>Adds LTE Cat M1, NB-IoT with 2G fallback connectivity to the STWIN</td>
</tr>
</tbody>
</table>

### Get the Software

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<td>Collect, Preprocess and communicate to the Cloud</td>
<td>STSW-STWINCELL</td>
<td>Binary and source code available for STM32</td>
</tr>
<tr>
<td>Visualize data</td>
<td>DSH-PREDMNT</td>
<td>Web based application</td>
</tr>
</tbody>
</table>
Setup STEVAL-STWINKT1 and P-L496G-CELL2

1. Connect the battery.
2. Route the right voltage to the power supply pin of the STMOD+ connector.
3. Insert the SIM card into the related socket of the STMOD+ cellular add-on board.
4. Assembly the main board with the plastic box and connect the cellular add-on board.
5. Power via USB receptacle and connect the STEVAL-STWINKT1 to a PC via the STLINK-V3MINI
6. Download STSW-STWINCELL binary file into STEVAL-STWINKT1’s MCU
Log in to the dashboard and register the device

1. Sign Up or Sign In (myST credentials)
2. Add new device and download the zip file containing the certificates
3. Open the device’s dashboard
Start a terminal emulator software and set the parameters as follow:

- **Terminal**
  - [New line]
  - [Receive]: AUTO
  - [Transmit]: LF
  - [Local Echo] selected

- **Serial**
  - [Port]: as the port assigned to ST-LINK debugger by OS
  - [Baud rate]: 115200
  - [Data]: 8 bit
  - [Parity]: none
  - [Stop]: 1 bit
  - [Flow control]: none
  - [Transmit delay]: 10 ms each

After pressing the reset button on the STEVAL-STWINKT1 ...

... the console will show it

```plaintext
Hello
```

---

A cellular expansion board, MB1329B, provided with the BG96 module have to be plugged into the STM0D+ connector.

MCU Unique device ID is 0x20333348334E501300280012

- Network Interface initialized:
Your Cellular parameters need to be entered to proceed.
Select the SIM slot (O = External, 1 = Internal):
Configure parameters of STSW-STWINCELL

1. Select the SIM slot to be used.
2. Enter the APN for the cellular network operator you are going to use and the optional credential as well.
   - Wait for the cellular module initialization and its network registration.
3. Enter the AWS IoT Endpoint: `a1azohj3ky8ktj-ats.iot.eu-west-1.amazonaws.com`
   - Enter the Device’s name
4. Enter the certificates for the AWS IoT device (you can find it inside the downloaded zip file):
   - Root certificate authority (CA)
   - Device certificate
   - Device private key

---

- Network Interface initialized:
  - Your Cellular parameters need to be entered to proceed.
  - Select the SIM slot 0 (O - External), 1 (Internal).
  - You have selected the external SIM.

- Enter Sim Operator Access Point Code (e.g. EM or ESYELI etc): `n90t.tds.tdl.ts`
  - You have entered <n90t.tds.tdl.ts> as the Sim Operator Access Point Code.
  - Enter the username (it can be NULL) (max 16 chars):
    - You have entered < as the username.
  - Enter the password (it can be NULL) (max 16 chars):
    - You have entered < as the password.

- Network Interface Starting:
  - **CIC connection**
  - Initializing the cellular module
  - Network Interface connecting:
    - Trying to connect with the external SIM
    - Waiting for RING modem running
    - Signal not known or not detectable yet (be patient)

- Signal Level: -77 dBm

- GPRS module registered
  - Registration done in 60050 milliseconds

- Retreiving the cellular operator: "I.TIM"
  - Module initialized successfully: Qucet!

- ProductID: B06E
- FW version: B0MAR02090193
- SIM Id: (1cc) 8990020000222936787

- Network Interface started:
  - Device Name: Qucet!
  - Device ID: B06E
  - Device Version: B0MAR02090193

- Network Interface connected:
  - IP address: [10.18.44.4]

---

Enter server address (example: `xxx.iot.region.amazonaws.com`):

```
allip=64v4ha-ats.iot.eu-west-1.amazonaws.com
read_allip=64v4ha-ats.iot.eu-west-1.amazonaws.com
```

Enter device name: `mything`

```
STWINLB06E
read_STWINLB06E
```

Enter the AWS IoT Endpoint: `a1azohj3ky8ktj-ats.iot.eu-west-1.amazonaws.com`.

Enter the Device’s name.

Enter the certificates for the AWS IoT device (you can find it inside the downloaded zip file):
- Root certificate authority (CA)
- Device certificate
- Device private key
Since the needed parameters have been successfully entered …

- The on board components are going to be initialized.
- The MQTT connection is going to be established.

According to the streaming time the STEVAL-STWINKT1 will publish via the STMOD+ cellular add-on board the data for each feature.
The features that will be used can be selected during FW compiling. The user can choose from one up to all four features acting on the values of the following key words inside the file ‘aws_iot_config.h’:
• USE_ENV_FEAT
• USE_INE_TDM_FEAT
• USE_INE_FDM_FEAT
• USE_ACO_FEAT
Predictive Maintenance Dashboard
Register other devices and get the Full Picture

Overall devices enrolled and status

Assets and Status
Geo localization
Thank you