



# IoT Solution Optimizer

## User Guide: Service Version 2.3

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# USER GUIDE: SERVICE VERSION 2.3

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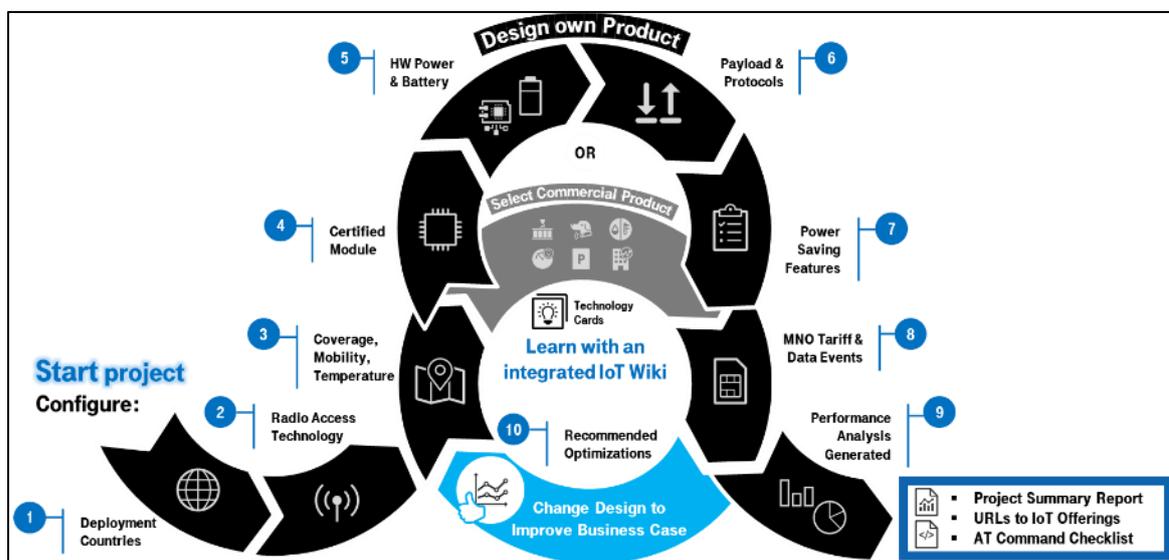
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# 1. Introduction

Thank you for your interest in the IoT Solution Optimizer, a cloud-based service that digitalizes and scales-up technical consultancy for agile Internet of Things (IoT) product design. The IoT Solution Optimizer leverages “virtual twin modeling” technologies to assess implementation choices in seconds. Users may model the effect of deployment characteristics (temperature, mobility, coverage) on their design, or choose to optimize their service’s communication efficiency or battery life performance. This innovative and powerful capability helps enterprises accelerate their time-to-market, reduce costs and the dependency on multiple proof-of-concepts.

The IoT Solution Optimizer bridges the supplier fragmentation affecting the IoT industry, by combining the expertise of various segments (3GPP™ wireless communication chipsets and modules, batteries, IoT applications, 3GPP™ features, mobile operator networks, etc.) into an experience guiding customers through the development of more power-efficient M2M/IoT solutions. Within minutes, users can compose their own design by selecting hardware components and characterizing their application’s intended behavior. Best network features are presented in parallel, with insights on how they can be used to maximize investments. In case that customers prefer a standard product offering instead, they may conveniently select from among the numerous products integrated into the service’s solution shelves. After users finish configuring the deployment scenario for their product, the IoT Solution Optimizer models device performance, delivering reliable results and multiple optimization opportunities. An analysis that would previously take several man-weeks of investigation to complete, is now delivered in just seconds. This improves time-to-market for customers, by empowering them to identify risks, ensure proper integration of feature support, and weigh-out their design choices. The usage flow of the IoT Solution Optimizer is shown in Figure 1.

Figure 1: IoT Solution Optimizer project creation flow



## 2. Technical Considerations

The following URL that may be used to reach the IoT Solution Optimizer service worldwide via the Internet:

- [www.iotsolutionoptimizer.com](http://www.iotsolutionoptimizer.com) (and associated sub-domains)

The user interface is based on a secure Azure Web App with auto-scaling, compatible with most PC browsers. Currently, the service is not optimized for use on small-screen devices, such as smartphones, as there is no mobile version of the application available.

For the best experience with the IoT Solution Optimizer, it is recommended to use the latest version of Firefox, Chrome, Internet Explorer, Microsoft Edge, or Safari. Although the IoT Solution Optimizer Web App may also operate with other browsers, unforeseen technical issues may occur. As there will be a major update of the IoT Solution Optimizer at least twice a year, it may be necessary to periodically clear the browser's cache. This allows one to properly render and use new features which are implemented per release. Please also enable cookies and Javascript under browser settings. One may also need to install the Adobe PDF Reader browser plugin add-on for PDF in-browser viewing if it is already not available.

For further information, please refer to the instructions for browser settings, available here:

- Chrome: <http://www.google.com/support/chrome/>
- Firefox: <http://support.mozilla.org>
- Internet Explorer: <http://support.microsoft.com/en-us/products/internet-explorer>
- Microsoft Edge: <https://support.microsoft.com/en-gb/products/microsoft-edge>
- Safari: Information available under Menu option "Preferences"
- Adobe Reader: <http://get.adobe.com/reader/>

In case that technical issues are encountered with the browser, it is possible to troubleshoot the installation by following these simple steps:

1. Install the latest, available browser versions,
2. Clear the browser's cache,
3. Try a different browser and/or different computer.

(It may be beneficial to have more than one browser installed on the computer. If one runs into problems while using the IoT Solution Optimizer, moving to another browser may resolve the issue. One can also try moving to a different computer to see if the problem persists. This may help to identify whether the issue was a problem with the browser or computer, or with the IoT Solution Optimizer).

4. Still having problems? If a technical issue persists, please report the problem to the Tool Support team via the Contact option (refer to [Chapter 3.3](#)).

### 3. Welcome! Homepage

Upon logging into the IoT Solution Optimizer web service, users will load the “Welcome!” homepage ([Figure 2](#)). This initial screen shares the same headers and footers with all subsequent pages of the IoT Solution Optimizer service.

The IoT Solution Optimizer’s header menu bar is found just underneath the mobile network operator branding at the top. **Breadcrumbs** on the left-hand side of the header menu bar indicate horizontally the page-hierarchy under which one finds themselves. Once users start new projects or open existing ones, they may go back to the “Welcome!” homepage simply by selecting breadcrumb links further to the left. Depending on user-specific access rights, the leftmost breadcrumb (whose name is white-labeled by your service provider) may load a services page granting quick-access to the Technology Card library.

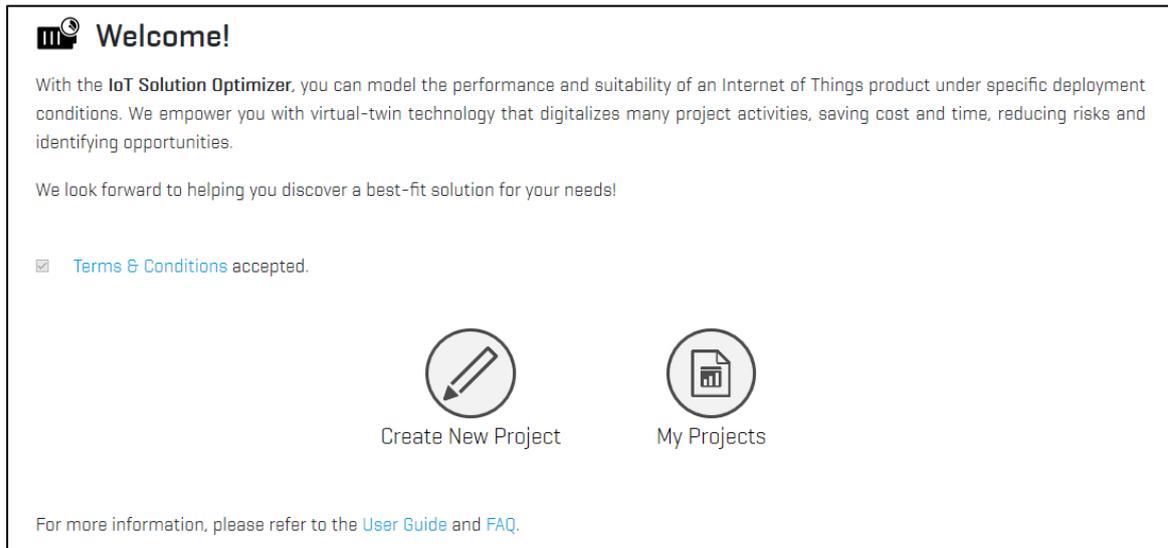
Likewise, on the right-hand side of the header menu bar, one will find their account username (typically an e-mail address). By selecting this, a drop-down list of **account management features** emerges, containing “My Account” and “Log out” options.

The footer of the IoT Solution Optimizer also embeds additional features which are helpful whenever users may have questions regarding the service and who to reach out to for assistance:

- **Imprint** – This page loads in a new browser tab, providing information in compliance to local regulation. Depending on the region, this may include the service provider’s name, address, telephone number and e-mail address, trade registry number, Tax-ID number, etc.
- **Terms & Conditions** – This is a copy of the current IoT Solution Optimizer “Terms & Conditions of Service Usage,” loading in a new browser tab (refer to [Chapter 3.1](#)).
- **Contact** – Selecting this opens the contact form which can be used to compose a new message to the Tool Support team (refer to [Chapter 3.3](#)). By selecting the country from the drop-down list, the request is routed to the proper support personnel.

The content of the “Welcome!” homepage includes a generic description of the service that the IoT Solution Optimizer provides. Just below is a selection box for accepting “Terms & Conditions” (please refer to [Chapter 3.1](#)), and links further below to download this User Guide and the Frequently Asked Questions (FAQ) document.

Figure 2: "Welcome!" homepage



### 3.1. Terms & Conditions of Service Usage

In order to start using the IoT Solution Optimizer service, it is required to accept the "Terms & Conditions of Service Usage". These can be read by selecting the colored words "Terms & Conditions" on the Welcome! page, or via the link integrated into the footer of the browser window. By selecting the tick box next to "Terms & Conditions," users acknowledge that they have read and fully agree to the web service usage and privacy policies. As part of the accepted "Terms & Conditions of Service Usage," users explicitly grant their service provider the right to collect data regarding their projects, in compliance to the European Union's General Data Protection Regulation (GDPR), which is among the strictest worldwide. The project data of users is used for the purpose of improving the IoT Solution Optimizer web service, as well as for performing trend analyses of successful (and unsuccessful) M2M or IoT product designs or their aspects. It is important to note that the service provider's analysis algorithms do not include any private data associated with user accounts. This is important to highlight, as the IoT Solution Optimizer cannot reveal a link between private data and project data.

From time-to-time, the "Terms & Conditions of Service Usage" may be updated to reflect new regulations and service features, requiring users to accept the new agreement before being able to use the service. Once the agreement is selected, it is not possible to deselect the tick box. Users must delete their account if they do not want to accept the conditions any further.

Failure to accept the web service usage and privacy policies prevents further usage of the IoT Solution Optimizer. Only after the "Terms & Conditions of Service Usage" are accepted,

do the two main menu options appear for users: "My Projects" (refer to [Chapter 4](#)) and "Create New Project" (refer to [Chapter 5](#)).

## **3.2. My Account**

The "My Account" feature of the IoT Solution Optimizer is accessible on the right-hand side of the header menu bar, under the account holder's username (typically an e-mail address). When selected, a drop-down list of account management features appears, containing "My Account" and "Log out" options. Under "My Account," one can update their contact information, consisting of their first name, last name, phone number, mobile number, e-mail address, company name and company address. Mandatory fields are marked with "\*". The e-mail address used during the registration process serves as one's username. It cannot be changed thereafter via the "My Account" page. Please contact Tool Support for further assistance.

The security question and answer can be defined here, in case that account credentials are lost. Furthermore, there is a tick-box to give consent to receive e-mail notifications from the service, e.g. on expiration of one's account. With this feature, users can conveniently unsubscribe anytime from receiving alert messages from the service.

### **3.2.1. Change Password**

The "Change password" button is located in the "My Account" page. Users must confirm their current password and enter a new password twice. By selecting "Update password," the account updates with the new credentials.

### **3.2.2. Two-factor Authentication (2FA)**

*Please note: Using 2FA in IoT Solution Optimizer is mandatory. Users will be automatically asked to configure 2FA upon their first log-in into the service (refer to [Figure 3](#)). As per the service provider's "Terms & Conditions of Service Usage," users are not allowed to pool or share their username, password and a 2FA code with third parties. Each account is tied to specific user, and their e-mail address and smartphone 2FA application.*

The "Two-factor Authentication" button is located in the "My Account" page. Users can reset their recovery codes. Likewise, the Authenticator app can be reconfigured, with the authenticator key reset option. Configuration of two-factor authentication is done using a smartphone authenticator app, which scans the QR code shown in the IoT

Solution Optimizer (refer to [Figure 4](#)). The verification code given by the smartphone authenticator app is entered in the field at the bottom of the page.

Figure 3: "Enable Authenticator" page

## Two-factor authentication

Your login is protected with an authenticator. Select method for two-factor authentication:

E-mail

Currently only two-factor authentication via e-mail is configured for your account. You can always configure two-factor authentication via a smartphone authenticator application (such as Google or Microsoft Authenticator) under your user account settings: "My Account" > "Two-factor authentication" > "Configure authenticator app".

Configure my authenticator application after login.

Authenticator code:

Don't have access to your authenticator device? You can [log in with a recovery code](#).

Figure 4: "Enable Authenticator" page

## My Account

### Enable Authenticator

To use an authenticator app go through the following steps:

1. Download a two-factor authenticator app like Microsoft Authenticator for [Windows Phone](#), [Android](#) and [iOS](#) or Google Authenticator for [Android](#) and [iOS](#).
2. Scan the QR Code or enter this key  into your two-factor authenticator app. Spaces and capitalization do not matter.



3. Once you have scanned the QR code or input the key above, your two-factor authentication app will provide you with a unique code. Enter the code in the confirmation box below.

Verification Code

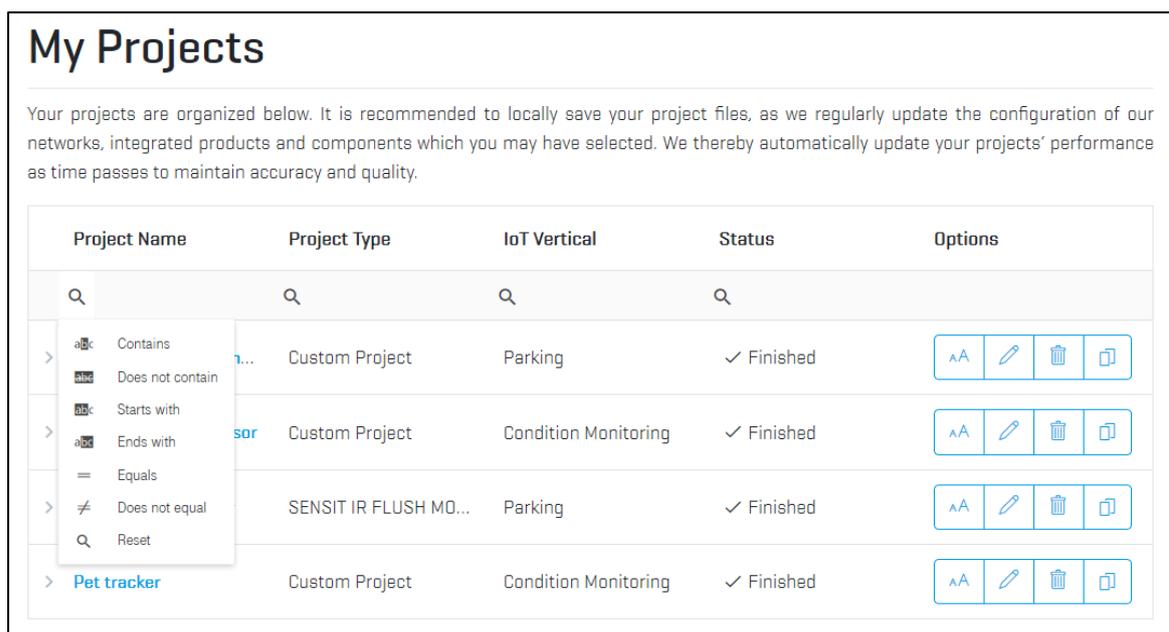
### 3.3. Tool Support

It is possible to contact the IoT Solution Optimizer’s Tool Support team by using the Contact option integrated into the footer of the service’s webpages. For proper routing of your request, please make sure to select the tariff country of your service provider.

## 4. My Projects

Users of the IoT Solution Optimizer can conveniently browse and edit their projects in the “My Projects” page. This feature can be accessed either via the main menu option in the “Welcome!” page, or via the breadcrumbs in the webpage header menu bar. Both in-progress and completed projects are displayed in table format, organized according to editing date, with the most recently created or modified project at the top. By using the filtering options available under each column (refer to [Figure 5](#)), users can quickly define a search mask or filter to sort their numerous projects.

Figure 5: “My Projects” page - Filtering criteria



The screenshot shows the "My Projects" page with a table of projects. A dropdown menu is open under the "Project Name" column, displaying various filtering options. The table contains the following data:

Project Name	Project Type	IoT Vertical	Status	Options
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	
> <input type="text"/> Contains	Custom Project	Parking	✓ Finished	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
> <input type="text"/> Does not contain	Custom Project	Condition Monitoring	✓ Finished	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
> <input type="text"/> Starts with	SENSIT IR FLUSH MO...	Parking	✓ Finished	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
> <input type="text"/> Ends with	Pet tracker	Condition Monitoring	✓ Finished	<input type="text"/> <input type="text"/> <input type="text"/> <input type="text"/>
> <input type="text"/> Equals				
> <input type="text"/> Does not equal				
> <input type="text"/> Reset				

With the convenient action buttons to the right of each project, one can (option functions, from left to right) rename, edit, delete, or copy projects. Not only can users edit a project by selecting the pencil icon in the “Actions” area of the table, but they can also modify it by selecting its name under the “Project Name” column. If a project is copied, users are asked to give the replicated configuration a unique name.

The “My Projects” table lists for all projects their “Project Name”, “Hardware Type” (whereby either “Custom Project” is shown, or a pre-integrated product’s name), “IoT Vertical” (the type of IoT application), and “Status” (either “In Progress” or “Finished” is shown). Each

project consists of a folder containing up to three documents. These files are accessed by selecting the twisty to the left of the project name. As seen in [Figure 6](#), those projects which are not finished yet will display no files, showing only the text, "Project files will be generated once you finish your project." Completed projects (as shown in [Figure 7](#)) include a "Project Summary Report," (refer to [Chapter 6.12](#)), an "AT Command Guide" (refer to [Chapter 6.12.3](#)), as well as an mobile network operator-specific IoT landing page (see [Chapter 6.12.4](#)). These files are regenerated each time that a project is modified, or the underlying configuration database of the IoT Solution Optimizer is updated by the Tool Support team. It is therefore essential to save one's project files locally in case that one wants to archive the configuration and performance of a specific design.

*Figure 6: "My Projects" page – In-progress projects*

## My Projects

Your projects are organized below. It is recommended to locally save your project files, as we regularly update the configuration of our networks, integrated products and components which you may have selected. We thereby automatically update your projects' performance as time passes to maintain accuracy and quality.

Project Name	Project Type	IoT Vertical	Status	Options
🔍	🔍	🔍	🔍	
<span style="font-size: 0.8em;">▼</span> <a href="#">Bohinj smoke detector</a>	Custom Project	Safety	🌀 In Progress	<span style="font-size: 0.8em;">AA</span> <span style="font-size: 0.8em;">✎</span> <span style="font-size: 0.8em;">🗑️</span> <span style="font-size: 0.8em;">📄</span>
Project files will be generated once you finish your project.				
<span style="font-size: 0.8em;">&gt;</span> <a href="#">Ljubljana parking sen...</a>	Custom Project	Parking	✓ Finished	<span style="font-size: 0.8em;">AA</span> <span style="font-size: 0.8em;">✎</span> <span style="font-size: 0.8em;">🗑️</span> <span style="font-size: 0.8em;">📄</span>
<span style="font-size: 0.8em;">&gt;</span> <a href="#">Trieste humidity sensor</a>	Custom Project	Condition Monitoring	✓ Finished	<span style="font-size: 0.8em;">AA</span> <span style="font-size: 0.8em;">✎</span> <span style="font-size: 0.8em;">🗑️</span> <span style="font-size: 0.8em;">📄</span>

Figure 7: "My Projects" page – Finished projects

## My Projects

Your projects are organized below. It is recommended to locally save your project files, as we regularly update the configuration of our networks, integrated products and components which you may have selected. We thereby automatically update your projects' performance as time passes to maintain accuracy and quality.

Project Name	Project Type	IoT Vertical	Status	Options
🔍	🔍	🔍	🔍	
> Bohinj smoke detector	Custom Project	Safety	⚙️ In Progress	⌵ ✎ 🗑 📄
▼ Ljubljana parking sen...	Custom Project	Parking	✓ Finished	⌵ ✎ 🗑 📄
<b>Project Files:</b> <ul style="list-style-type: none"><li>📄 Project Summary Report</li><li>📄 AT Command Guide</li><li>📄 REŠITVE ZA PODJETJA INTERNET STVARI</li><li>📄 SAFT Product Specification Request</li><li>📄 SIMCom Contact Form</li></ul>				
> Trieste humidity sensor	Custom Project	Condition Monitoring	✓ Finished	⌵ ✎ 🗑 📄

## 5. Create New Project

Users can start a new project in the IoT Solution Optimizer by selecting the "Create New Project" main menu option. This loads the "Create New Project" page, where users must give their project a unique name and select "Next" (refer to [Figure 8](#)). Once a name has been given to a project, it appears in the "My Projects" page (refer to [Chapter 4](#)) with a dedicated project folder. Please note that it is not possible for a user to give the same name to more than one project under their account. The service will prompt with an error message, requesting one to change the name before saving.

One can use the breadcrumbs to navigate either back to the "Welcome!" page by selecting "IoT Solution Optimizer" or to the "My Projects" page. One can also select "Back" to navigate to the "My Projects" page.

Figure 8: "Create New Project" page

## Create New Project

Please give your project a name:

## 6. Service Wizard

The Service Wizard is implemented at the top of all IoT Solution Optimizer project configuration pages. The wizard serves two key purposes. Firstly, it highlights to users where they currently are within the project configuration flow. By hovering the cursor over each node, a pop-up appears showing the name of each page. The user can therefore learn what completed and pending configuration tasks are. Secondly, users can select the colored wizard nodes to navigate back and forward through their projects to reconfigure different elements of their design. By going back to change an element in a project, the IoT Solution Optimizer will perform a plausibility check on the rest of the design and inform the user whenever a subsequent page requires reconfiguration. For example, changing the deployment network to one which does not support some 3GPP™ features may require the user to reconfigure previously selected power saving features later in the configuration flow.

Once one clicks on “Create New Project” and gives their project a name, the Service Wizard is launched to guide one through the configuration (refer to [Figure 9](#)). Service Wizard appears as a cluster of large, interconnected circles (representing major “stages” in the configuration flow of projects), and smaller nodes in-between (representing individual configuration pages), appearing in the following order:

Step 1: “**Solution Profiling**” stage

- “**IoT Vertical**” – Identifies the M2M/IoT industry that the service classifies under
- “**Mobile Operator Network**” – Defines tariff network, deployment network(s)
- “**Access Technology**” – Specifies radio access technology of IoT device
- “**Deployment Characteristics**” – Defines the deployment coverage type(s), temperature, mobility model and roaming

Step 2: “**Hardware**” stage

- “**Product Shelf**” – Identifies whether a custom design or standard offering will be modeled
- **[Custom design only]** “**Module or Chipset**” – Selects 3GPP™ modem certified in chosen market(s)
- **[Custom design only]** “**Hardware Components**” – Defines the power consumption of other components, including voltage regulation (LDO)
- **[Custom design only]** “**Battery**” – Configures the power source of the IoT device

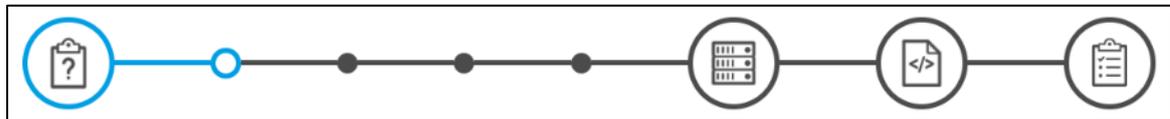
Step 3: “**Application**” stage

- “**Communication Activity**” – Defines each application and device management message sent/received between device and server; per message, the following are defined by the user:

- **[Custom design only] "Payload & IoT Protocol"** – Specifies application payload, the messaging and/or service enablement protocol, and the public or private cloud used
- **[Custom design only] "Transport Protocol"** – Configures the Transport Layer protocol, keep-alive messages, and transport security
- **"Data Events"** – Select a data tariff and define the application and device management message frequency, in conformance to "No Harm to Network" rules
- **[Custom design only] "Power Saving Features"** – Sets the corresponding 3GPP™ features

#### Step 4: "Project Summary Report"

*Figure 9: Service wizard – Initial state*



As seen with numerous entries having a label "**[Custom design only]**" in the list above, several configuration steps are only available when users elect to assemble their own IoT solution design. The affected pages in the "Hardware" and "Application" stages appear only after the user selects the option "Design your own custom product" in the "Product Shelf" page (refer to [Chapter 6.5](#)). Once this is done, the corresponding additional nodes appear in the wizard for these stages.

Users who instead select a pre-configured product off the IoT Solution Optimizer's "Product Shelf" page can proceed directly to the "Data Events" page. The product's hardware and application configurations are hidden from view and cannot be modified. For more information about the components used in a product, please contact its vendor. A product specification and contact information can be found under the corresponding "More info" button next to the product.

## 6.1. IoT Vertical

*Please note: this option is available in all projects, regardless of whether the user decided to build a custom design or selected a pre-integrated product off the IoT Solution Optimizer's virtual product shelf (refer to [Chapter 6.5](#)).*

The first page of the "Solution Profiling" stage involves assigning an M2M/IoT vertical industry to the project (refer to [Figure 10](#)). This step is necessary in order to associate the project with similar product designs. Not only does this help pre-configure subsequent input pages with reference values for each vertical industry, but it aids the IoT Solution

Optimizer in organizing the collected data into use case “silos” for machine learning and business intelligence.

Figure 10: “Select Vertical” page

### IoT Vertical

Please select which vertical your [IoT application](#) best corresponds to:

[Next](#)

 Agriculture	 Asset Tracking	 Building Construction
 Building Monitoring	 Condition Monitoring	 Developer Kits
 Elderly Care	 Environmental Monitoring	 Farming Equipment
 Gateways	 Health	 Logistics
 Manufacturing	 Parking	 Pet Tracking
 Predictive Maintenance	 Retail	 Safety
 Security Products	 Service Buttons	 Smart Grid
 Smart Home	 Smart Meters	 Street Lighting
 Transport	 Vending Machines	 Waste Management
 Wearables	 White Goods	 X-Sharing

Not found what you're looking for? Please contact Tool Support.

[Next](#)

Verticals are purposely not organized alphabetically on this page to encourage them to consider which association best-fits their project to the numerous, listed categories. For example, a sensor mounted on a bicycle may be an “Asset Tracker” if used for security purposes, “Health” if used in conjunction with a health monitoring application, “Condition Monitoring” for assessing wear and tear or vibration on its mechanical components, or “X-Sharing” if used in a “rent the bike” commercial model. There are subtle differences

between each of the M2M/IoT applications, even if at the end the product is physically mounted on a bicycle.

Please note that the integration of new M2M/IoT verticals to the IoT Solution Optimizer is independent of its service releases. That means that additional options may become available independently of regularly scheduled updates. If a specific vertical industry is missing for the intended use case, please contact Tool Support via link integrated at the bottom of the page.

In order to proceed to the subsequent page “Mobile Operator Network” in the project configuration flow, please select the “Next” button at the bottom of the page. If users do not select a vertical, they are prompted with an error message, “Please select an IoT vertical corresponding to your application.”

## 6.2. Mobile Operator Network

*Please note: this option is available in all projects, regardless of whether the user decided to build a custom design or selected a pre-integrated product off the IoT Solution Optimizer’s virtual product shelf (refer to Chapter 6.5).*

The IoT Solution Optimizer can be used to model the performance of M2M and IoT solutions on different networks provided by mobile network operators (MNOs). Each network has been characterized in the service’s database according to its available 3GPP™ radio access technology, network features and parametrization, as well as band support. By selecting one or more deployment networks, the IoT Solution Optimizer adapts the configuration options in subsequent pages. For instance, a specific network may not support LTE-M radio access technology, or specific power saving features. Furthermore, chipsets or modules may not support the network bands of a specific market, or even be allowed by that selected MNO on their network.

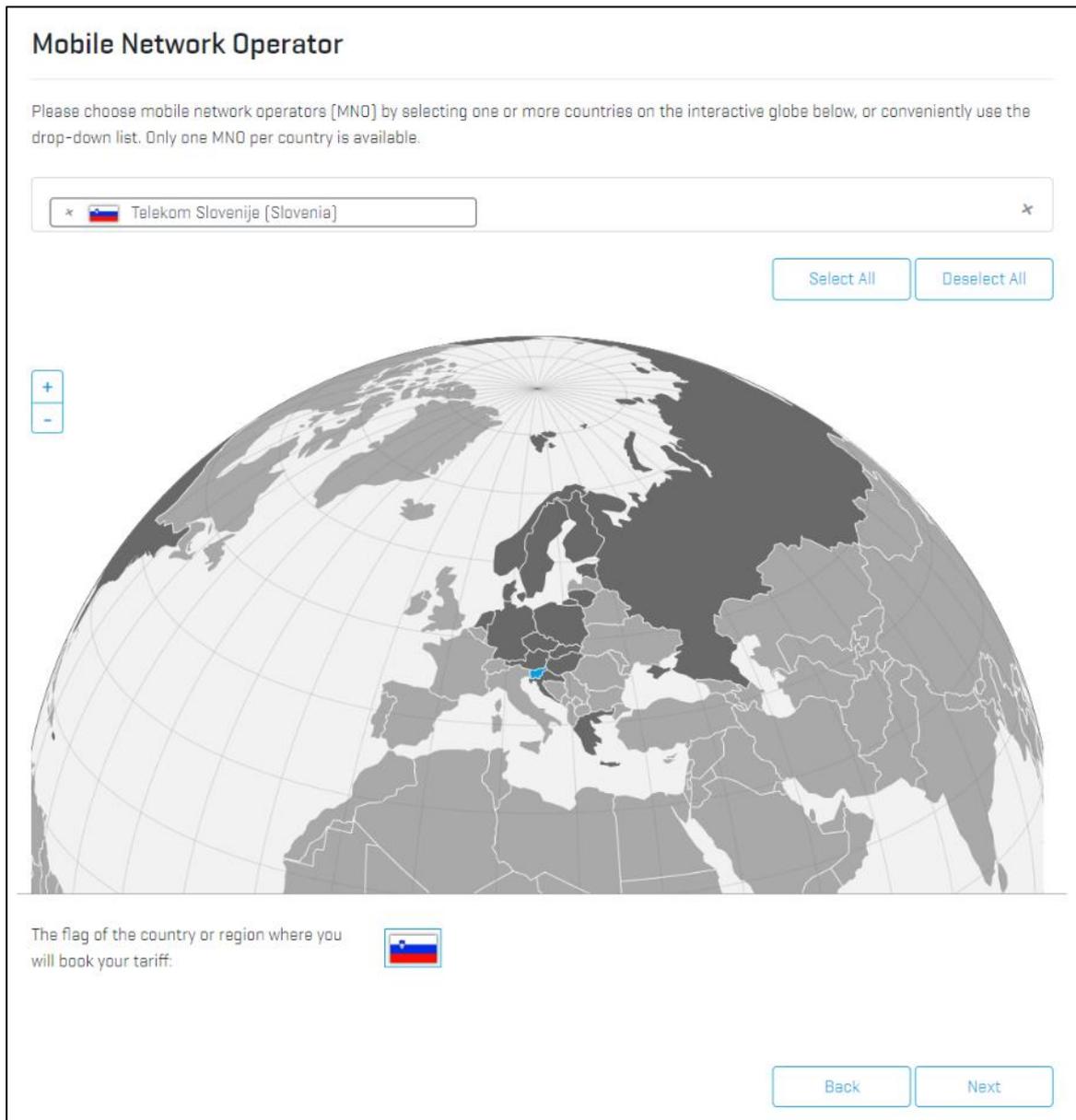
The IoT Solution Optimizer includes network modeling for multiple MNOs across the world (refer to [Figure 11](#)). Countries with networks integrated into the service’s database are displayed in dark grey. A network can be selected by clicking on its country in the interactive globe. Only one representative MNO network is available per market. Users may elect to select all markets at once by using the “Select All” button. Likewise, the “Deselect All” button will cancel the selection of one or multiple countries, returning the interactive globe to its original state.

Whenever one or more networks are selected, an option appears below the globe asking users to select the flag of the country where the SIM subscription (tariff) will be booked. This refers to the MNO that will be the user’s connectivity provider. By hovering the cursor

over the flag or country on the globe, the integrated MNO's name is displayed in a pop-up. Only one flag can be selected per project.

If users decide to model their project across a footprint of multiple countries, an option is given to specify the percentage of devices in each market, as a function of time or volume distribution. The IoT Solution Optimizer will model the performance of the configured product in each market and apply these percentages as a weighting factor at the end, in the project analysis.

Figure 11: "Mobile Operator Network" page - Single market selected



It is important to note that the integration of new networks to the IoT Solution Optimizer is independent of its service releases. That means that additional markets may become available independently of regularly scheduled updates.

In order to proceed to the subsequent page “Access Technology” in the project configuration flow, please select the “Next” button at the bottom of the page.

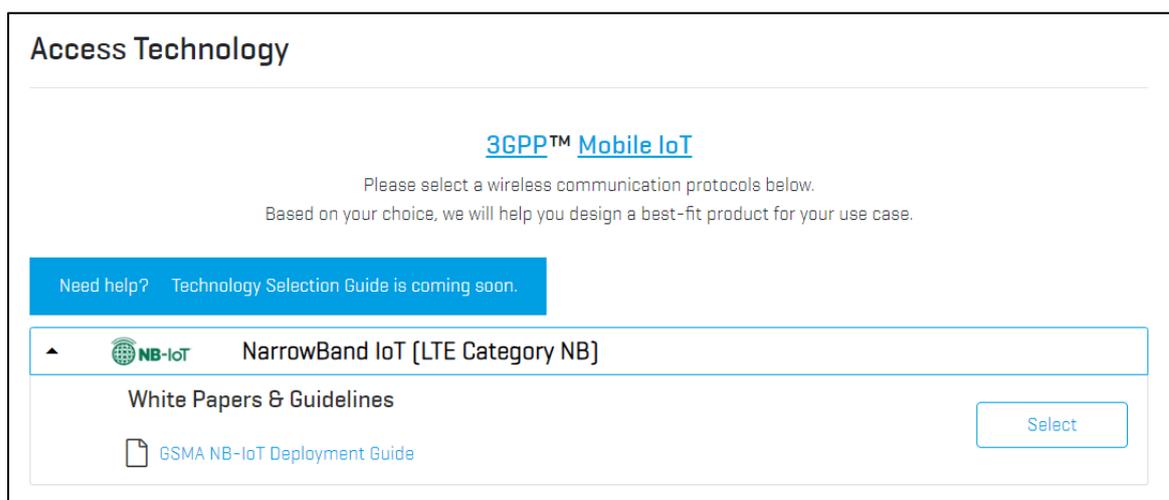
### 6.3. Access Technology

*Please note: this option is available in all projects, regardless of whether the user decided to build a custom design or selected a pre-integrated product off the IoT Solution Optimizer’s virtual product shelf (refer to Chapter 6.5).*

Once one or more MNO networks have been selected, a selection of available 3GPP™ radio access technologies (RAT) is presented in the next page. Please note that RATs are only presented if they are supported by all the MNOs selected in the “Mobile Operator Network” screen. Depending on the selected market(s), the IoT Solution Optimizer displays up to two Mobile IoT WAN technologies: NarrowBand IoT (NB-IoT) and LTE-M (eMTC), as well as GSM (2G). Users may learn more by either selecting the “Technology Card” links, or by downloading the available white papers and guidelines, as seen in [Figure 12](#). Although LTE-M and GSM are currently displayed on the user interface, modeling these technologies will become possible only during later releases of the IoT Solution Optimizer.

A Technology Selection Guide is planned in a future service version to help users understand which technology choice(s) are best fit for their IoT application. This feature will be accessible in the grey box at the top of the accordion. In order to proceed to the subsequent page “Product Shelf” in the project configuration flow, please click on the “Select” button within the desired RAT in the accordion.

*Figure 12: “Access Technology” page*



## 6.4. Deployment Characteristics

*Please note: this option is available in all projects, regardless of whether the user decided to build a custom design or selected a pre-integrated product off the IoT Solution Optimizer's virtual product shelf (refer to Chapter 6.5).*

Once the user has completed the definition of their product, the next step is to specify the conditions of its deployment. As seen in Figure 13 the "Deployment Characteristics" page includes configuration points for the users to define the coverage quality. A second configuration area further below (shown in Figure 14) allows one to set the deployment temperature and mobility model, including roaming options.

The three entry fields for configuring of coverage quality represent the portion of devices, or of the time that each device spends on average, within three coverage conditions: Outdoor (good coverage), Indoor (poor coverage) and Deep Indoor (very poor coverage). As users enter values into these fields, the percentages adapt automatically, as the total must add up to 100%. In case that one wants to better understand how these three coverage conditions map to the 3GPP™ Coverage Enhancement (CE) Levels, "Technology Cards" are available to explain the details. The IoT Solution Optimizer will run its performance modeling for a 100% deployment in each environment, as well as for the composite deployment based in the inputs given by the user.

*Figure 13: "Deployment Characteristics" page – Coverage*

### Coverage

Where will your IoT application be installed?

CE-Level 0: Outdoor  
CE-Level 1: Indoor  
CE-Level 2: Deep Indoor

**Outdoor**      **Urban Area**      **Rural Area**

**Indoor**      **Indoor**      **Outdoor / Indoor**

**Deep Indoor**

Note: Performance modeling will be simulated for 100% deployment in each environment above, as well as for a composite deployment based on user-configured percentages.

Further down on the same page, the temperature (minimum, average, and maximum) in degrees Celsius (°C) can be defined. This feature filters out all components and devices that are not rated to work within the configured operating temperature range. The temperature is also used to assess the impact on battery capacity if a SAFT A.S. battery is used.

Below this area of the screen, one can configure the mobility model via a toggling switch. Users can specify a non-moving placement of the device by sliding the switch to “Static,” or they can opt for “Mobile” in case that the IoT device is deployed on a vehicle or will be activated in different regions of the same network, or beyond. By choosing a “Mobile,” the IoT Solution Optimizer will consider that the wireless chipset or module will need to periodically perform a Tracking Area Update (TAU) once it enters a new Tracking Area, which is a portion of the Radio Access Network grouped into a paging area. For this very reason the next configuration item is a query of the average geographical distance travelled between data transaction events. As the IoT Solution Optimizer knows how many Tracking Areas are in each network, as well as the size of each market, a probability is calculated to specify how often such a Tracking Area Update is performed, on average.

By selecting the “Next” button, users may end the project configuration flow and view their “Project Summary Report.”

Figure 14: “Deployment Characteristics” page – Temperature Mobility Model configuration

### Temperature

---

Deployment Temperature Range [MIN, AVG, MAX]? +22°C

A horizontal slider bar with three dark grey markers. The leftmost marker is at -20°C, the middle marker is at +22°C, and the rightmost marker is at +30°C.

Note: This filters out devices and components (e.g. modules, batteries) not supporting the operational temperature range.

### Mobility Model

---

Static  Moving

Please indicate the average geographical distance that your device moves between messages:  km

Please select if international [roaming](#) is required for your application.

Please indicate how often your devices will typically roam onto new mobile networks:  times / month

#### **IOT SOLUTION OPTIMIZER’S BEST PRACTICE**

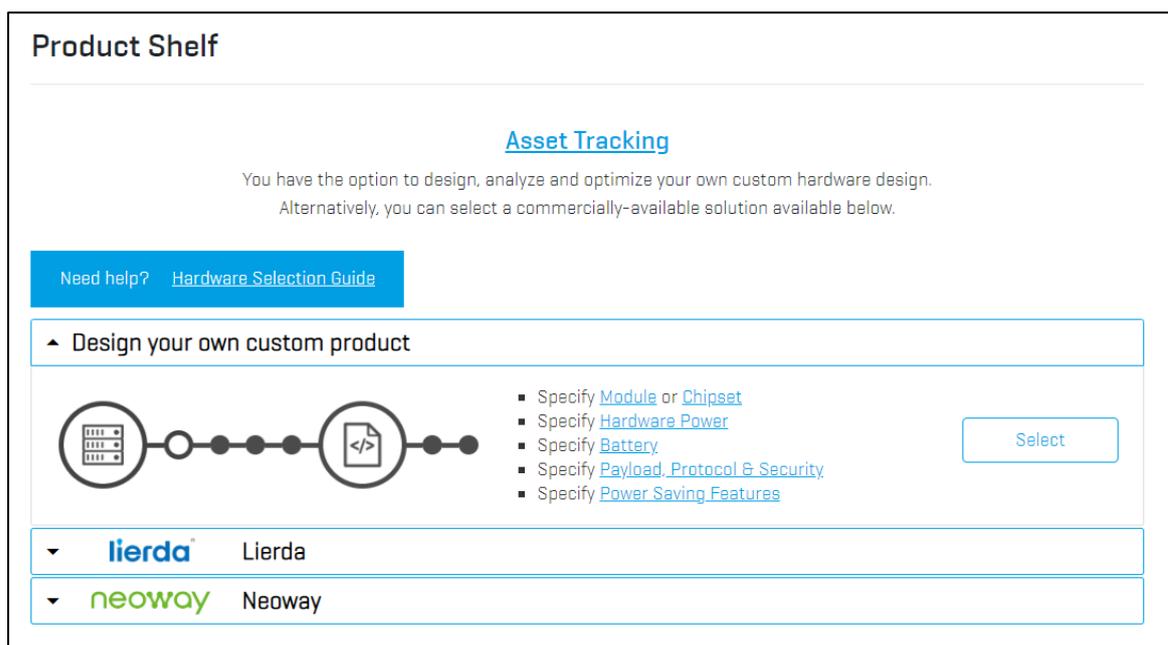
M2M/IoT devices that are roaming will need to perform a system scan to search for NarrowBand IoT or LTE-M coverage once the home network is left. Depending on the wireless communication chipset or module used, such scans may be power intensive. The last configuration topic of the IoT Solution Optimizer design flow is to specify how often an IoT device will roam on average into adjacent networks. This will help determine how much power consumption should be accounted for in the performance modeling.

## 6.5. Product Shelf

The IoT Solution Optimizer allows users to model either pre-configured “standard offering” products, such as M2M/IoT vertical solutions, or custom designs. The latter option is particularly valuable for those enterprises wishing to design their IoT devices and applications. By using the IoT Solution Optimizer, companies can quickly identify the trade-offs between different design options, and avoid common mistakes or limitations affecting their business case. The selection of which path to take for each project is done in the “Select Hardware Type” page.

Custom designs are offered as the first option in the page’s selection accordion (refer to [Figure 15](#)), when the twisty is opened, regardless of which vertical had been picked on the previous page. A bulleted list appears, highlighting which steps must be completed in order to properly configure a custom solution design. “Technology Card” links are available to give more information regarding each step. The diagram also illustrates the number of additional nodes that will appear in the Service Wizard once this option is selected.

*Figure 15: “Product Shelf” page – “Design your own custom product” option*

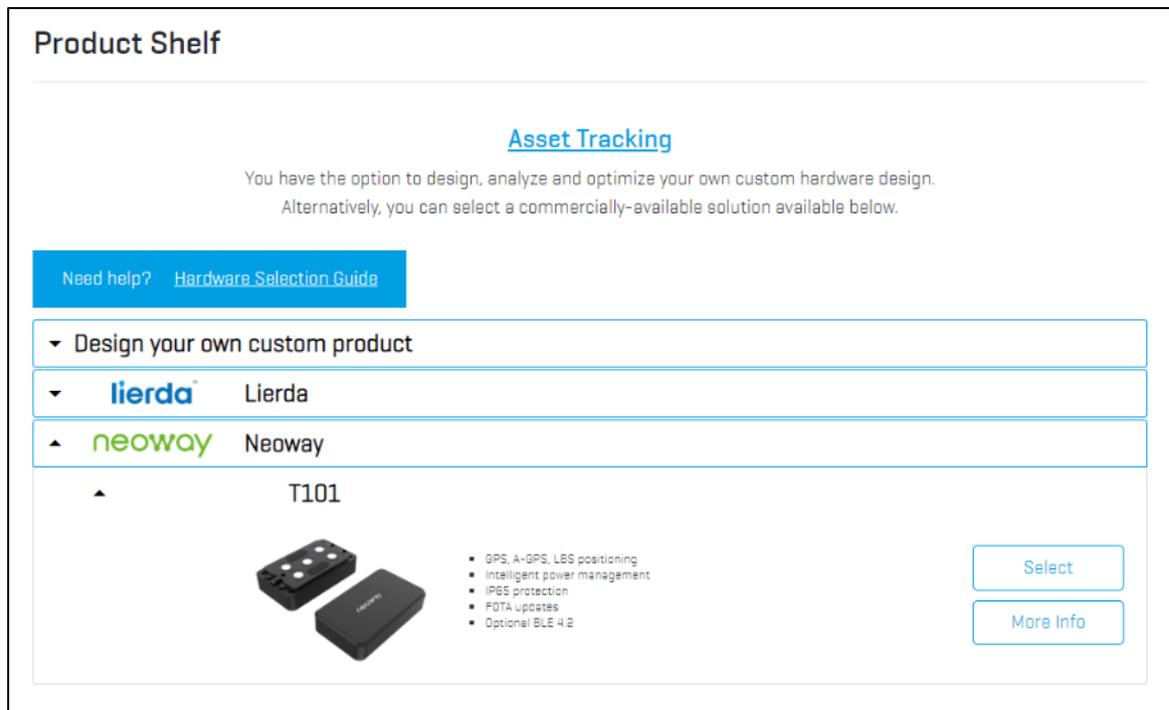


The screenshot displays the 'Product Shelf' interface. At the top, there is a section for 'Asset Tracking' with a sub-header 'Asset Tracking' and a description: 'You have the option to design, analyze and optimize your own custom hardware design. Alternatively, you can select a commercially-available solution available below.' Below this, there is a blue button that says 'Need help? Hardware Selection Guide'. The main content is an accordion menu with the title 'Design your own custom product'. When expanded, it shows a diagram of a hardware design process with a server icon, a code icon, and a list of steps: 'Specify Module or Chipset', 'Specify Hardware Power', 'Specify Battery', 'Specify Payload, Protocol & Security', and 'Specify Power Saving Features'. A 'Select' button is located to the right of the list. Below the accordion, there are two supplier options: 'lierda Lierda' and 'neoway Neoway', each with a dropdown arrow.

Pre-integrated solutions in the IoT Solution Optimizer’s product shelf are offered just below “Design your own custom product” in the page’s selection accordion (please see [Figure 16](#)). The displayed product offering changes depending on which vertical had been picked on the previous page. By opening each supplier in the accordion, a list of their products will appear, each entry consisting of a product picture and key selling points. A product specification or 1-Pager marketing sheet may be opened as a separate browser tab by selecting the “More Info” button. Users may locally save these documents on their computer, if desired. Wherever a product has been proposed by a partner of the IoT Solution ecosystem, an icon may appear on the left-hand side of the product picture.

“Technology Cards” links may be available in the Key Selling Points, allowing users to learn more about the supplier’s offering.

Figure 16: “Product Shelf” page – Example of standard offering

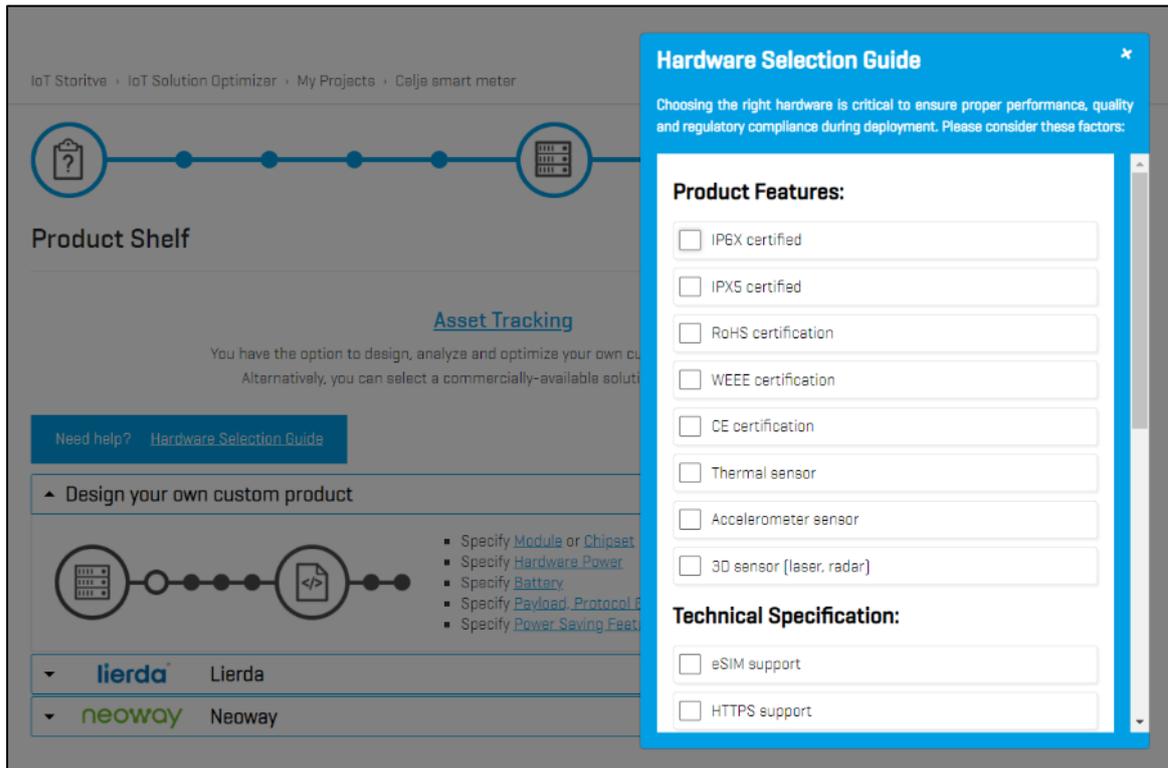


If no product has been placed on the virtual product shelf of that IoT vertical, no solutions will appear. Please note that the integration of new M2M/IoT standard offerings to the IoT Solution Optimizer virtual product shelves is independent of its service releases. That means that new products may become available independently of regularly scheduled updates. If users would like to learn more about integrating their products to a product shelf, please contact the Tool Support team via that “Contact” link available in the webpage footer.

An additional feature integrated into the “Product Shelf” screen is the **Hardware Selection Guide**, as shown in Figure 17. The feature is accessible by selecting the link in the grey box above the accordion. With it, users can filter the device catalog according to vertical-specific product features and technical specifications to identify a best-fit hardware for their use-case. After the catalog has been filtered, simply return to the link in the grey box above the accordion to remove the filter or change the search criteria. Please note although the configuration of the that the existing filtering criteria is independent of IoT Solution Optimizer service releases, implementation of new filtering criteria standard can only be done within the regularly scheduled service releases.

If users decide to design their own custom product, pressing “Select” loads the “Module or Chipset” page (refer to Chapter 6.6) in the project configuration flow. If users instead press “Select” on a standard offering, this opens the “Data Events” page (refer to Chapter 6.10); the intermediate steps in the project configuration flow are skipped, as explained in Chapter 6, above.

Figure 17: Vertical-specific “Hardware Selection Guide” filters the “Product Shelf” catalog



## 6.6. Module or Chipset

*Please note: This option is only available in projects where the user has decided to build a custom design (refer to Chapter 6.5).*

The first step in creating a custom hardware design is to select the wireless communication module or chipset that shall be used in the modeling.

Similar to the implementation of the “Product Shelf” page (refer to Chapter 6.5), pre-integrated modules and chipset are displayed in accordions, as shown in Figure 18. It is important to note that one’s selection of network (refer to Chapter 6.2) and radio access technology (see Chapter 6.3) will dictate which wireless communication modules and chipsets are shown on these accordions. In most cases, users will select a wireless communication module, as only those enterprises with a sizable R&D and investment capacity can perform a direct integration of the chipset; for more information, please refer to the corresponding “Technology Cards.”

## IOT SOLUTION OPTIMIZER'S BEST PRACTICE

The IoT Solution Optimizer integrates the world's largest portfolio of certified modules and chipsets for 3GPP™ Mobile IoT technologies. After a successful evaluation of a module or chipset product, detailed power measurements of its performance on live networks is gathered and integrated. This allows the IoT Solution Optimizer to properly characterize the performance of this IoT device component, and accurately model it under numerous signal conditions and payload sizes. All measurements are performed in very conservative network signal conditions, near the edge of each Coverage Enhancement (CE) level, on both the uplink and downlink. The following figures are representative only, but are exemplary of the very conservative network conditions under which measurements are taken:

- Coverage Enhancement (CE)-Level 0: RSRP: -112 dBm, SINR: 9 dB
- Coverage Enhancement (CE)-Level 1: RSRP: -122 dBm, SINR: 1 dB
- Coverage Enhancement (CE)-Level 2: RSRP: -133 dBm, SINR: -8 dB

Figure 18: "Module or Chipset" page

### Module or Chipset

**Certified Wireless Modules**

Please select one of the certified wireless communication [modules](#) below.

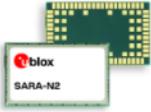
[Need help?](#) [Module Selection Guide](#)

▲  **u-blox AG**

▼ SARA-N200

▼ SARA-N210

▲ SARA-N211



- Ultra-low power consumption delivering 10+ years battery life
- Excellent extended range in buildings, underground [MCL 164dB]
- Extended temperature range of -40°C to +85°C and ISO/TS16949 manufacturing
- Easy migration between u-blox 2G, 3G, and 4G modules
- Very small SARA LBA form factor for easy manufacturing
- Support for both IP based and Non-IP based Small Data over NAS [SDoNAS]

[Select](#)  
[More Info](#)

▼ SARA-R410M-02B

▼ **AI-Link** AI-Link

▼  **Cheerzinc**

▼ **Fibocom** Fibocom

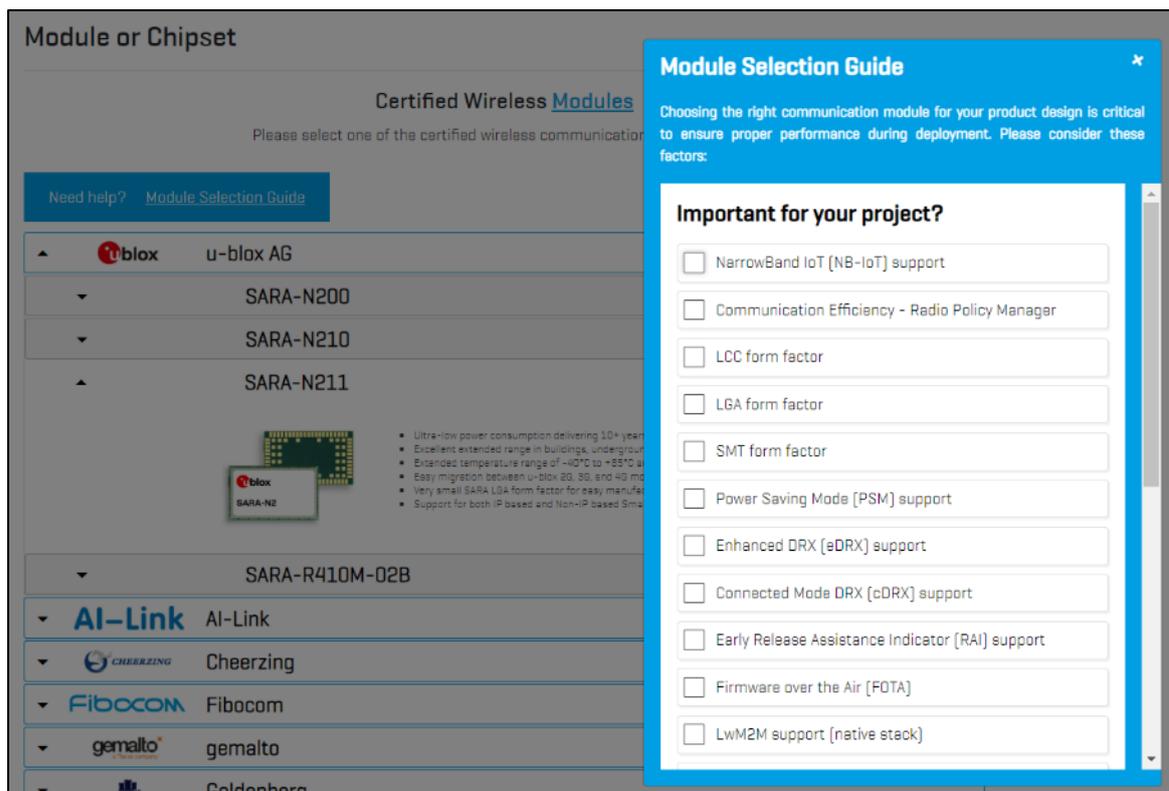
▼  **gemalto**

By opening each supplier in either accordion, a list of products will appear, each of which consists of a product picture and key selling points. A product specification or 1-Page marketing sheet may be opened as a separate browser tab by selecting the "More Info"

button. Users may locally save these documents on their computer, if desired. “Technology Cards” links may be available in the Key Selling Points, allowing users to learn more about the supplier’s offering.

Please note that the integration of new wireless communication chipsets and modules into the IoT Solution Optimizer virtual product shelves is generally independent of its service releases. That means that new modems may become available independently of regularly scheduled updates. By pressing “Select” users can advance to the next page in the project configuration flow, “Hardware Power.”

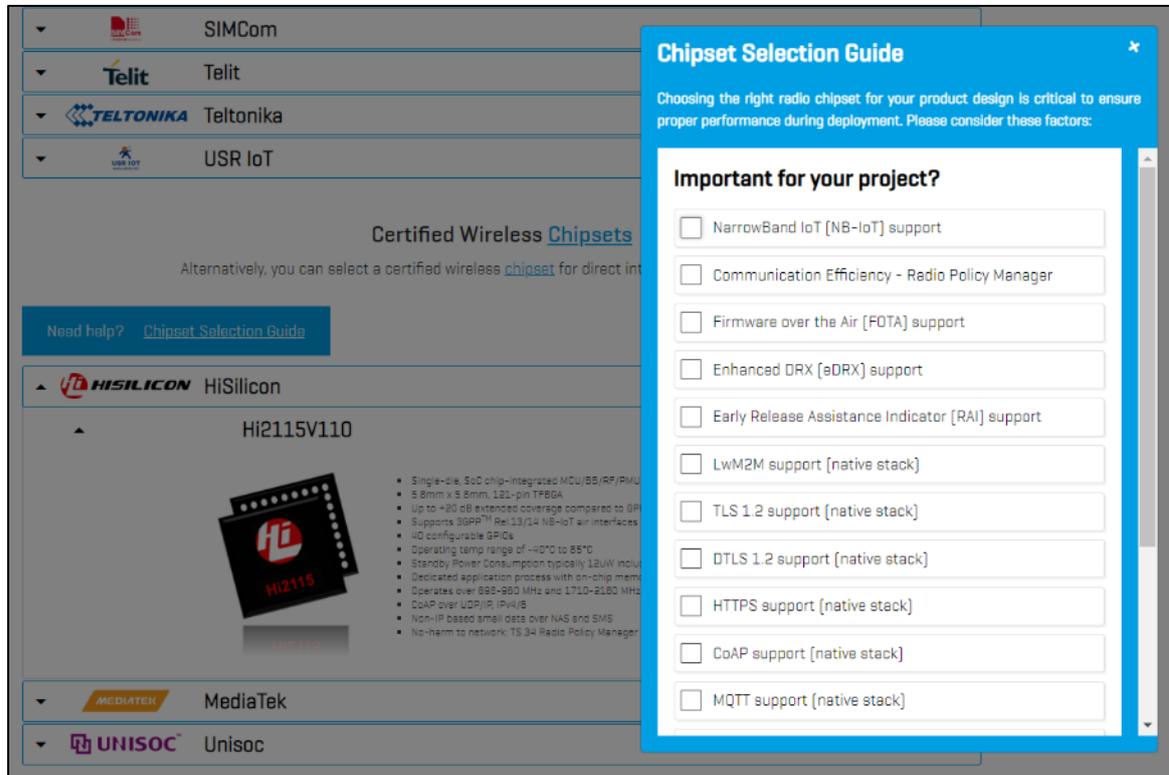
Figure 19: “Module Selection Guide” feature



In order to filter chipsets and modules, the IoT Solution Optimizer offers a Module and Chipset Selection Guide. As the IoT Solution Optimizer already integrates dozens of wireless communication modems, this functionality helps users quickly identify which components have a technical specification best suited for their specific project needs. By selecting the link above the accordion list, a pop-up window will appear showing various filtering criteria. Selecting one or more features on this list, and pressing the “OK” button, will result in the display of matching modules or chipsets on the accordion below. To undo the filtering of the list, or to continue applying additional selection criteria, simply select the Module or Chipset Selection Guide again. Please note that the Module Selection Guide will only filter the module accordion list (refer to Figure 19); likewise, the Chipset Selection Guide (shown in Figure 20) only sorts the chipset accordion, which is implemented further below.

Over time, the number of criteria for filtering modules and chipsets is subject to change. These criteria can be flexibly added by the service administrator independently of major IoT Solution Optimizer deployment releases.

Figure 20: “Chipset Selection Guide” feature



## 6.7. Hardware Components

*Please note: This option is only available in projects where the user has decided to build a custom design (refer to Chapter 6.5).*

In the first half of the screen, there is configuration point for the voltage conversion or regulation, if used in the IoT device’s design. A low-dropout voltage regulator (LDO) is typically used if the intended battery outputs a higher voltage than what the selected module/chipset supports. The LDO essentially steps-down the voltage from the battery to ensure proper input voltage level for the module/chipset and the remaining circuitry. Use of an LDO introduces the inefficiency of a leakage current, otherwise known as quiescent current. Use the “Voltage Conversion or Regulation” configuration to indicate if no voltage conversion is necessary (see Figure 21), or if a low-dropout voltage regulator is required (see Figure 22). In the case of the latter, the user has the option to either configure the parameters of the LDO they wish to use (by specifying its name, drop-out voltage, and quiescent current), or they may simply use a reference solution (STMicroelectronics LD39050, a 500mA low quiescent current and low noise voltage regulator). For more

information, please visit the product's page at: <https://www.st.com/en/power-management/ld39050.html>.

The lower part of this page accounts for the power consumption of all the remaining hardware components in the IoT device, apart from the battery and wireless communication chipset or module. This includes the microcontroller (MCU), linear regulator, GNSS solution, DC/DC converter, sensors, actuators, etc. Two options exist for completing the "Hardware Power" page: "Constant" and "Wake-up & Sleep." Depending on the selected use case in the "IoT Vertical" screen, the option is pre-configured, with recommended values proposed based on aggregated, anonymized data from similar projects in the database.

- With the "Constant" current consumption configuration (see [Figure 23](#)), the user is required to define an average hardware current consumption between any two bi-directional data transaction events. Take a parking sensor, for example. These devices usually perform a message handshake with the cloud platform each time that a car pulls into the parking space, as well as when a car leaves the space. A user modeling a parking sensor in the IoT Solution Optimizer would enter here a value representing the average hardware current consumption for the time period between parking events when the parking space is unoccupied, and within each parking event, when the parking space is occupied.

**Caution: Please take note that the default unit here is in micro-Amperes; placing a very large number in milli-Amperes may skew the results of the prognostication.** Users are also encouraged to specify the maximum peak current for the hardware components. This has a direct impact on which battery should be selected in the next step of the project configuration flow.

*Figure 21: "Hardware Power" page – Constant configuration*

### Hardware Components

---

#### Voltage Conversion or Regulation

Please select your implementation technology:

An ideal power supply (efficiency factor) will be assumed for your project.

Should I use a voltage converter or regulator?

Figure 22: "Hardware Power" page – Constant configuration

### Hardware Components

#### Voltage Conversion or Regulation

Please select your implementation technology: Low-dropout Voltage Regulator [LDO]

If your battery configuration outputs a higher voltage than what your selected module/chipset supports, an LDO component can be used to down-step the voltage.

Should I use a voltage converter or regulator?

The LDO component's inefficiencies can affect the device's battery life. Simply activate the following check box to consider the corresponding power losses:

Include daily power losses from a linear voltage regulator using \*approximate LDO loss modeling, with nominal values taken from a reference solution [LD39050].  
 \*Currently, temperature variations and application-specific currents are not used to determine quiescent currents more precisely.

Alternatively, you may define values of your LDO regulator for consideration in the power consumption modeling:

LDO Model Name:

Drop-out Voltage ( $V_{drop}$ ):  V

Quiescent Current ( $I_q$ ):   $\mu A$

Figure 23: "Hardware Power" page – Constant configuration

#### Other HW Power Consumptions

The average current consumption for all remaining hardware components [MCU, sensor, actuator, GNSS, etc.] is modeled here.

Configuration [please refer to the picture below for more details]: Constant  Wake-up & Sleep

Average current consumption value [as a constant current between data transaction events]:   $\mu A$

What is the maximum peak current for the hardware components above?  mA

If unsure, please set these value to 0  $\mu A$ ; in this case, the battery cut-off voltage may not be modeled accurately, and additional hardware power consumption will need to be considered on-top. Recommended values are currently shown above.

Back Next

Figure 24: "Hardware Power" page – Wake-up & Sleep configuration

### Other HW Power Consumptions

The average current consumption for all remaining hardware components (MCU, sensor, actuator, GNSS, etc.) is modeled here.

Configuration [please refer to the picture below for more details]: Constant  Wake-up & Sleep

Average current consumption duration and value [for **wake-up current** between data transaction events]:  sec   $\mu\text{A}$

Average current consumption value [for **sleep current** between data transaction events]:   $\mu\text{A}$

What is the maximum peak current for the hardware components above?  mA

If unsure, please set these value to 0  $\mu\text{A}$ ; in this case, the battery cut-off voltage may not be modeled accurately, and additional hardware power consumption will need to be considered on-top. Recommended values are currently shown above.

### IOT SOLUTION OPTIMIZER'S BEST PRACTICE

When designing an IoT device for Mobile IoT use cases, it is necessary to carefully plan the power consumption of all hardware components apart from the wireless communication module or chipset and the efficiency of the battery. Some IoT applications may take advantage of the module's capability to enter a "deep sleep mode" with micro-Ampere current consumption. That said, the rest of the device hardware continues to consume power, for instance, to run an IoT device application on the microcontroller, to ping sensors or actuators managing an asset, or to obtain positioning data from a GPS receiver. The average current drain is therefore non-zero and use case (often IoT vertical)-specific. The IoT Solution Optimizer currently proposes vertical-specific default values that evolve with the project data collected globally. As we learn what typical power consumption looks like per vertical, we share these insights with our users.

The IoT Solution Optimizer currently approximates the impact of hardware inefficiencies and power drain. It is important to note that multiple hardware design aspects, such as component aging, shielding, antenna integration, etc. are currently not accounted for in the simulation. Such elements could impact the suitability of a design for a customer's business case. Furthermore, to model several performance characteristics, nominal conditions have been assumed for some of the hardware components. As such, all results given by the IoT Solution Optimizer are not intended to be used as the sole input for product development activities. Please consult the individual component suppliers for more detailed guidance.

- In case that the user wants to model the hardware power consumption using alternating periods of higher and lower current draw (for example, capturing the differences between activity and inactivity periods), they may elect to use the “Wake-up & Sleep” configuration option (refer to [Figure 24](#)). They are required to define in the first entry field an average current consumption during the “wake-up time” window associated with bi-directional data transaction events. This may represent a power surge during the operation of the device; for example, it may represent the brief moments in time when the application on the microcontroller or GPS receiver are active. In-between such peaks of activity, there may be much lower power consumption on average; a different average current consumption value can thus be configured separately for this “sleep time” window of time in the second entry field. Like the basic configuration use case, users may specify the maximum peak current for the hardware components in the third entry field.

## 6.8. Battery

*Please note: This option is only available in projects where the user has decided to build a custom design (refer to [Chapter 6.5](#)).*

The last step in the “Hardware” stage of the project configuration flow is the “Battery” page. Like the earlier “Product Shelf” and “Module or Chipset” pages, a product accordion is available.

By default, one can configure a custom battery (refer to [Figure 25](#)). The option is available at the top of the accordion. This requires specification of nominal voltage, capacity and yearly self-discharge percentage. The modeling performed with this feature is approximative, as there are numerous aspects which are not considered – such as the impact of temperature, chemical decompositions and an internal battery architecture. Depending on the selected use case in the “IoT Vertical” screen, values are pre-configured, with recommended values based on similar projects pre-existing in the database.

Alternatively, the accordion showcases a selection of Lithium-Thionyl Chloride (Li-SOCl<sub>2</sub>) and Lithium-Manganese Oxide (Li-MnO<sub>2</sub>) batteries from one of the world’s foremost battery suppliers for Mobile IoT applications, SAFT A.S. ([www.saftbatteries.com](http://www.saftbatteries.com)). By selecting SAFT batteries for their design (refer to [Figure 26](#)), users can leverage special modeling algorithms developed jointly with SAFT experts. Each SAFT product entry in the accordion consists of a product picture and key selling points. A product specification or 1-Page marketing sheet may be opened as a separate browser tab by selecting the “More Info” button. Users may locally save these documents on their computer, if desired. “Technology Card” links may be available in the Key Selling Points, allowing users to learn more about the supplier’s offering.

Whenever detailed battery voltage curves are implemented per temperature range, the **average temperature** set in the “Deployment Characteristics” screen is used to model the correct battery capacity. This feature is available for most SAFT batteries.

Figure 25: “Battery” page – “Custom Battery” feature

The screenshot shows a web interface for configuring a battery. At the top, there's a header 'Battery' and a sub-header 'Custom Battery'. Below the header, there's a blue button that says 'Need help? Battery Selection Guide'. The main configuration area is titled 'Please configure your custom battery design (this does not consider an deployment temperature):'. It contains four input fields: 'Nominal Voltage' with a value of 3,60 and a unit of V; 'Nominal Capacity' with a value of 7,70 and a unit of Ah; 'Nominal Capacity' with a value of 27,72 and a unit of Wh; and 'Yearly Self-discharge' with a value of 1,00 and a unit of %. To the right of these fields is a blue 'Select' button. Below the input fields, there's a note: 'The impact of the deployment temperature specified earlier cannot be modeled if using this custom battery.' At the bottom of the form, there's a dropdown menu showing the SAFT S.A. logo and the text 'SAFT S.A.'.

As seen in Figure 27, by selecting the “Battery Selection Guide” feature, a pop-up card is overlaid, which helps users identify best-fit batteries for their use case. Different categories are presented on the interactive card, including the expected operating temperature range of the IoT device, the expected battery life, electronics type, and the battery configuration (number of batteries connected in serial and parallel). By selecting those aspects of the product design that may be more critical, the IoT Solution Optimizer can assess the integrated SAFT S.A. products and propose those batteries best suited for the IoT application and its deployment environment. After pressing “OK,” a list of potential batteries may be presented in different serial and parallel combinations. Users can either select one of these to advance to the “Payload” page or leave the card by simply clicking the user interface outside of it.

Please note that the integration of new batteries to the IoT Solution Optimizer virtual product shelves is independent of its service releases. That means that new solutions may become available between regularly scheduled updates. If users would like to learn more about how to use SAFT battery products in their designs, a “Product Specification Request” (PSR) form can be filled out and supplied to SAFT representatives for technical support. Such a PSR sheet will be generated automatically in the “My Projects” folder.

After selecting a pre-integrated battery in the accordion or via the “Battery Selection Guide,” or alternatively defining a custom battery, users may proceed to the next step in the project configuration flow, the “Payload” page.

Figure 26: "Battery" page – SAFT S.A. battery

## Battery

Please specify the battery characteristics and configuration, or conveniently select a product from the catalog below.

[Need help?](#) [Battery Selection Guide](#)

▼ **Custom Battery**

▲ **SAFT S.A.**

▼ **LM 17500**    3 V Primary lithium-manganese dioxide [Li-MnO<sub>2</sub>] [spiral cell]

▲ **LM 26500**    3 V Primary lithium manganese dioxide [Li-MnO<sub>2</sub>] [C-size spiral cell]

Nominal Voltage:  V

Nominal Capacity:  Ah

Nominal Capacity:  Wh

Yearly Self-discharge:  %

Discharge Current:  mA

Temperature Range:  °C to  °C

Deployment Temperature (average):  °C

How many batteries in series?  S

How many batteries in parallel?  P

The lowest number of batteries that can be put in series depends on your LDO configuration in the "Hardware Components" screen.

Select

More Info

▼ **LS 17500**    3.6 V Primary lithium-thionyl chloride [Li-SOCl<sub>2</sub>] [Bobbin cell]

▼ **LS 26500**    3.6 V Primary lithium-thionyl chloride [Li-SOCl<sub>2</sub>] [Bobbin cell]

▼ **LSH 20**    3.6 V Primary lithium-thionyl chloride [Li-SOCl<sub>2</sub>] High power D-size spiral cell

Figure 27: "Battery Selection Guide" feature

## Battery

Please specify the battery characteristics and configuration, or conveniently select a product from the catalog below.

[Need help?](#) [Battery Selection Guide](#)

▼ **Custom Battery**

▲ **SAFT S.A.**

▼ **LM 17500**    3 V Primary lithium-manganese dioxide [Li-MnO<sub>2</sub>] [spiral cell]

▼ **LM 26500**    3 V Primary lithium manganese dioxide [Li-MnO<sub>2</sub>] [C-size spiral cell]

▲ **LS 17500**    3.6 V Primary lithium-thionyl chloride [Li-SOCl<sub>2</sub>] [Bobbin cell]

Battery Selection Guide

Choosing the right battery for your product design is critical to ensure proper performance during deployment. You should consider numerous factors:

**Important for your project?**

**Minimum Expected Battery Life?**

0 years
15 years

5 years

**Operating Voltage Range?**

3.6 Volt
10.8 Volt

3.60    5.00

**Battery Configuration?**

How many batteries in series?  S

How many batteries in parallel?  P

## 6.9. Communication Activity

*Please note: The pages associated with this feature are only available in projects where the user has decided to build a custom design (refer to Chapter 6.5).*

IoT applications may exchange messages between the device and the server at different rates. Oftentimes, there are different types of messages needing to be transmitted: hourly humidity reports, daily digests, and monthly software updates, for instance. The IoT Solution Optimizer allows you to model the impact of different application messages and device management updates - including Firmware Over-the-Air (FOTA) events for updating the wireless communication module/chipset and its protocol stack, as well as Software Over-the-Air (SOTA) messages to manage the device application running on the microcontroller (MCU).

Based on the relationship tree illustrated in [Figure 28](#), the IoT Solution Optimizer presents the user with different possible combinations of messaging or management protocols and transport bearers. Users can opt to go for a more lean, Mobile IoT-friendly packaging of the data (for example, MQTT-SN over Non-IP Data Delivery), or for heavier, more inefficient solutions (such as HTTP, over TCP/IPv6). Warning messages may appear in yellow-colored boxes in case that the selected approach may not be advisable to use with an underlying 3GPPTM Mobile IoT bearer. Users may study the "Technology Cards" for more insights. Additional tips are provided under the links titled, and "Which messaging protocol should I use?" and "What is the industry-standard IoT protocol for service enablement?" in [Figure 30](#), as well as "Which transport protocol should I use?" and "Which type of encryption should I use?" in [Figure 32](#).

*Figure 28: Relationship tree of M2M/IoT protocols*

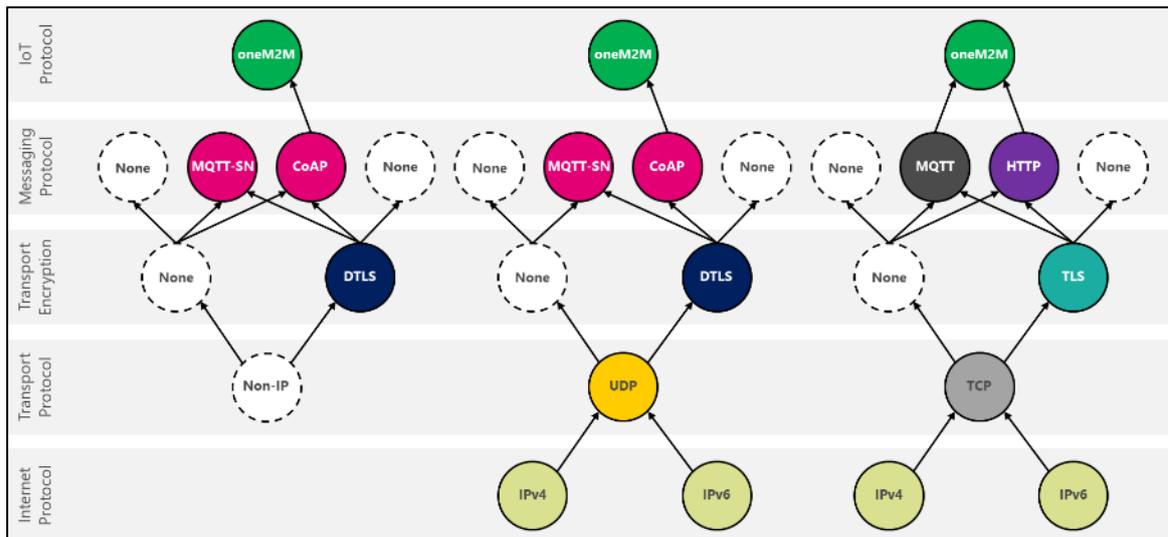


Figure 29: "Communication Activity" page

Message Name	Message Type	Series Cadence	Status	Options
Q	[All]	Q	[All]	
> Hourly Message	Application Message	Daily	✓ Finished	
> Daily Report	Application Message	Daily	✓ Finished	

Back Next

Figure 30 shows the summary page for configured application messages and firmware/software updates. By selecting the "Add new message" button, users enter into a message creation flow for an individual application message or firmware/software update, as shown in Figures 30-34, below.

- **"Payload & IoT Protocol"** – Located at the top of the first page in the message creation flow, this configuration area defines each transacted message; refer to Figure 30. It consists of the following elements:
  - Configuration of the message's name.
  - Toggle switch to specify if the transacted data is an application message or a firmware/software update.
  - Definition of the cloud platform via a drop-down ("Step 1").
  - Selection of IoT or service enablement protocol via a drop-down ("Step 2").
  - Election of a messaging protocol via a drop-down ("Step 3").
- **"Configure Reporting Events"** – Further below on the same page (refer to Figure 30), there is a template that allows users to assemble the payload and overhead exchange between device and IoT server. The following actions are possible:
  - Drag-and-drop Uplink (dark blue) and Downlink (light blue) **application payload** "boxes" from the left pane of the page into the Bytes vs. Time chart to its right. Uplink messages constitute IoT device application-originated messages to the server, whereas downlink messages are server application-originated messages sent to the IoT device. One has the free choice to define here how many messages the application sends to/from the IoT

device in a typical bidirectional data transaction event between IoT device and server. In order to delete a message, simply select it, and choose "Delete" on the grey pop-up dialog box that appears. Messages can also be sized by entering a value in the same dialog box. By hitting "Save," one can apply a configuration to each individual message.

Group selection or changes to payload messages is not supported; the desired action must be done for each individual uplink and downlink message separately. It is also not possible to re-order the payloads once placed in the Bytes vs. Time chart. Please delete any incorrect messages and reassemble the handshake in the correct sequence it transpires, advancing in time from left-to-right.

Each time that a blue payload box is dropped into the chart, the IoT Solution Optimizer will configure the IoT or service enablement protocol and/or messaging protocol configured in "Payload & IoT Protocol - Steps 2-3", above

- Configure MQTT, MQTT-SN, CoAP, or HTTP **messaging protocol** by left clicking on the correspondingly labeled, colored boxes. In case that one of the available protocols is not natively supported by the module, an asterisk ("\*") will appear next to its name, with a corresponding informational text below.
- Configure the **ETSI IoT protocol** by left clicking on the green oneM2M boxes and selecting the corresponding operations (refer to [Figure 30](#)); JSON vs. XML syntax may be selected in case that MQTT was chosen in "Payload & IoT Protocol - Step 3", above. Additionally, a DELETE request on the Downlink or Uplink may be applied via the corresponding feature. Technology cards are provided to train users with the details of oneM2M protocol and each operation type supported.

Figure 30: "Payload and IoT Protocol" page for Application Messages and FOTA

## Payload & IoT Protocol: Hourly Message

---

Message Name:

Application Message  Firmware Update (FOTA)

Step 1: Please select a cloud provider for your application messages:

Step 2: Please select an IoT or service enablement protocol for your application messages:   
 What is the industry-standard IoT protocol for service enablement?

Step 3: Please select your messaging protocol:   
 Which messaging protocol should I use?

---

## Configure Reporting Events

Compose the reporting event "handshake" between the device and the application server:

1. Drag and drop the UL/DL blue payload boxes from the left panel into the timeline on the right;
2. Left-click on each UL/DL blue payload box placed on the timeline to specify the number of Bytes sent or to delete the message;
3. Left-click on the protocol overhead layers below the UL/DL blue payload boxes to specify the number of Bytes sent.

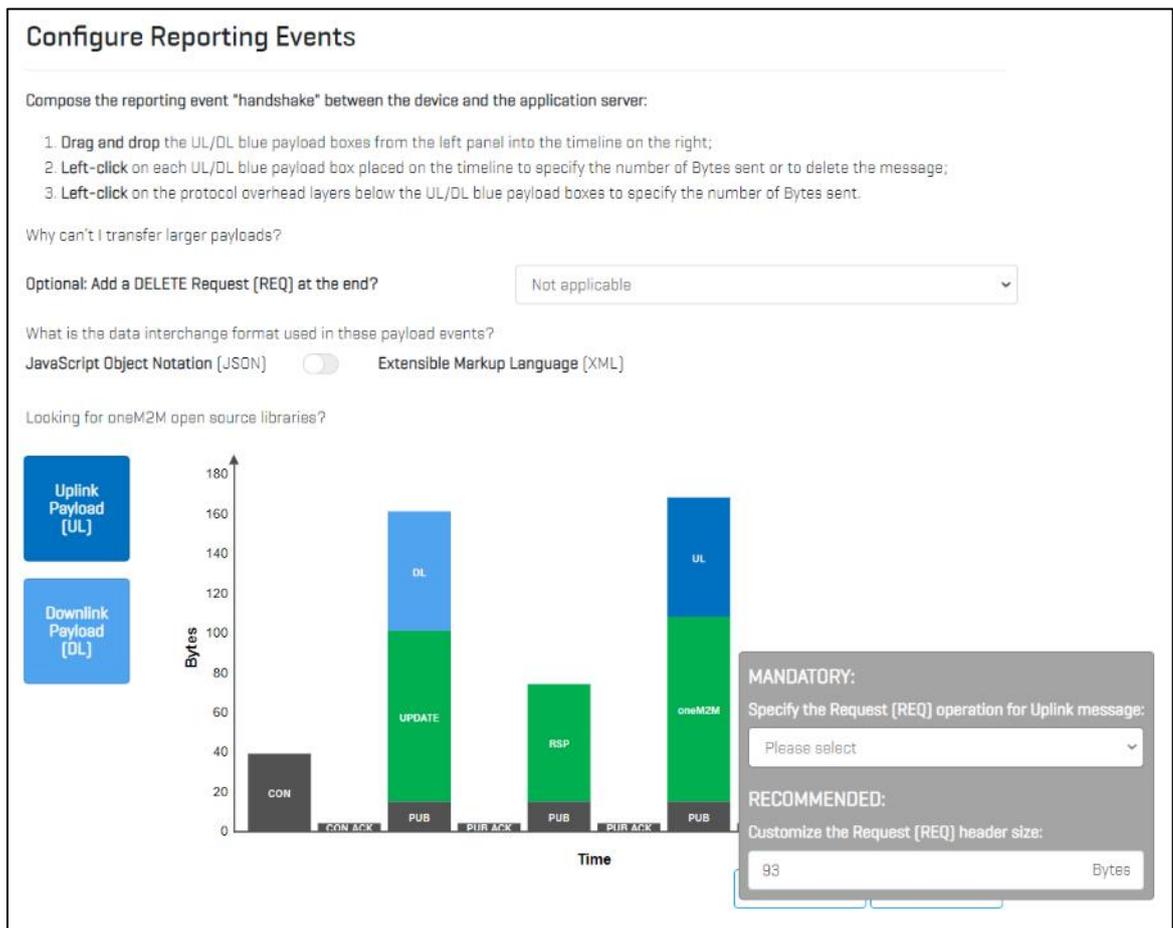
Why can't I transfer larger payloads?

Uplink Payload [UL]

Downlink Payload [DL]

Message	Direction	Bytes
CON	Downlink	40
CON ACK	Uplink	5
PUB	Downlink	15
PUB ACK	Uplink	5
PUB	Downlink	60
PUB ACK	Uplink	5
PUB	Uplink	60

Figure 31: "Payload and IoT Protocol" page – oneM2M Configuration



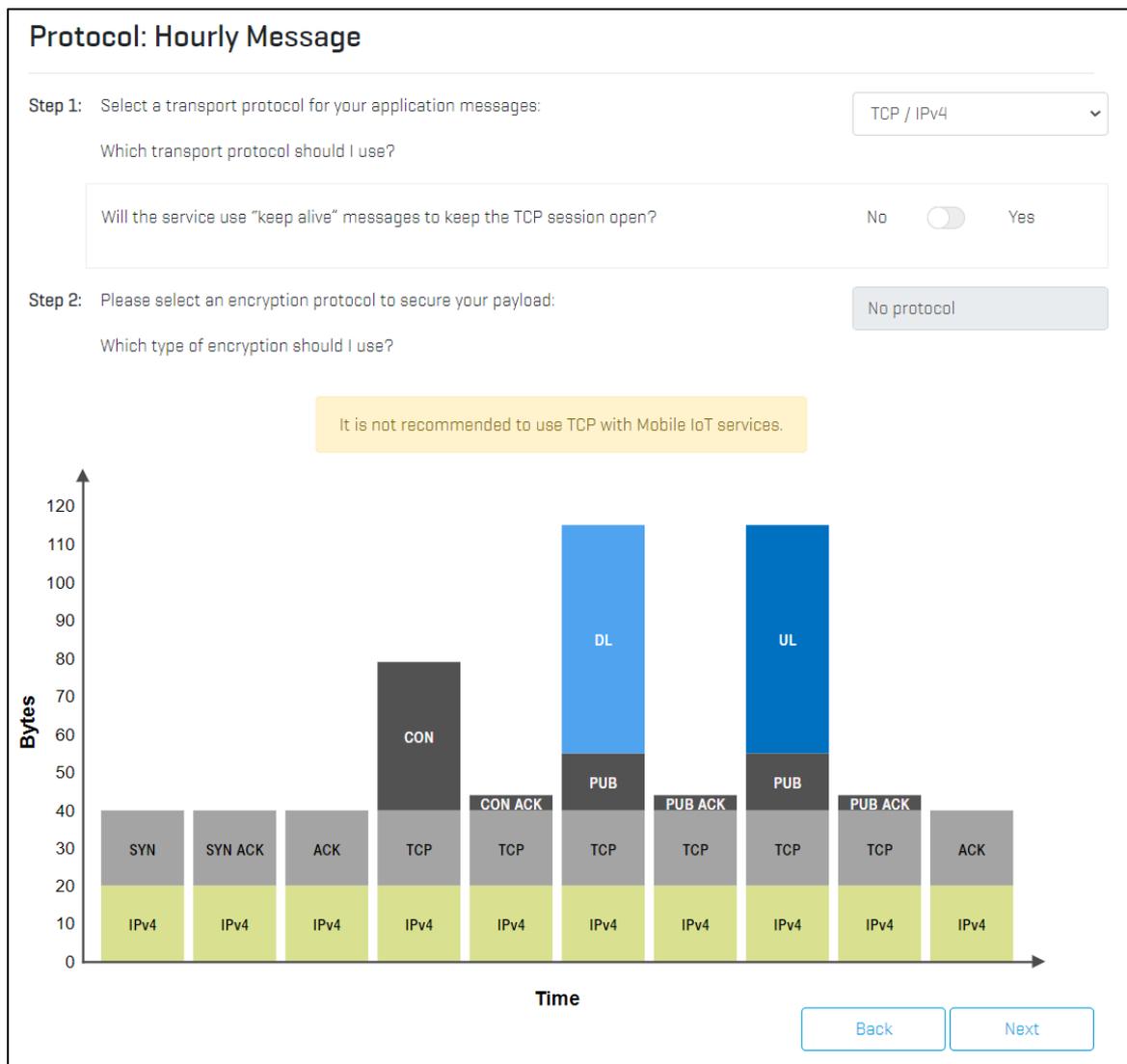
Users may proceed to the "Transport Protocol" page, by selecting the "Next" button. If any of the drop-downs in one of the "Payload & IoT Protocol" steps were not selected, an ETSI IoT protocol operation is not configured for the oneM2M requests, or if no payload has been dropped into the chart, an error warning will be shown.

- **"Transport & Internet Protocol"** – On the second page in the message creation flow, users have the ability to specify how the payload is sent over the Internet (refer to Figure 32):
  - Select the **transport protocol** ("Step 1") by choosing between Non-IP data delivery (NIDD), TCP/IPv4, TCP/IPv6, UDP/IPv4, and UDP/IPv6. Please note that the list of available transport protocols is filtered based on network and chipset/module support for these. A Technology Card link explains the benefits and drawbacks of each protocol type that may be available.
  - If TCP/IPv4 or TCP/IPv6 are selected, a box appears in the UI allowing for the configuration of **"Keep Alive" messages** that maintain the TCP session active, preventing teardown due to firewall or gateway time-outs. As seen in Figure 32, "Keep Alive" messages are by default turned OFF. If the user toggles the switch to activate "Keep Alive" messaging, it is necessary to

specify the interval at which the device sends these messages to the IoT server (refer [Figure 33](#)). In the IoT Solution Optimizer, it is assumed that the "Keep Alive" pings are device-originated (Uplink) transport messages.

- Define an **encryption protocol**, if needed ("Step 2"). Currently, this feature is deactivated. A Technology Card link explains the purpose and main characteristics of Transport Layer Security (TLS), Transport Layer Security for HTTP (HTTPS), as well as Datagram Transport Layer Security (DTLS).

Figure 32: "Transport Protocol" page for App Messages & FOTA, without "Keep Alive" Messages

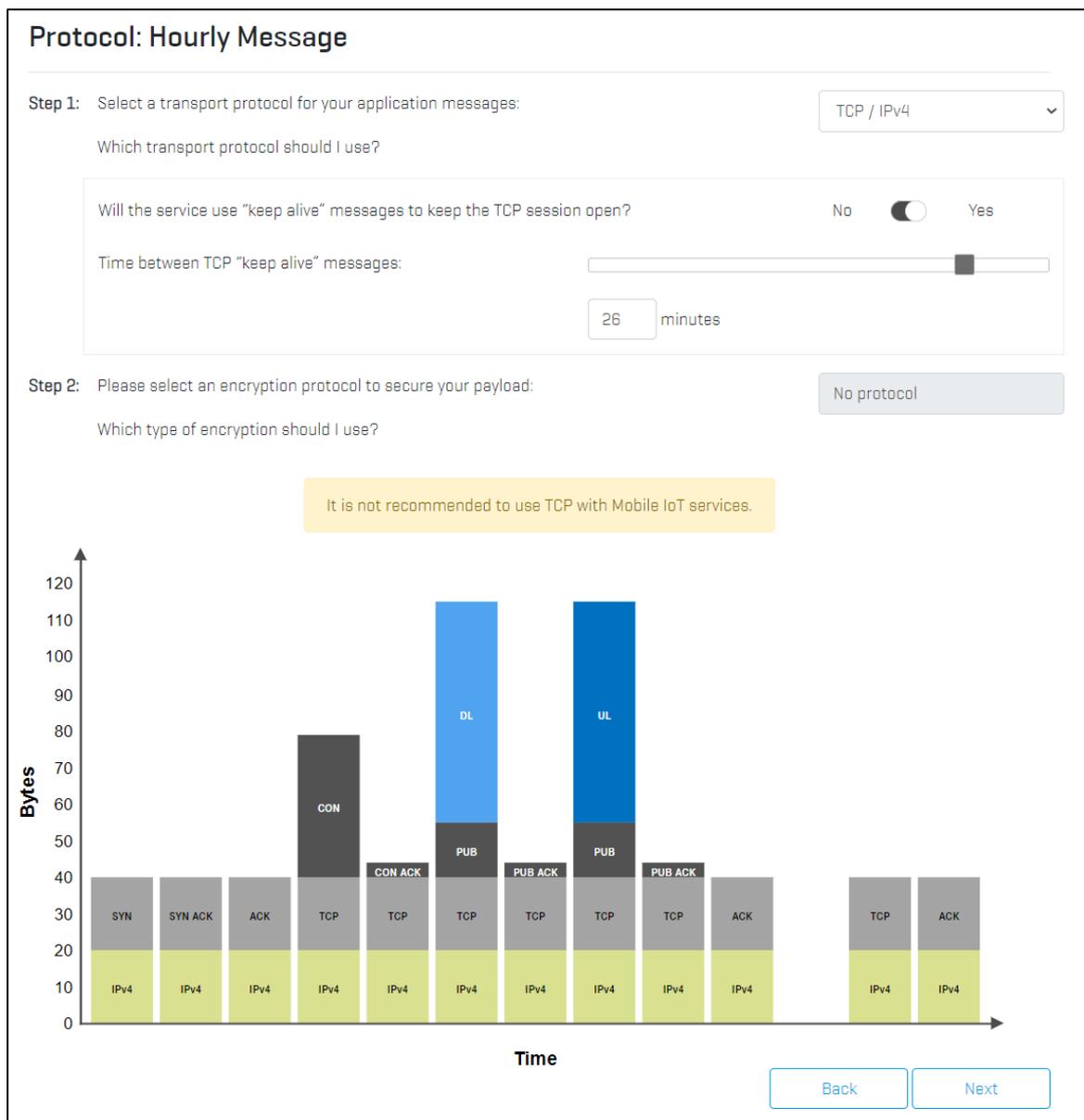


The **Maximum Transmission Unit (MTU)** supported by the selected chipset or module controls the size of the payload plus protocol that the IoT Solution Optimizer allows to module as one message. A warning message is presented on either protocol pages whenever this limit is exceeded per message by the sum of implemented CoAP, MQTT, MQTT-SN, HTTP, TLS or DTLS transport encryption, or oneM2M IoT protocol overhead, in addition to the application payload.

Please note that the x-axis is unitless; it is important to note though that the messages are arranged in sequence, from left to right. The details of payload transmission duration are well-accounted for in the cloud-based calculation model separately.

Users that want to use oneM2M, can select "Yes" on the toggle switch and set each of the operations per request event. Response messages are added automatically. Wherever possible as per the ETSI specification, the IoT Solution Optimizer allows one to configure the payload and response message sizes. At the end of the sequence it is also possible to append a Delete Request operation.

Figure 33: "Transport Protocol" page for App Messages & FOTA, with "Keep Alive" Messages



## 6.10. Data Events

*Please note: this option is available in all projects, regardless of whether the user decided to build a custom design or selected a pre-integrated product off the IoT Solution Optimizer's virtual product shelf (refer to Chapter 6.5).*

### **IOT SOLUTION OPTIMIZER'S BEST PRACTICE**

Mobile IoT technologies are highly optimized for maximum power efficiency. It would be contrary to the specification for IoT applications to send data with very large payloads, low latency requirements and/or with a high frequency of messages. Technologies such as NarrowBand IoT (NB-IoT) and LTE-M (eMTC) are therefore not suitable for real-time and streaming services. They are also not intended to be used as the "cheapest" bit pipe option for connecting typical 2G/3G/LTE applications. Failing to adapt IoT application behavior to the paradigm of NB-IoT and LTE-M may not only prematurely drain a battery in an IoT device, but it may congest or damage the MNO's network. A few devices transmitting large payloads every minute, in close proximity to each other, may congest a cell, taking service away from other paying customers. Keeping this in mind, it is troublesome to consider the quality of service that one can expect on service providers networks that have no governance models or rules in place, or that even entering marketing-driven "megabyte offering" competitions. The IoT Solution Optimizer guides developers in setting up communication patterns that Mobile IoT-compatible, avoiding congestion to networks.

The IoT Solution Optimizer supports **multiple tariffs per MNO**, wherever configured. Each tariff can be assigned different limits on the maximum payload that may be transmitted per month and/or the maximum number of messages that can be originated within a 24-hour window. Convenient links may be presented allowing users to open the online pages of the MNO in a new tab, to study the MNO's different connectivity offerings. Occasionally, the selection of tariff country may be restricted to one or several markets, depending on the configuration that your service provider has chosen.

In order to avoid damage to MNO networks, the IoT Solution Optimizer compares the proposed IoT application traffic (application messaging data, plus protocol overhead) to market-specific rules bound to the user-selected tariff. These limits determine the maximum allowed monthly data volume and the maximum number of events per day on the selected tariff network, whereby one "event" is each transmission specified in the "Payload" and "Protocol" screens of the "Communication Activity" node.

As seen in [Figure 34](#) the user interface indicates the maximum number of events per day, week, month, or year which a user may transmit the previously configured payload and protocol on the selected tariff network, given both tariff rules. If there are less than one events per day, use the "Weekly" option. Similarly, if there are less than one events per week, use the "Monthly" option, etc. Based on how the IoT application traffic is configured,

one of the two restrictions will predominate. If the IoT application in question however requires higher throughput or more frequent communication than what NB-IoT tariffs and technology offer, please consider using an alternative LPWA technology, such as LTE-M, an upgrade to higher-category LTE. Additional information can also be found under the “*Why can't I transfer more?*” link at the lower left-hand corner of the page.

Figure 34: “Data Events” screen

**Tariff Selection**

NB-IoT Tariff [[See Details](#)]

**Data Events**

**Series Cadence:**

Daily  
 Weekly  
 Monthly  
 Yearly

24,00 times

Each bi-directional data transaction event of your IoT application generates:

**1009 Bytes**

According to your market's available tariff, the maximum number of times you can transmit this pattern of data daily is:

**96 times**  
**[2923.20 events/month]**

[Why can't I transfer more?](#)

[Back](#) [Next](#)

By selecting the “Next” button, users revert to the “Communication Activity” page (refer to [Figure 30](#)), where they can iteratively add additional application and firmware update messages in parallel, or press “Next” to advance to the next stage in the project configuration flow, the “Power Saving Features” page.

Note that whenever users configure additional application and firmware update messages, the IoT Solution Optimizer checks to ensure that the total consumed data fits within the selected tariff. Users may conveniently increase their tariff to send more data. Eventually, the capacity allocated to the highest tariff is consumed, and the IoT Solution Optimizer may prompt the user to remove messages or reduce the amount of data traffic, in accordance with the tariff’s policies and set monthly data volume.

## 6.11. Power Saving Features

*Please note: This option is only available in projects where the user has decided to build a custom design (refer to Chapter 6.5).*

The 3GPP™ specification has defined various Power Saving Features which can be used in NarrowBand IoT and LTE-M solutions to conserve battery power. Additional information on how to use these features is thoroughly documented in the “Technology Cards” embedded in the page. The IoT Solution Optimizer presents numerous power saving features in its user interface, and preconfigures a best-fit combination of these:

- Release 12 Power Saving Mode (PSM)
- Release 13 Enhanced Discontinuous Reception (eDRX)
- Release 13 Early Release Assistance Indication
- Release 13 Long-Periodic Tracking Area Updates
- Release 13 Connected Mode Discontinuous Reception (cDRX)

Although not specified by 3GPP™, system integrators may choose to simply shut-down the wireless chipset or module. An option for this method is also supplied, as it may have unintended side effects on the performance, such as the need to perform prolonged system selection scans upon each power-up of the modem.

*Figure 35: “Power Saving Features” screen*

### Power Saving Features

Shut-down chipset/module between data transaction events

Tracking Area Updates (TAU): Standard  Long-Periodic

Power Saving Mode [PSM]

Extended Discontinuous Reception [eDRX]

Connected Mode Discontinuous Reception [cDRX]

The IoT application you have configured so far works best with this configuration of power saving features.

If desired, you can adapt the parameters below to customize your application's behavior:

Long Periodic TAU Timer (T3412)  
310 hours

PSM Activity Timer (T3324)  
30 seconds

Back Next

The IoT Solution Optimizer presents only those power saving features that are available based on the user's project criteria. Not only must the MNO network support the feature, but also the selected wireless communication chipset or module must allow for

configuration and usage of the functionality. Occasionally, a wireless communication chipset supports a feature, yet the wireless communication module supplier does not make it available for use by IoT applications via their proprietary AT command interface. One of the benefits of the IoT Solution Optimizer is that users can quickly identify what options their component and network choices offer. MNO networks may also support or lack specific features. By adapting their design to the MNO configuration, device manufacturers and IoT service providers may improve their performance and secure greater interoperability.

Furthermore, the "AT Command Guide" generated for each project (refer to [Chapter 6.12.3](#)) under "My Projects" elaborates on how each feature can be activated and used by the IoT application.

Users can override the IoT Solution Optimizer's proposed defaults (refer to [Figure 35](#)). As they enable and disable the features on the left-hand side by (de-)selecting tick boxes or the moving the Tracking Area Update slider, the power consumption profile graphic below dynamically updates, thereby showing the impact of using each power saving feature. In parallel, the list of available configurable options on the right-hand side of the page updates. These items represent power saving feature timers and settings which the IoT device application can specify to the MNO's networks to override operator-configured default settings. In case that the field is greyed-out, this indicates that the overriding of such network-side defaults in the selected tariff network is not (yet) possible.

Please note that updating of these MNO network capabilities in the IoT Solution Optimizer is independent of its service releases. That means that once operator networks cater to IoT application overriding of default settings, greyed-out fields are made configurable, independent of any regularly scheduled updates.

#### **IOT SOLUTION OPTIMIZER'S BEST PRACTICE**

It is critical to note that 3GPP™ power saving features must be applied according to the specific IoT application use-case. Activating more is certainly not better, as some features can lead in specific cases to a waste of battery life, or even a failing product design. The IoT Solution Optimizer proposes which power saving features match best to your communication needs, thereby avoiding costly mistakes that lead to increased power consumption or broken use cases.

When initially loading the "Power Saving Features" page, the IoT Solution Optimizer indicates an initial configuration of power saving features based on whether the configured use case is uplink- or downlink-centric. In the case of the latter, further differentiation is made between IoT applications that infrequently communicate (meaning they can leverage Enhanced Discontinuous Reception), versus those that communicate too frequently (and therefore should not use eDRX).

## 6.12. Project Summary Report

The “Project Summary Report” is generated once the end of the project configuration flow is reached. To access the results, users must read and accept a disclaimer titled “How to interpret your results” (refer to Figure 36). As per the disclaimer, it is recommended that users of the IoT Solution Optimizer contact their component-suppliers for more detailed implementation guidance and modeling.

Depending on the type of hardware product that was configured, the details of this report will vary. If a pre-configured hardware was selected off the product shelf, the hardware and software components used within that solution are not displayed (refer to Figure 37). The IoT Solution Optimizer is implemented in this way in order to avoid revealing confidential details of a supplier’s product implementation. Alternatively, users that decide to design their own custom product, a full inventory of the configured hardware and application features is displayed in the report; an example is shown in Figure 38.

Figure 36: “How to interpret your results” disclaimer screen

The screenshot displays the IoT Solution Optimizer interface for a project named 'Celje CO2 sensor'. A modal window titled 'How to interpret your results' is overlaid on the right side of the screen. The modal contains the following text:

**How to interpret your results**

The IoT Solution Optimizer modeling of your design's performance and suitability is only an approximation. The results given here are not intended to be used as the sole input for product development activities. Please consult your suppliers for more detailed guidance.

Multiple product design and deployment aspects (such as battery storage time, aging, shielding, antenna integration, etc.) may not be accounted for in the simulation. Such elements may impact the suitability of the design for your business case. Furthermore, to model several performance characteristics, nominal conditions have been assumed for some components.

By selecting "Continue", you agree to view these results as Indicative only.

[Continue](#)

The background interface shows the following configuration details:

- Mobile Network Operator: Telekom (with flag)
- Selected Tariff: [unspecified]
- Access Technology: NarrowBand IoT (L)
- IoT Vertical: Condition Monitoring
- Module or Chipset: SIMCom SIM7020E
- Hardware Components:
  - Wake-up duration: 10.00 sec
  - Average wake-up power consumption: 3,991.19  $\mu$ A
  - Average sleep power consumption: 5.01  $\mu$ A
  - Maximum Peak Current: 13.15 mA

Figure 37: "Project Summary Report" screen – Pre-integrated virtual shelf products

## Celje CO2 sensor

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- [Chapter 1: Project Configuration Summary](#)
- [Chapter 2: Project Analysis](#)
- [Chapter 3: Project Optimization Recommendations](#)

Optimize Project

Finish Project

Print Report

---

**Chapter 1: Project Configuration Summary**

<b>Mobile Network Operator</b>	Telekom Slovenije (Slovenia)	
	Selected Tariff	Basic Tariff
<b>Access Technology</b>	NarrowBand IoT (LTE Category NB)	
<b>IoT Vertical</b>	Condition Monitoring	
<b>Application</b>	Efento NB-IoT Sensor	
<b>Communication Activity</b>	Configured Number of Transactions per Day	6.00
<b>Deployment Characteristics</b>	Outdoor	49.92 %
	Indoor	29.01 %
	Deep Indoor	21.07 %
	Mobility Model	Moving
	Distance Travelled each Day	5.00 km
	International Roaming	Enabled
	Number of Roaming Events per Month	10.00
	Deployment Temperature	22.0 °C
	Deployment Temperature	22.0 °C

Figure 38: "Project Summary Report" – Chapter 1. Project Configuration Summary

## Celje CO2 sensor

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**Table of Contents**

- Chapter 1: Project Configuration Summary
- Chapter 2: Project Analysis
- Chapter 3: Project Optimization Recommendations

Optimize Project

Finish Project

Print Report

Your project can be optimized (see highlighted, blue comments below). Please select the button above to edit your project and improve its performance in the corresponding area[s].

---

### Chapter 1: Project Configuration Summary

<b>Mobile Network Operator</b>	Telekom Slovenije (Slovenia)	
	Selected Tariff	Basic Tariff
<b>Access Technology</b>	NarrowBand IoT (LTE Category NB)	
<b>IoT Vertical</b>	Condition Monitoring	
<b>Module or Chipset</b>	SIMCom SIM7020E	
<b>Hardware Components</b>	Wake-up duration	10.00 sec
	Average wake-up power consumption	3,991.19 µA
	Average sleep power consumption	5.01 µA
	Maximum Peak Current	13.15 mA
<b>Voltage Conversion</b>	<b>Low-dropout Voltage Regulator (LDO)</b>	
	LDO Model Name	Example LDO
	Drop-out Voltage	0.30 V
	Quiescent Current	18.00 µA
<b>Battery</b>	<b>SAFT S.A. LS 17500</b>	
	Capacity	3.6 Ah
	Capacity	13.0 Wh
	Voltage	3.6 V
	Self-discharge Rate	1.00 %
	Battery Configuration	1S1P
<b>Communication Activity</b>	Mean Transmitted Data per Month (Uplink)	145 KBytes
	Mean Transmitted Data per Month (Downlink)	116 KBytes
	Transport Layer Encryption Used	No protocol
	Configured Number of Transactions per Day	24.00
	Cloud Service Used	Not applicable
<b>Power Saving Features</b>	Shut-down chipset/module	Disabled
	Tracking Area Updates (TAU)	Long-Periodic
	Long-Periodic TAU Timer	1116000 sec
	Extended Discontinuous Reception [eDRX]	Disabled
	Power Saving Mode [PSM]	Enabled
	PSM Activity Timer [T3324]	30 sec
<b>Deployment Characteristics</b>	Outdoor	49.92 %
	Indoor	29.01 %
	Deep Indoor	21.07 %
	Mobility Model	Moving
	Distance Travelled each Day	5.00 km
	International Roaming	Enabled
	Number of Roaming Events per Month	10.00
	Deployment Temperature	22.0 °C

The Project Summary Report offers the options to edit the project, print the report, or finish. The former takes users back to the “IoT Vertical” screen, whereas the latter opens the “My Projects” folder, where project files await one’s review. By scrolling further down in the “Project Summary Report,” users may view an analysis of their design as well as numerous optimization possibilities. These features (corresponding to the report’s “Chapter 2: Project Analysis” and “Chapter 3: Project Optimization Recommendations”) are described below.

### **6.12.1. Project Analysis**

The IoT Solution Optimizer models device performance using a calculation model for 3GPP™ NarrowBand IoT technology. Within seconds, a detailed performance assessment of expected battery life in different Coverage Enhancement (CE) levels is delivered for the selected product, in the chosen network, and with the specified deployment scenario (number of messages per day, mobile, roaming or static).

Upon selecting “Continue” on the “How to interpret your results” (refer to [Figure 36](#)), users explicitly agree to view results as indicative only. Chapter 2 of the Project Summary Report consists of a “Power Consumption Analysis” bar chart (see [Figure 39](#)). Here, users can see the prognosticated battery life of the product for a 100% deployment in each Coverage Enhancement (CE) level (i.e., coverage environment), as well as for the composite deployment based on the inputs given by the user in the “Deployment Characteristics” page. By hovering the cursor over each bar, the user can see the expected battery life of the device for each scenario displayed in a pop-up window. Further below are additional disclaimers, including the downlink channel conditions (RSRP and SINR values) under which performance measurements for the selected wireless communication chipset or module were taken.

#### **IOT SOLUTION OPTIMIZER’S BEST PRACTICE**

It is important to note though that the modeling of the IoT device's performance and suitability is only an approximation. The results given by the service are not intended to be used as the sole input for product development activities. Users are required to consult their component suppliers for more detailed guidance. Multiple product design and deployment aspects may not be accounted for in the simulation. Such elements may lead to a serious degradation of the expected battery life. Furthermore, the use of a custom battery may contribute an additional deviation, as temperature, architecture, production and chemistry aspects cannot be captured properly. At the end, the value presented is a “ball-park” figure. A potential deviation is drawn for users on the bars of the chart. Considering the millions of dollars spent every year in the development and refinement of products for the price-sensitive Mobile IoT M2M/IoT market, just having such an approximation can help drive down significant assessment cost and risks, and improve time-to-market by avoiding common mistakes.

Figure 39: Analyze "Power Consumption Analysis" bar chart

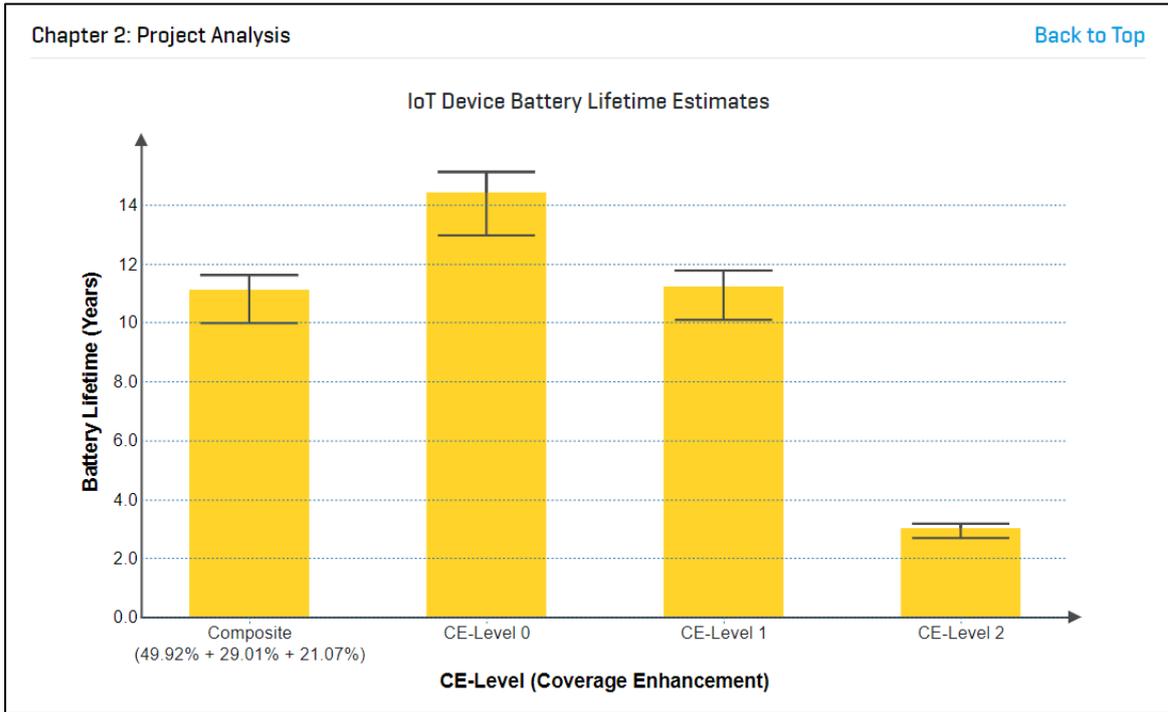


Figure 40: Analyze "Power Consumption Analysis" – Composite Power Consumption

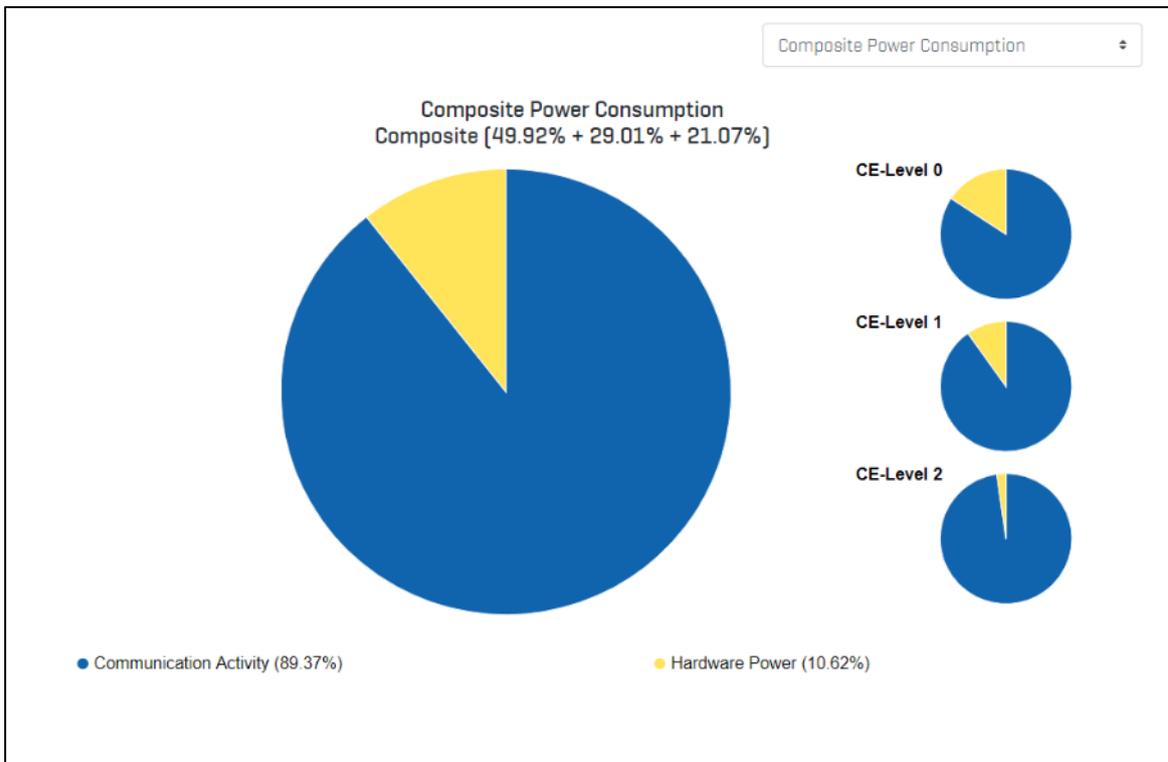
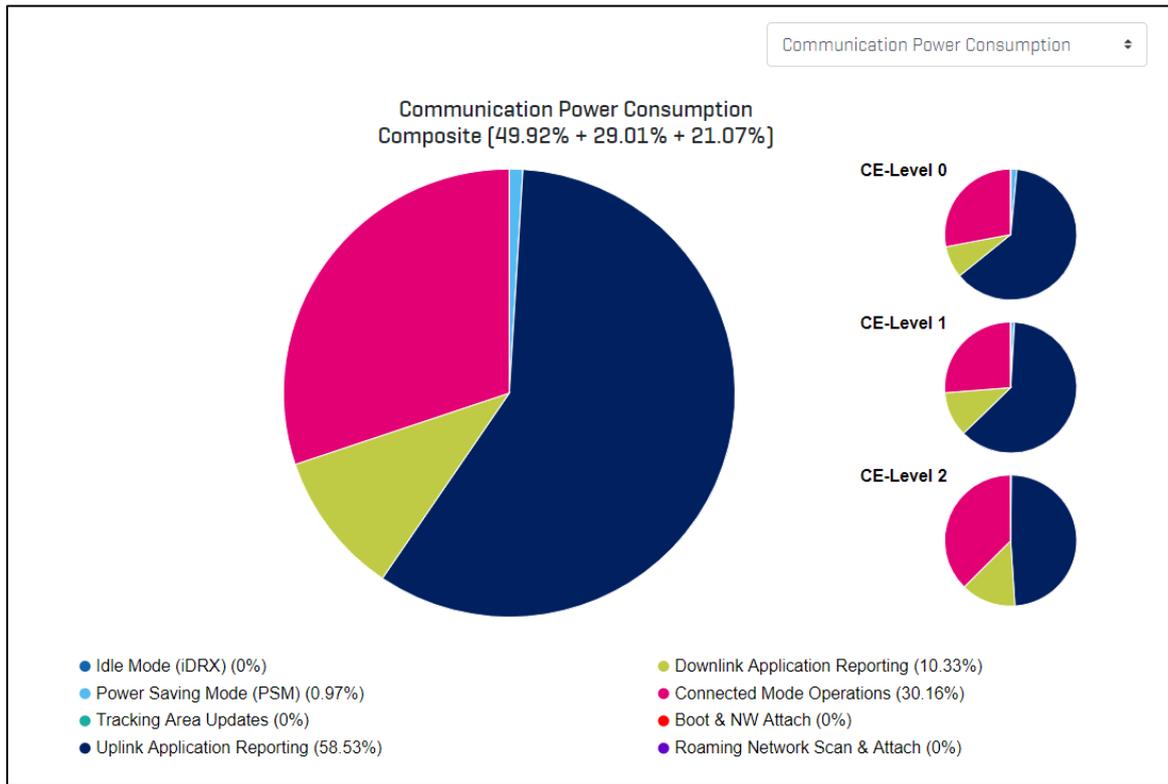


Figure 41: Analyze “Power Consumption Analysis” – Communication Power Consumption



Scrolling further down, the “Power Consumption Analysis” pie charts can be seen. Please note that this graphic is only generated when the user had chosen to design their own custom product. The pie charts in Figure 40 and Figure 41 are not available for pre-configured hardware that is selected off the product shelf. The IoT Solution Optimizer is implemented in this way in order to avoid revealing details of a supplier’s proprietary product implementation.

Currently, two sets of pie charts are generated by the IoT Solution Optimizer. Simply use the drop-down selector at the top right corner to toggle between both sets:

- **[Custom design only] “Composite Power Consumption”** chart – Summarizes the power consumption caused by communication activity, in blue color, versus all energy consumed by non-modem hardware components, in yellow color (refer to Figure 40). The former includes the module and application activity, including transmission and reception of data. The latter consists of contribution of the MCU, sensor/actuator chip, GNSS solution, antenna inefficiency, voltage regulation, etc. to the power budget.
- **[Custom design only] “Communication Power Consumption”** chart – Looking only at the previous chart’s communication activity (blue color) slice, this set of graphics indicates where the power consumption for communication took place – during the Connected Mode, Idle Mode, power saving features, roaming and network attaches, etc. (refer to Figure 41). The “Power Consumption Analysis” pie

charts can be used to start identifying potential areas where power consumption can be saved. As seen in the graphics, each application and hardware element's contribution to the overall power drain varies as function of the Coverage Enhancement (CE) level (coverage environment). By selecting the different element labels below the main pie chart, users can magnify the corresponding pie slice in the circle above and read the percentage contribution in a pop-up window. Likewise, users can interactively select the different pie charts to the right to study in detail how the power contribution of each application and hardware element changes from one CE-Level to the next. Like the previous "Power Consumption Analysis" chart, the different circles here represent how products remaining only in that coverage environment would behave. The composite circle shows what the final product's performance is, based on the percentage allocations set previously in the "Deployment Characteristics" page.

### 6.12.2. Project Optimization Recommendations

Chapter 3 of the IoT Solution Optimizer's Project Summary Report presents multiple simulations of the same project showing the impact that varying different design aspects may have on battery life. These "what-if" scenarios allow enterprises designing their own products to quickly gain insights into potentially fruitful optimization options, and to quickly discard scenarios proving to be less beneficial. As the service is cloud-based, the IoT Solution Optimizer can run hundreds of calculations a second to compress man-weeks of calculation work, turning around impressive, interactive charts usable for project reporting and business case analyses. Currently, the Project Optimization Recommendations consist of the following graphics:

- **[Custom design only] "Hardware Average Power Consumption"** chart – Impact of the MCU, sensor/actuator average power consumption on battery lifetime (refer to [Figure 42](#)); **"Application Reporting Period"** chart – Impact of the application reporting interval on battery lifetime; one graphic is generated per configured application and device management message, and selected via the drop-down (refer to [Figure 43](#));
- **[Custom design only] "PSM Activity Timer"** chart – Impact of T3324 timer optimization on battery lifetime (refer to [Figure 44](#));
- **[Custom design only] "Enhanced DRX Configuration"** charts – Impact of eDRX feature optimizations on battery lifetime – the Paging Transmission Window (PTW) and the eDRX Cycle; (refer to [Figure 45](#)).
- **[Custom design only] "Data Payload"** chart – Impact of data payload size on battery lifetime; one graphic is generated per configured application and device management message, and selected via the drop-down (refer to [Figure 46](#));

As seen in the list above, the only optimization graphic generated for users who choose to use a pre-configured hardware from the product shelf is the “Application Reporting Period” chart. The IoT Solution Optimizer is implemented in this way in order to avoid revealing details of a supplier’s proprietary product implementation. Furthermore, standardized offerings can often not be customized by changing application properties or hardware components. Please contact the respective supplier to learn more.

All charts shown in [Figure 42](#), [Figure 43](#), [Figure 44](#), [Figure 45](#), and [Figure 46](#) are interactive. By placing the cursor over them, the users can learn what the different battery lifetime values are for a given x-axis variable.

The IoT Solution Optimizer highlights in bold blue alert prompts any instances where a 20% change in the current use case value might yield an optimization result that is greater than half a year. This helps users understand where the key opportunities may lie for improving their design.

Figure 42: Optimize “Hardware Average Power Consumption” chart

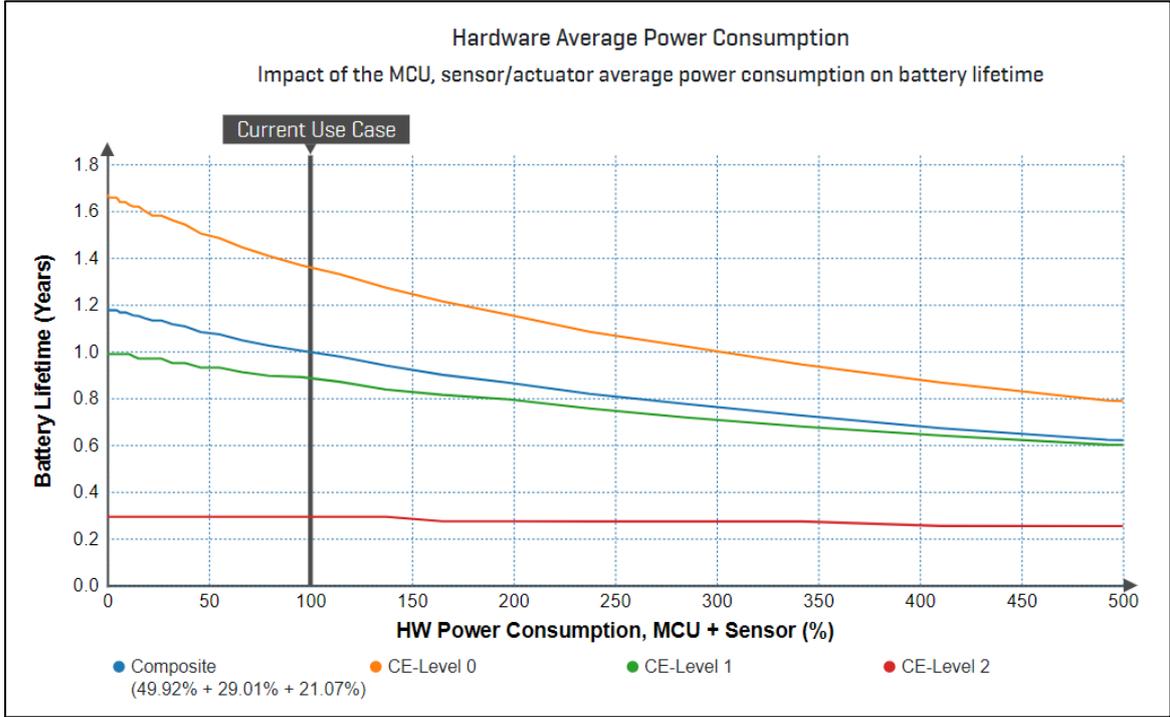


Figure 43: Optimize "Application Reporting Period" chart

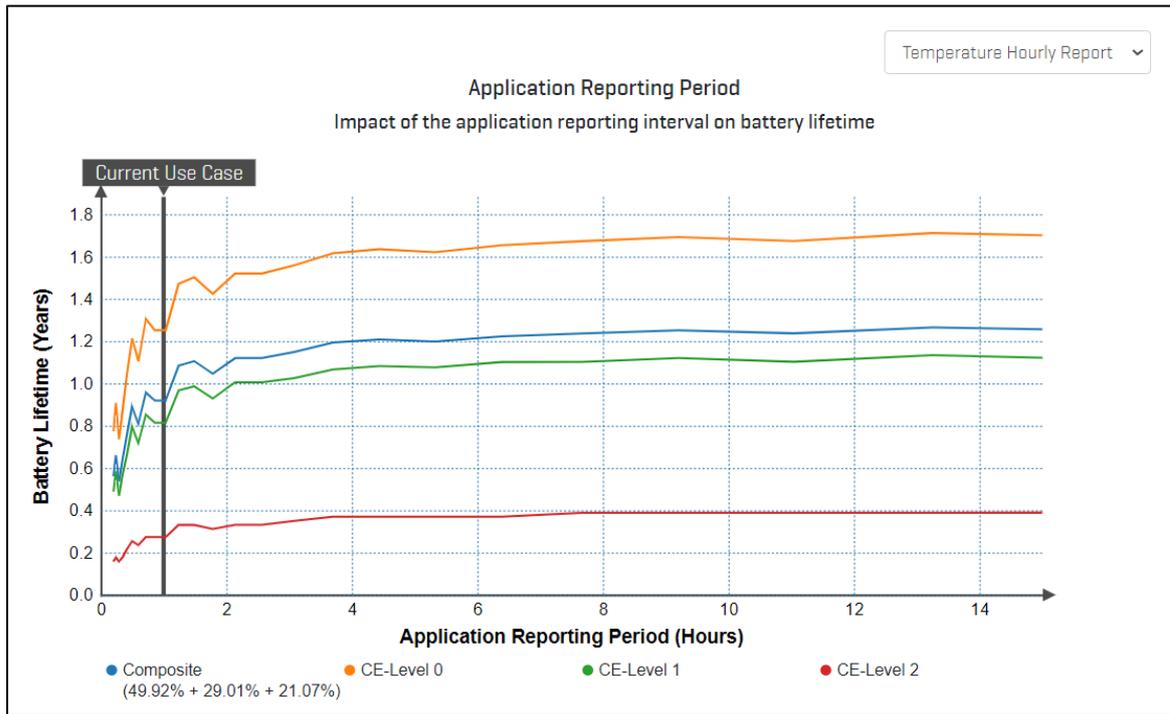


Figure 44: Optimize "PSM Activity Timer" chart

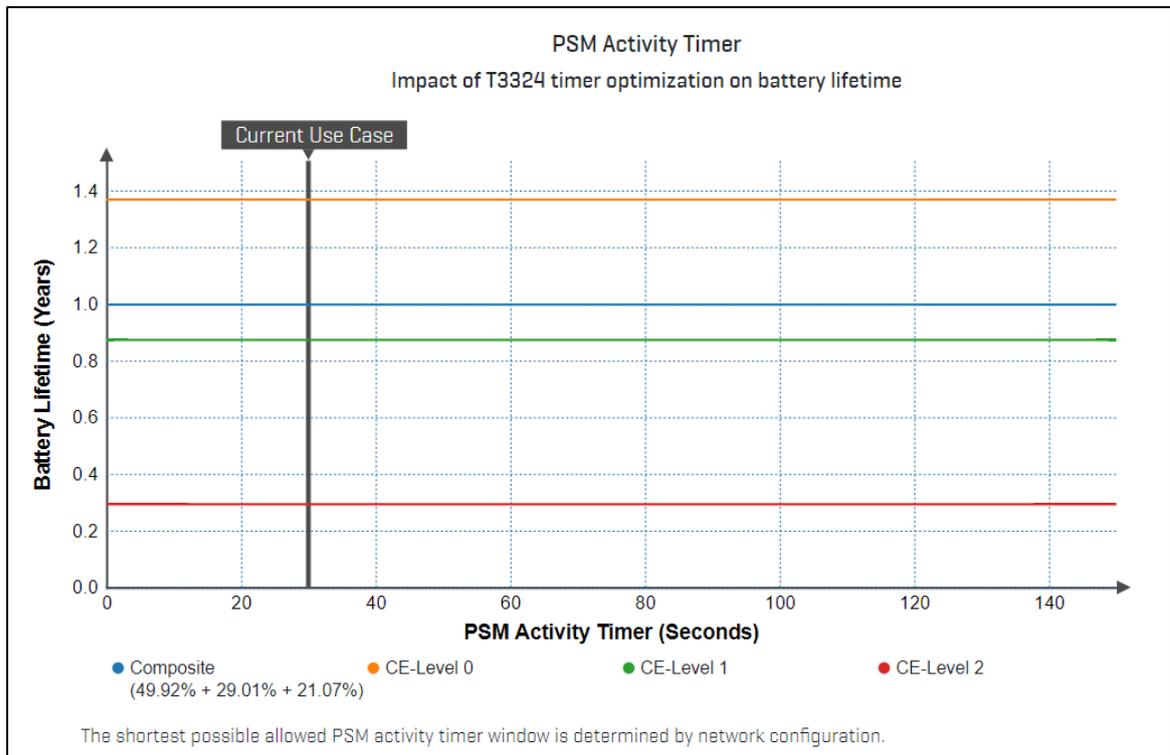


Figure 45: Optimize "Enhanced DRX Configuration" chart

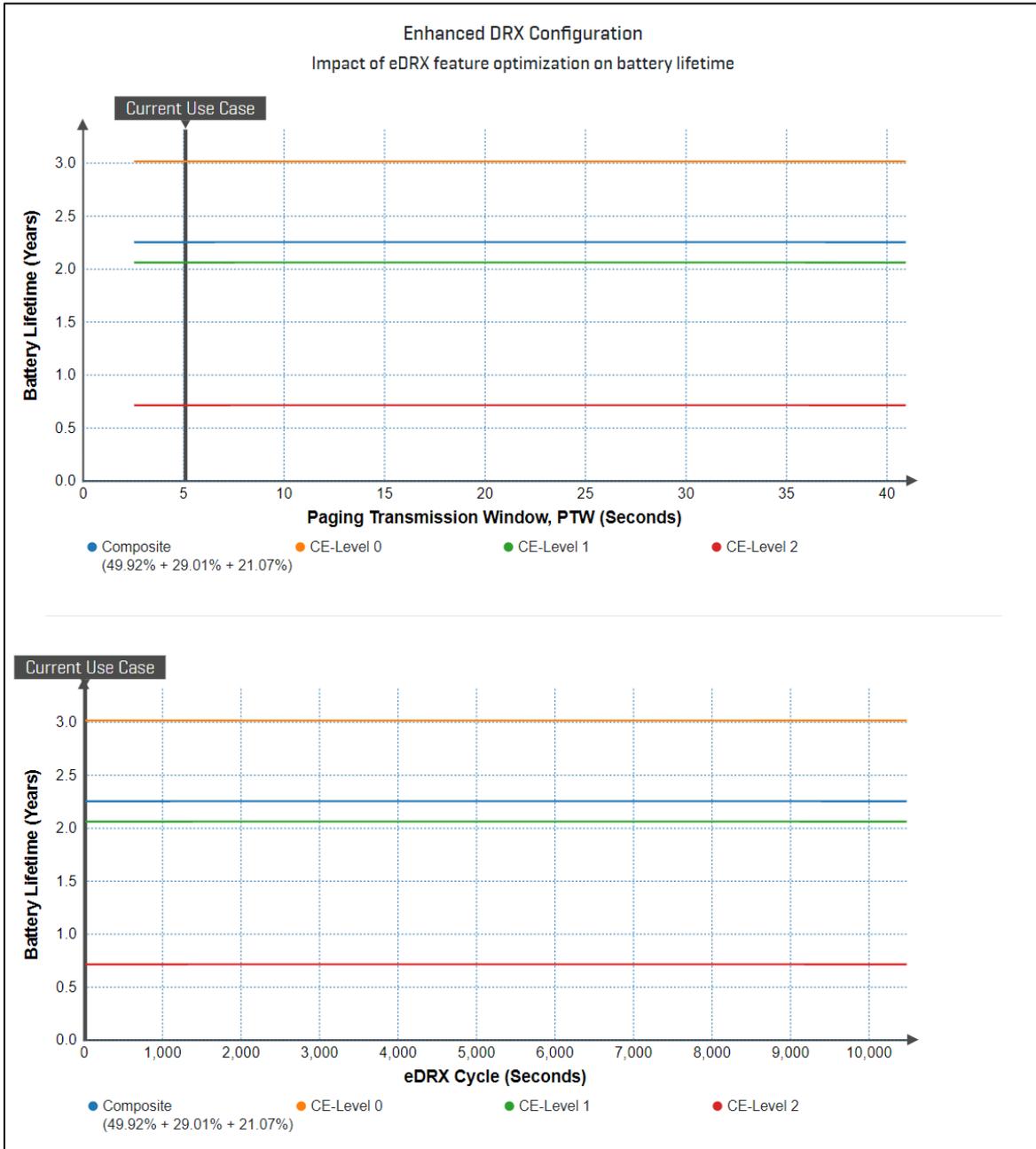
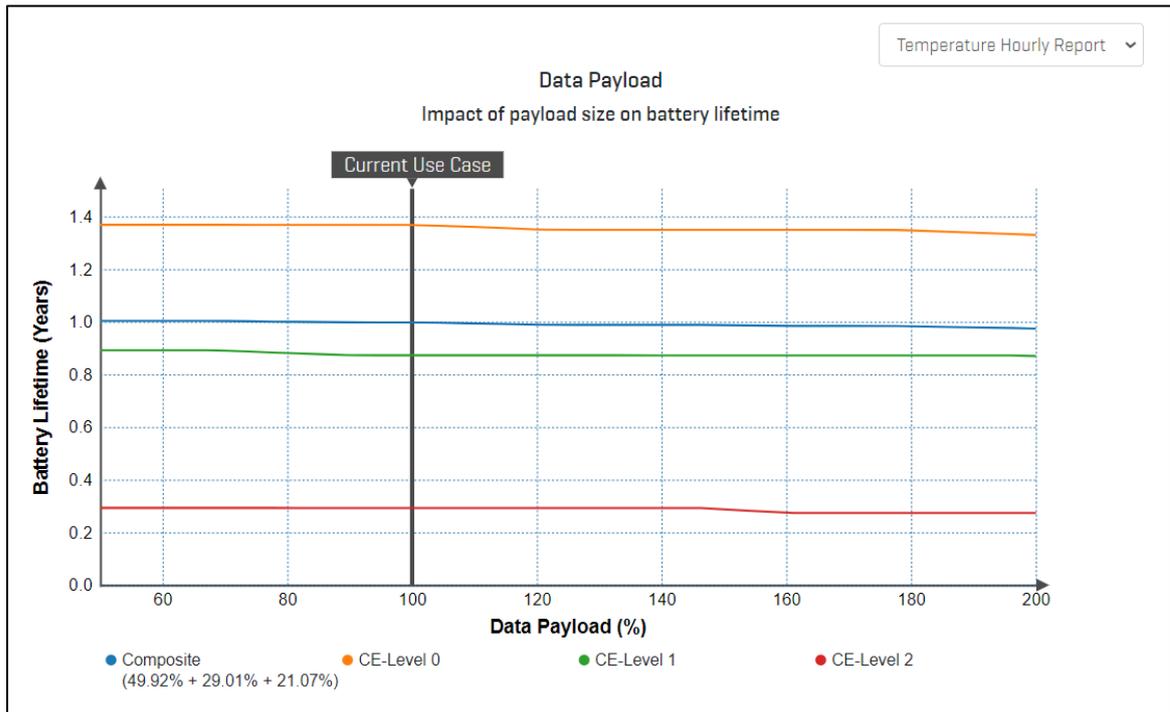


Figure 46: Optimize "Data Payload" chart



### 6.12.3. AT Command Guide

Please note: The AT Command Guide is only generated in projects where the user has decided to build a custom design (refer to Chapter 6.5).

The IoT Solution Optimizer generates an "AT Command Guide" for the custom products that users design (refer to

Figure 47). These documents are deposited in the respective project folders under "My Projects."

Key AT commands of each wireless communication chipset and module are mapped to specific features in the IoT Solution Optimizer project configuration. An AT command is therefore only displayed in the guide for a specific feature if the wireless communication chipset or module that the user selected supports it, if the tariff network supports the feature, and if the user decided to use that feature in their project. By changing the hardware used in the custom project, as well as its feature configuration, one will note that the AT command list in the guide adapts accordingly. As time passes, suppliers may remove or add feature support. The IoT Solution Optimizer Tool Support team manages the integrated AT command library so that it reflects the latest supplier offering.

The "AT Command Guide" is only intended to serve as a simplified "checklist" of all major features that should be activated on the wireless communication module or chipset, based on the user's IoT Solution Optimizer design inputs; therefore, the document is not meant to generate script that can be taken directly into the code-base of the IoT device application. It also does not replace the supplier's own AT command documentation. The IoT Solution Optimizer only shows a very small subset of the supplier's proprietary AT commands; there may be many more that are very relevant for individual use cases and implementations. Please contact the supplier for their official documentation and technical support.

Users who instead choose to model pre-integrated solution on the IoT Solution Optimizer's virtual product shelf generally do not have the possibility to change the AT command implementation of their IoT devices. An AT command interface for modifying the product's behavior is usually not made available by the supplier. These projects are therefore intentionally implemented in the IoT Solution Optimizer in a way that avoids creating an "AT Command Guide," as this may unintentionally reveal details of a supplier's proprietary product implementation or give the false impression that customization possibilities may exist. In case that the user has special needs for their deployment, they should contact the IoT device supplier. The latter's contact information is found on the product specification documentation, which can be downloaded with the "More Info" button found next to the product picture and description, in the "Product Shelf" page.

*Figure 47: "AT Command Guide" example*

## AT Command Guide

You can find the AT command related to your project **Dora & Tim SV2.3.2 Demo** in this page. Based on your design and choice of chipset or module, we have collected for you the most relevant AT commands in the table below. For more information, please refer to the supplier's AT command guidelines.

### General AT Commands

Purpose	Command String
Q	Q
Check the network registration status	AT+CEREG?
Configure the APN for IP-based connection	AT*MCGDEFCONT="IP",<APN name> AT+CGDCONT=1,"IP",<APN name>
Configure/activate the PSM mode	AT+CPSMS=[<mode>[,<Requested_Periodic-RAU>[,<Requested_GPRSREADYtimer>[,<Requested_Periodic-TAU>[,<Requested_Active-Time>]]]]]  <b>Example:</b> AT+CPSMS=1,,,01000011,00001111
Connect socket to remote address and port	AT+CSOCON =<socket_id>,<remote_port>,<remote_address>  <b>Example:</b> AT+CSOCON=0,5684,"10.23.22.85"

### AT Commands for Communication Protocols

Purpose	Command String
Q	Q
Create a TCP/UDP socket and send data to remote via socket	AT+CSOC=<domain>,<type>,<protocol>[,<cid>]  <b>Example:</b> AT+CSOC=1,2,1
Send data to remote via socket	AT+CSOSEND =<socket_id>,<data_len>,<data>[,<flag>]  <b>Example:</b> AT+CSOSEND=0,10,"3132333435"  <b>Example:</b> AT+CSOSEND=0,0,"Hello World"  AT+CSOCL=0 // Close the socket port
Configure/activate the eDRX mode	AT+CEDRXS=[<mode>[,<AcT-type>[,<Requested_eDRX_value>]]]  <b>Example:</b> AT+CEDRXS=1,4,"0101"
Modify eDRX parameters	AT*MEDRXCFCG=[<mode>[,<AcTtype>[,<Requested_eDRX_value>[,<Requested_Paging_time_window_value>]]]]  <b>Example:</b> AT*MEDRXCFCG=1,5,"0101","0111"

#### **6.12.4. Localized Onboarding Page**

Based on the tariff country and mobile network operator (MNO) defined in each project, the IoT Solution Optimizer will generate a URL link that opens a new browser tab to the MNO's online IoT web presence. These resources offer information on how to get onboarded with the MNO in question. The document may contain marketing information, contacts, links to online resources, and/or special offers which may be updated from time-to-time. By regularly returning periodically to "My Projects," one can browse for the most recent promotional documentation in each project folder.

### **7. Pop-up Cards**

Throughout the user interface of the IoT Solution Optimizer there are places where pop-up overlay windows can be implemented to convey information. In the IoT Solution Optimizer, this UI scheme is used for the purpose of presenting technology information in an embedded wiki, as well as marketing "Benefit" cards that illustrate the key selling points of service providers or suppliers.

#### **7.1. Technology Cards**

In the IoT Solution Optimizer UI, one may find dozens of underlined, colored words and phrases. These are links that open overlaid IoT wiki windows referred to as "Technology Cards" (refer to [Figure 48](#)). In order to return to the service's user interface, users simply can click the darkened user interface in the background. This action closes the active "Technology Card" and the user can see the area of the webpage previously covered. Alternatively, one can click the "x" icon at the top right-hand corner of the card.

By having an in-built wiki-engine, the IoT Solution Optimizer allows users of all backgrounds to better understand the various technologies and content presented by the service. Numerous screens provide guidance on best-practice design choices, as well as explaining limitations which may occur during the configuration of projects. Within each "Technology Card," additional links may appear. By selecting any of these, a new card opens and replaces the previous one. Users can use this feature to seamlessly navigate forward from one topic to another, discovering the numerous interdependencies between design options features and their impact on hardware and software implementation. It is important to note that for the sake of simplicity, no "Back" button is implemented. Instead, users can return to a wiki topic by either retracing their path, or by navigating forward through the embedded links to the same card, wherever possible. Occasionally, the "Technology Cards" contain hyperlinks to external webpages, or videos, as well as embedded pictures and documents.

Figure 48: "Technology Card" overlaid card

The screenshot shows the 'IoT Solution Optimizer' interface with a 'Technology Card' overlaid. The card is titled 'Mobile IoT' and contains the following content:

**Mobile IoT**

When comparing the various use cases of **M2M** and **Internet of Things** solutions requiring deployments on a wide scale, several key characteristics and needs are shared among the diverse industries, ranging from a need for low-cost devices, best-effort data transmissions, and throughputs in the lower bit rate ranges. Solutions fitting into this pattern can leverage Machine Type Communications (MTC) wide area network connectivity technologies classified as Low Power Wide Area (LPWA). 3GPP™ standardizes these technologies under the designation "Mobile IoT."

**Figure: Mobile IoT Application Characteristics and Types**

This scatter plot shows the relationship between Frequency of Communications (Y-axis, Low to High) and Average Traffic Per Connection (X-axis, Low to High). Applications are plotted as follows:

- Smart Meters: Low frequency, low traffic.
- Local Management: Low frequency, low traffic.
- Local Applications: Low frequency, low traffic.
- Smart Grids, Monitoring & Control: Low frequency, low traffic.
- Manufacturing & Process: Low frequency, low traffic.
- Transport Services: Low frequency, low traffic.
- Industrial Automation: Low frequency, low traffic.
- Public Transport: Low frequency, low traffic.
- Commercial Operations: Low frequency, low traffic.
- Remote Equipment & Sensor Access: Low frequency, low traffic.
- Consumer & Public Safety: Low frequency, low traffic.

**Figure: Mobile IoT Technologies in the M2M / IoT Business**

MARKET SEGMENTATION	CONNECTIONS in 2020	REQUIREMENTS	SUPPORTED TECHNOLOGY
<b>HIGH END</b> Smart City, Electronic billboards, ...	~10 Mbps	~10 Mbps	3G/4G
<b>MEDIUM</b> Smart Home, Wearable M2M, ...	< 1 Mbps	Low power consumption	3GPP (NB-IoT), 3GPP LTE-MTC (Cat. 12, Rel. 13)

The "Technology Cards" covers in Service Version 2.0 well over 120 topics related to Mobile IoT product design and optimization, organized broadly into the following categories:

- IoT Basics – Machine to Machine, Internet of Things, oneM2M
- IoT Vertical Industries – Characteristics of IoT application verticals
- IoT Device Hardware Components – Building blocks of IoT devices
- Power Supplies – Fundamentals of battery technology
- IoT Security Overview – Encryption Protocols
- Access Technologies – LAN: Bluetooth LE, ZigBee
- Access Technologies – WAN: 3GPP™ Mobile IoT radio access technologies
- Power Saving Features – 3GPP™ Mobile IoT features for power optimization
- Service Enablement – Device Management
- IoT Platforms – Azure, AWS, OceanConnect
- IoT Application – IP, Transport, Messaging/Management, Connection Efficiency
- MNO Offerings – Service Provider Service Differentiations
- Certifications – International, Regional

Users with access to the breadcrumb "IoT Services" have the option to view the "Technology Cards" in a library (refer to Figure 49); this is a separate experience from the IoT Solution Optimizer service described in this user guide.

Figure 49: "Technology Card" library

**TECHNOLOGY CARDS**

**Brush up on your IoT knowledge!**

Looking for information on specific technology topics, or just curious to learn more about recent IoT trends? We welcome you to explore our IoT wiki and research what drives the industry.

[Back](#)

- ▲ IoT Basics
  - ▼ Machine to Machine (M2M)
  - ▼ Internet of Things (IoT)
  - ▼ IoT Device
  - ▼ IoT Applications
  - ▼ IoT Vertical Industries
  - ▼ IoT Device Components (Hardware & Software)
  - ▼ Power Supply
  - ▼ 3GPP Connectivity
  - ▼ Service Enablement
  - ▼ IoT Application
  - ▼ oneM2M IoT Standard
  - ▼ Certifications & Alliances

## 7.2. Service Provider-specific Overlay Cards

At various places in the user interface of the IoT Solution Optimizer, overlaid cards that are service provider-specific may invariably appear, if configured. In order to revert to the service's user interface, users simply can click the darkened user interface in the background. This action closes the active overlaid card and the user can see the area of the webpage previously covered by it. Alternatively, one can click the "x" icon at the top right-hand corner of the overlay card.

These cards are different from the "Technology Cards" in that they appear to users upon the expiration of an account-specific timer running in the background. Please note that if the service provider changes the content of their overlay cards, the user-specific timer is reset, and the card is subsequently shown.

These service provider-specific cards serve as an advertisement of the technology and service differentiations that the provider offers its IoT customers. Within the cards there may be underlined, colored words. By selecting any of these, a "Technology Card" opens on top of the service provider's card. Users can either navigate through the technology wiki by selecting additional links within the topmost card, or simply click off it, to close it and

display the service provider card underneath. Alternatively, one can click the “x” icon at the top right-hand corner of the card.

## **8. Service Version 3.1 Update (Planned)**

During early 2021, the IoT Solution Optimizer Service Version 3.1 is slated to be released. This service update is planned to integrate many new compelling features including:

- LTE-M and multimode modeling
- Impact of TLS/DTLS/HTTPS transport layer encryption
- Positioning solutions component shelf (GNSS chips)
- Antenna solutions component shelf and Antenna Selection Guide
- Modeling antenna component placement on coverage and battery life
- eCommerce integration links to third party platforms

## **9. Conclusion**

The IoT Solution Optimizer team looks forward to supporting enterprises’ needs as accurately and efficiently as possible. Our clear target is to have a “Best-in-World” solution, which can connect businesses globally, 24/7, to the IoT opportunities of today and tomorrow.

In case that you have any questions, comments, or suggestions, please feel free to send a message to the Tool Support team. We look forward to hearing from you.

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