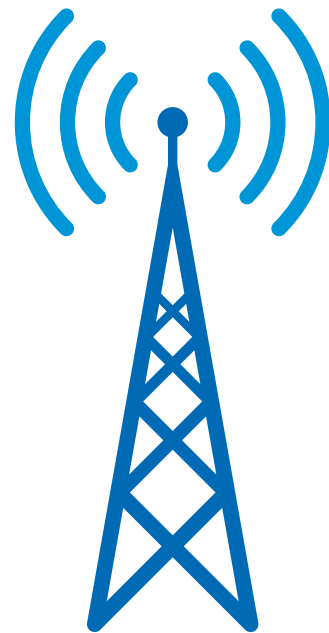


Solution description

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Kamstrup AMR and AMI



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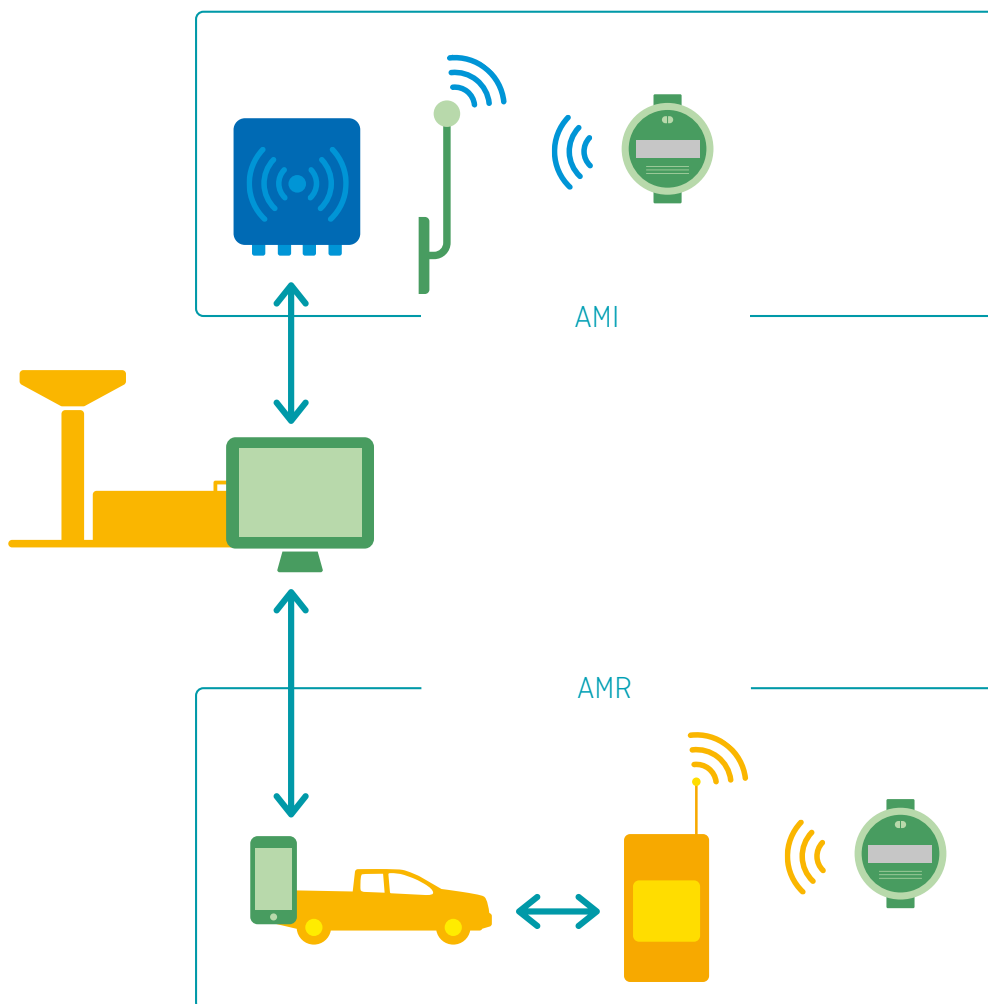
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The AMR/AMI Solution

Kamstrup's solution for reading water meters can be used for both drive-by meter reading (AMR) or remote reading via a radio network without leaving the utility (AMI).

The solution is modular, meaning the system offers standardized components that can fit together in a variety of ways. Therefore, your water system can start with AMR and seamlessly progress to AMI – by implementing the system either at one time or in steps. Both the AMR and AMI components are designed for simple installation and commissioning, making it easy to build your own network.



Accurate ultrasonic meters

Kamstrup flowIQ® ultrasonic water meters are based on the transit time method, in which flow is measured by the time it takes for an ultrasonic signal to pass from one transceiver to another. Transit time meters have no moving parts, so they have no risk of wear and tear to the internal components or damage from water impurities. This secures that meters will maintain their accuracy with no drift for the life of the meter.

A specially designed electronic circuit controls all measurements, references, readings, calculations and data communication. The meters are hermetically closed and vacuum-sealed to prevent humidity from reaching the electronics and avoid condensation between the glass and display. The meters is IP68 (submersible) type tested and suitable for installation in meter pits.

Meter and communication unit in one

Combining the communication unit and meter in one compact unit significantly reduces installation costs and time. By eliminating the need for fragile wires between the meter and communication unit, water systems can prevent unplanned budget dollars in maintenance costs due to animals, vandalism, flooding, etc. This adds predictability to future planning.

AMR and AMI meters

The meters are available in two different categories with different communication possibilities. AMR meters are optimized for drive-by operation, while AMI meters can be used for both AMR and AMI meter reading.



AMR meter

- Perfect for drive-by
- Daily values logged and available via IR



AMI meter

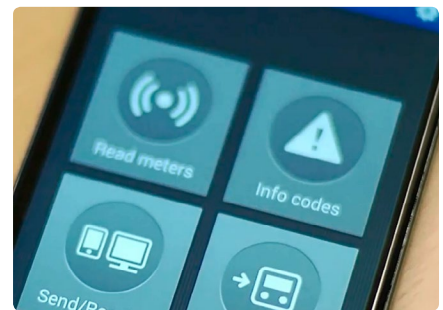
- Perfect for drive-by and AMI
- Hourly values logged and available via remote reading
- Upgradable firmware
- Remote configuring of alarm limit

Reading meters in an AMR Solution

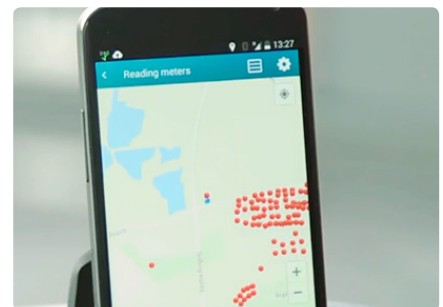
With AMR, meters are read by driving around the supply area with an Android mobile unit (smartphone or tablet) and a small reading unit (READY Converter). Meter data is collected within the READY App. When the reading is complete, meter data is transferred to READY Manager, which is the program on your computer that tracks and stores your meter data.



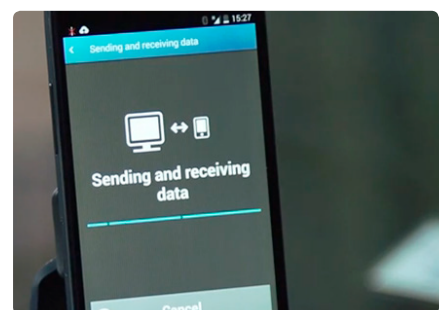
READY App is intuitive, making it easy to use. To start, press the “Send/Receive” button to synchronize data wirelessly between the READY App and READY Manager. Then, simply press “Read meters” on the start screen before starting your route.



During the meter reading process, READY App uses an integrated Google Maps module to show meters that have not yet been read, in order to maximize the efficiency of your route. As soon as the meters are read, they disappear from the map, which provides the meter reader with a clear picture of the remaining meters' locations. The map functions both as an indicator of the remaining meters and as navigation help during the reading. The reading continues during phone calls, but can also be put on hold and continued later.



When the meters have been read, a single push on the button “Send/Receive” makes the data available in READY Manager. This module ensures that the meter reader can continue with other tasks without having to return to the office to transfer data.



AMR and AMI – Solution description

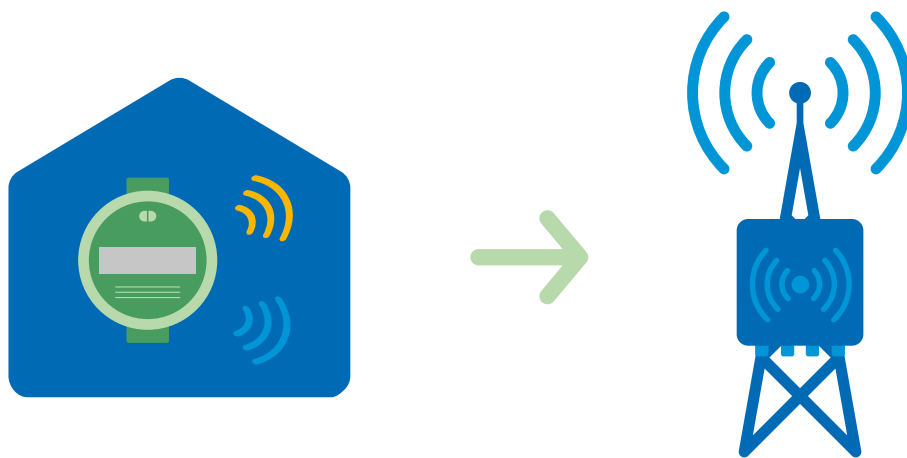
Reading of logged data from AMR meters

In addition to reading meters, the READy App allows for manual reading of the meter's data logger. By placing the Bluetooth®-enabled optical eye on the infrared connection port of the meter, the READy App can access daily consumption and info codes. Meter data can also be made available in READy Manager by synchronizing it in the same way as data read via a mobile unit. This information makes the READy App a useful tool to for you to quickly answer questions and solve billing disputes.



Reading meters in an AMI Solution

By installing one or more fixed data collectors in a supply area, the meters can be read remotely from the utility and the readings are automatically available in READy Manager.



A data collector consists of one or two antennas, a topbox and a base station.

The antennas are installed as high as possible to pick up signals from as many meters as possible. Typically, the antennas are installed on the roof of buildings in the area.

The topbox is installed as close to the antennas as possible. The antennas are connected to the topbox via coaxial cables; reducing the length of the cable increases the range of the antenna.

From the topbox the signal is digitally sent to the base station via a cable connection. The base station contains a internet modem that can either be based on a wired connection to the internet or use the build in 4G or CDMA connection. The base station is placed at ground level making it easy to change internet connection options (i.e. simcards) without the need for special equipment.

Automatic configuration of data collectors

To ensure the highest reading performance, Kamstrup AMI operates in dedicated frequencies between 450 – 470 MHz. Having a dedicated frequency in the geographical area where the meters are placed is comparable to having the highway for yourself. It ensures a high reading performance with a minimum number of collectors to install and maintain.

The collectors have built-in intelligence, meaning that as soon as the data collector is connected to power and internet, it automatically configures itself to the right frequency and connects to READy Manager. This means that no special IT knowledge is required to install a data collector and in a case where a collector is broken, it can be replaced with any un-configured collector from stock.

Installing AMI meters

The installation function within the READy App ensures the meter is installed correctly while minimizing installation costs and time. The installation function automatically configures the meter to the right frequency and verifies the meter's connection to the data collectors, thus minimizing the need for revisits during the rollout of meters.

Configuring meters in an AMI Solution

The meters can be individually configured to communicate according to different communication schemes. The communication schemes can be changed remotely via AMI.

Communication Schemes	
Daily values	With daily readings, the meter is read once a day at midnight.
Hourly values - updated every third hour	Every third hour, the meter transmits a data package containing the hourly values and historical info codes from the last three hours.
Hourly values - updated every hour	Every hour, the meter transmits a data package containing value and info codes from the past hour. NOTE: When a meter is set to this communication scheme, the battery warranty of the meter is voided.

No matter which communication scheme is used, info codes are transmitted instantly, so that they can be responded to quickly to reduce consequential damage.

Reading of logged data from AMI meters

With an AMI meter, no matter if the meter is operating in AMR or AMI mode, the logged data can be read from the street using the READy App. Meters with abnormal consumption patterns can be investigated immediately and without the need to wait for the consumer to make an appointment.

Logged Data	Logged Values
100 days	Hourly values for Volume and Reverse Flow Volume
460 days	- Daily Volume - Max & Min daily flows - Max, Min & Avg temperature



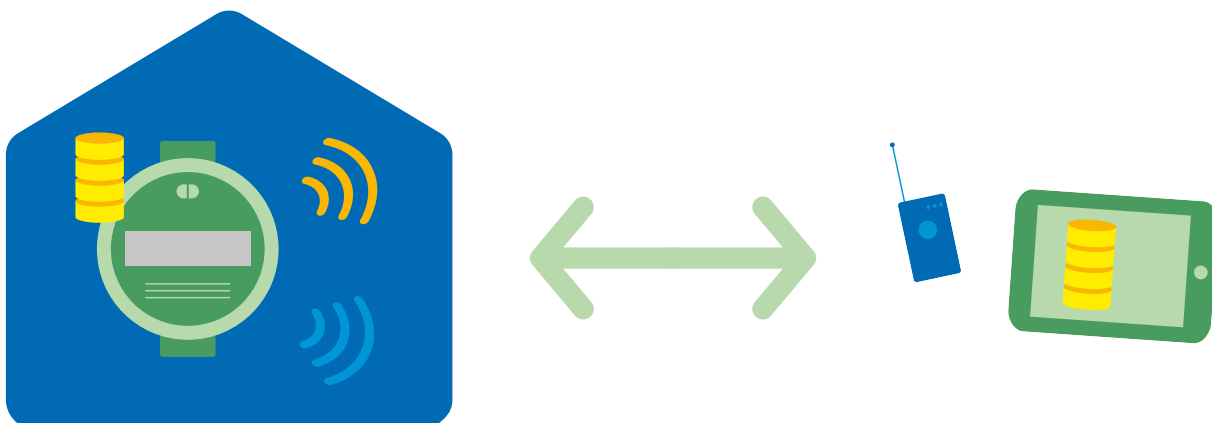
Remote configuring and firmware upgrade of AMI meters

AMI meters with built-in two-way communication can be configured from the street via the READy App or remotely via AMI. This means it is possible to update the meters with new settings from the street without waiting for the consumer to be home or facing logistical issues in accessing the meter.

Settings that can be changed from the street or remotely via AMI

Communication scheme	With daily readings, the meter are read once a day at midnight.
Transmitted register values	Every third hour, the meter transmit a data package containing the hourly values and historical info codes from the last three hours.
Limit adjustments	AMI meters can trigger events in case certain limits are exceeded. These limits can be adjusted.

Technology is always evolving. Firmware upgrades to Kamstrup meters protect your AMI investment by updating the “brains” of the meter with the latest firmware versions without making any hardware changes. Firmware upgrades can be made from the street via the READy App, without accessing the meter.



Intelligent operation ensures high performance

Kamstrup AMI is designed for high reading performance with a minimum number of network components. This is achieved by adding intelligent radio control functions to the network.

Function	Description	Advantage
Automatic power optimizing	When a large number of radio transmitting devices are placed within a small geographical area, the collective “radio-noise” will normally reduce the performance level and result in meters not being read from time to time. Kamstrup AMI continuously monitors the signal strength of which data packages from the meters are received in the collector. By lowering the transmission power of meters received with unnecessarily high signal strength (often meters close by), other meters that would normally not be read due to “radio-noise” can be read. All of this is automatically controlled by the AMI solution.	• Higher reading performance with less network components • Longer battery lifetime on meters close by Note: All meters are designed for operating at maximum transmission power, so lowering the power on nearby meters will potentially extend the life of the meter battery.
Automatic path optimization	In case of a network with more than one collector, the system automatically selects the most optimal collector to read each meter. In cases where a collector is out of operation, other collectors will automatically take over the reading of meters within its range.	• Higher reading performance with less network components
Acknowledgement & retransmission	When a meter transmits a data package with meter readings, it will receive an acknowledgement when the package is received in the collector. If the meter does not receive the acknowledgement it will automatically include the meter readings in the next data package sent. This will continue for up to 18 hours or until the meter receives an acknowledgement for a received data package. This means that a data package can contain up to 18 hourly values.	• Higher reading performance with less network components

AMI Fall-back options

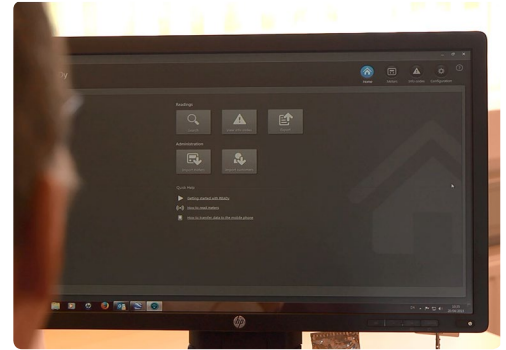
Kamstrup AMI is designed to be durable and provide a high reading performance. In cases of unforeseen or planned downtime of the AMI, meters can still be read from street using the READy App and a Bluetooth® converter. Data from AMI meters read via the App and converter become available in READy Manager when synchronizing the App. Data can then be utilized in exactly the same way as if it was read via AMI.

In cases where the AMI is unavailable for a longer period, i.e. if meters are installed in areas not yet covered by the AMI, the meters can be configured to work as an AMR meter. The meters can then be read via drive-by until the AMI is available in that area.

As a final layer of fall-back protection, the internal log stores the daily readings 460 days back in time and hourly values 100 days back in time. The log can be retrieved either from the street via the converter or from the meter via the optical eye.

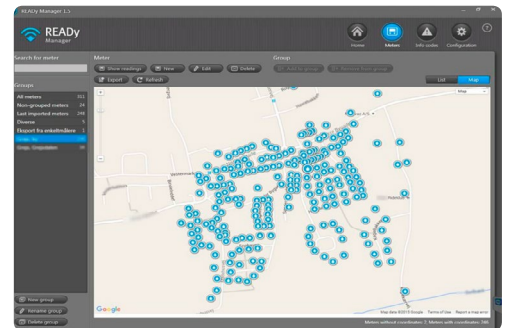
READY Manager

The handling of meters and meter data takes place in READY Manager. READY Manager opens with a start page and icon-based navigation, making the interface intuitive and easy to use. Basic how-to help can be found by clicking the help icon on the start page.

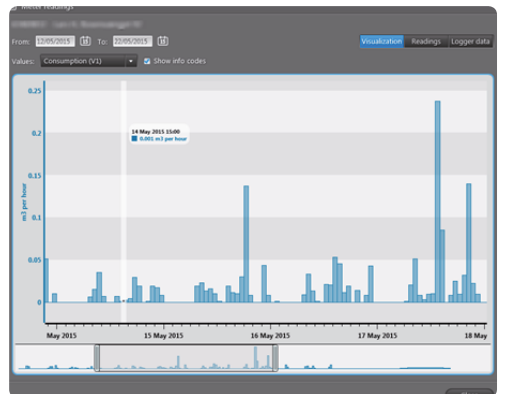


READY Manager – Visualization of meters

The location of each meter is shown directly on a map in READY Manager to ensure the best overview of the installed meters. By clicking a meter on the map, further information about that meter is shown. The map is based on Google Earth, and therefore, it is possible to use the street view function to see physical features and other details about the installation sites.



READY Manager uses bar charts to visualize historical consumption for individual meters. This provides straightforward data from which your water system can make informed decisions about maintenance. In the same chart, info codes are also shown, making it easy to see possible correlations between consumption and info codes. READY Manager also makes it possible to compare multiple meters in the same graphical chart. The comparison includes data from either pressure sensors, district meters or consumption meters. By comparing pressure and flow in one section, it is possible to discover dimensioning errors and/or assess the need for pressure boosters or pressure reducing valves in parts of the network.



READY Manager - Export of data

To simplify the integration with third-party billing systems, READY Manager makes it possible to export data in flexible export formats. It is possible to generate most formats by selecting the data to export, the order and the separator.

Data can be either exported ad hoc or by creating an automatic job, which exports data to a user-defined FTP/FTPS server in selected intervals. Alternatively, you can set up READY Manager to automatically send out the read data via email in certain intervals.

The handling of meters and meter data takes place in READY Manager. READY Manager opens with a start page and icon-based navigation, making the interface intuitive and easy to use. Basic how-to help can be found by clicking the help icon on the start page.



READY Manager – Info codes and notifications

All meters with alarms and other meter notifications (info codes) are shown in the overview menu “Info codes”. Here, alarms can be sorted quickly so the newest and most important info codes can easily be found.

Available Info codes	Description	AMR meters	AMI meters
Leak	By monitoring the consumption pattern, the meter is able to identify leaks in the installation. With information about leaks, the utility can warn the consumer before the water bill escalates. Consequential damage from leaking pipes can be reduced when the leak is discovered early.	X Trigger level is configurable via the IR interface on the meter	X Trigger level is configurable from the AMI network or from the street via app and converter.
Burst	If the consumption in a predefined interval exceeds a certain limit, this is registered as a burst. Quickly being aware of bursts can dramatically decrease water loss and the cost of consequential damage.	X Trigger level is configurable via the IR interface on the meter	X Trigger level is configurable from the AMI network or from the street via app and converter.
Tamper	If forced access to the meter is detected, this is registered as tamper. When tamper is registered, the meter will continue to operate and measure, but an indication in the display and the data package will indicate that tampering has been attempted.	X	X
Dry	If the meter is not filled with water, it will trigger the info code “dry”. Meters can be dry either because the supply is interrupted, or because the meter has been taken out of the installation i.e. with the purpose of stealing water.	X	X
Reverse	If the water is flowing in the wrong direction in the meter, it is either because the meter is installed in the wrong direction, or because the water is flowing back into the distribution network. In either case it is valuable information for the utility in order to secure revenue or avoid contamination.	X	X

Available Info codes	Description	AMR meters	AMI meters
Low Batt	Some meters might live significantly longer on the battery than specified. Knowing which meters are close to the end of their lifetime makes it possible to improve asset management and lower the lifecycle cost of the meters.		X
Ambient temperature limits	Knowing the ambient temperature of the meter is especially important in areas with temperatures below freezing. The info code "Ambient temperature Low" can warn you of meters that are at risk of frost bursting thus avoiding water loss and consequential damage. The info code "Ambient temperature high" can warn you of risk of bacteria growth and gives you the opportunity to flush water in the system to lower the temperature.		X Trigger level is configurable directly from the AMI network or from the street via app and converter
V1 above Qmax	If a meter is operating outside its flow range, this will result in an info code, giving the utility the chance to change the meter to a suitable size. Right-sizing meters is crucial for reducing non-revenue water and managing pressure.		X

With the notification feature in READy Manager, the system can automatically forward selected info codes via text message and/or email to a user-defined number of recipients. It is possible to determine which meters and which kind of info codes should trigger a text message/email.

Automatic notification of active info codes

Configuration of automatic emails/SMS regarding active info codes to be sent at specific intervals

New Edit Delete									
Recipient	Active	Subject	Group	Frequency	Immediately	Last sent	Status		
+45 51449281	True	READy Testutility-Notification	Group 5	Daily (12:20)	True	7/29/2016 11:49 AM +02:00	Failed	The connection to the SMS service failed.	
+45 51449281	True		All meters	Daily (12:20)	True		Failed	ServiceUnavailable	
+45 60185500	True		All meters	Daily (12:00)	False	8/3/2016 3:00 PM +02:00	Success	The SMS was delivered.	

AMR and AMI – Solution description

READy Manager - Advanced search functions

Being able to easily navigate data collected from AMI is key to harvesting the value of the system. READy Manager has intelligent search functions, where you can combine different categories of meters with freely definable search words.

Examples include:

- Choosing to only search among meters that have a certain consumption within a specified period
- Finding all meters with final reads within a specific time period
- Finding all meters where the registers have wrapped the last day

READy Manager – Final read function

With Kamstrup AMI, a final read for consumers moving out can be completed without visiting the meter. The AMI system marks the reading as final for that consumer, indicating the time of vacancy, and is used for final billing. It is possible to search for final reads with the advanced search functions and export all final reads with the export functionality.

READy Manager - Reading performance reporting and visualization

For AMI networks, the demand for high performance is more and more evident. Having the right tool to validate and document the data collection success is important for your operations, as well as other stakeholders, such as city officials. With the performance reading reporting and visualization module, you have access to an overview of the network performance of meters selected. Based on pre-defined performance indicators, you can verify the quality of your network's performance.

Meters available in READy Manager are listed for an easy overview. Each meter is shown within a user-defined area, with its percentage of data messages received. It is possible to create a report that shows the reading performance of a group of meters according to user-defined parameters.

The screenshot shows the 'Performance overview' section of the READy Manager interface. On the left is a sidebar with navigation links: 'Info codes', 'Performance reporting', 'Performance overview' (highlighted), 'Notifications', and 'Meter exchange'. The main area has a header with filters: 'Meter group' (set to 'All meters'), 'Performance criteria' (set to 'Daily readings'), 'Start date' (8/3/2016), and 'End date' (8/3/2016). There is an 'Update' button. Below the filters, it states: 'Average performance for the selected group: 0.00 %', 'Meters in group: 14891', and 'Meters with missing readings: 14891'. A table displays data for four meters, showing their serial numbers, last missing reading dates, and average performance percentages.

Address	Postal code	City	Serial number	Last missing reading in period	Average performance
			6791223	8/3/2016	0.00 %
			69744164	8/3/2016	0.00 %
			69744165	8/3/2016	0.00 %
			69744166	8/3/2016	0.00 %

Data security and hosting

Kamstrup AMI is end-to-end encrypted using multiple data security levels. This ensures your consumers' data is protected. Data communication from each meter is individually encrypted using AES 128-bit encryption. This means consumption data from the meter can only be decrypted by the associated READY Manager and by the mobile units authorized by READY Manager.

Before meters are installed, encryption keys are automatically loaded into READY Manager via direct connection to My Kamstrup portal. Therefore, new meters are automatically available in READY Manager shortly after purchasing them; this automated process eliminates the potential for human error when importing new meters into READY Manager. Furthermore, meter and reading data are stored safely via Kamstrup's secured hosting solution.

Kamstrup is certified to ISO 27001:2013, Information Security Management Systems, which is among the most stringent security certifications.



Think forward

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