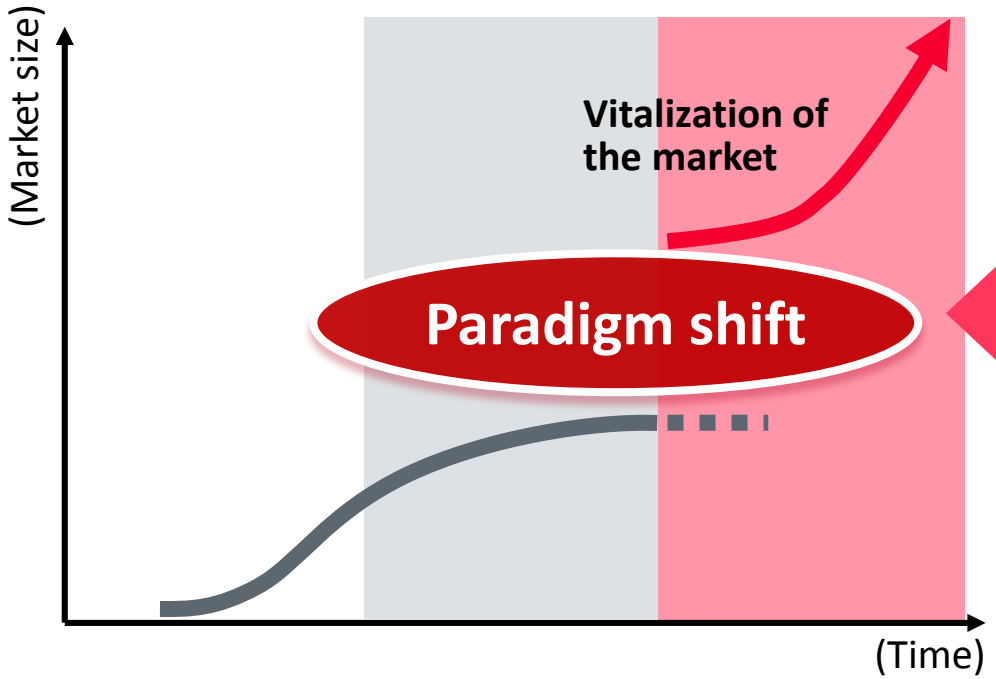
Information Meeting 2018

Murata and Market Environment

The marriage of new technologies and applications keeps the market expanding!



<New technologies>

5G, IoT

AI, AR, VR

<New applications>

xEV, Connected cars

ADAS/Automatic driving

Smart devices, Telemedicine

Smart factory

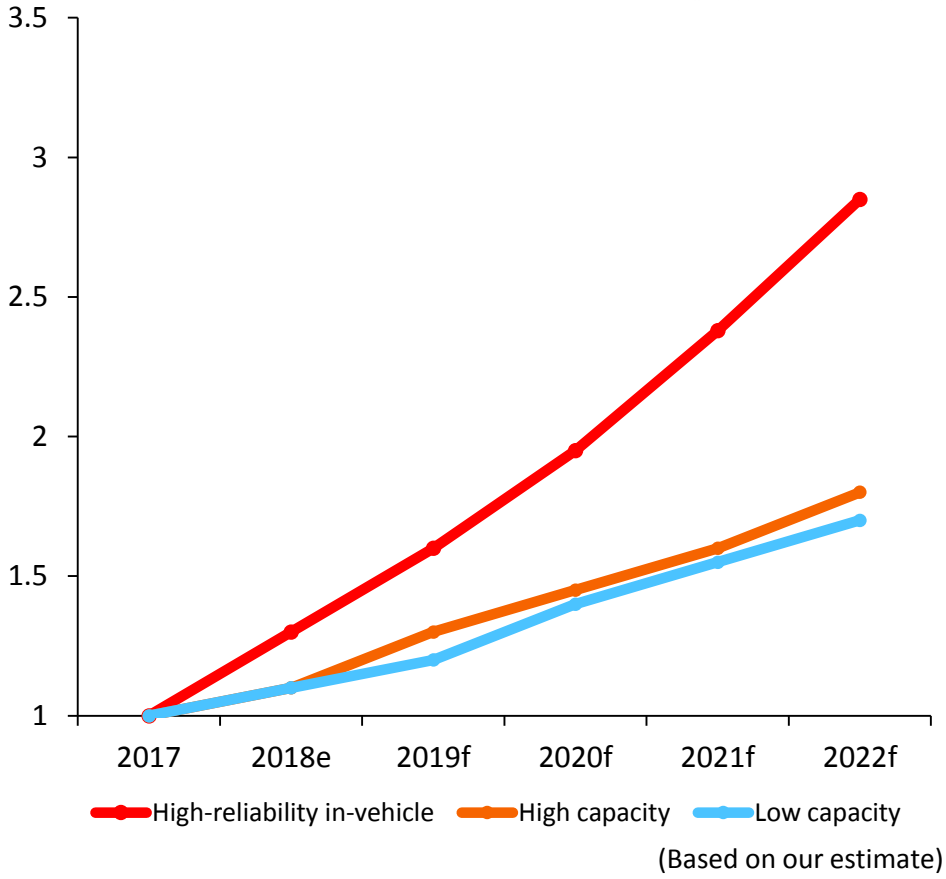
The advent of new markets and players creates need for electronic components.

↓

Business opportunities expand for Murata, which has a wide variety of product lineup and a broad customer base!

Medium to Long-term Prospects of In-vehicle MLCCs

MLCC demand forecast (quantity based)



(Based on our estimate)

Technologies required of high-reliability in-vehicle products

High temperature guarantee
(Up to 125°C)

Measures against risk of short circuit
(Use of resin electrodes)

<<Environment specific to vehicles>>
High temperature environment
Use of high-power electronic circuits

Long-term reliability
(Compliance with domestic and foreign standards)

High voltage support
(Supports 100 V)

Need arises for smaller ECUs in order to provide more in-vehicle space
--> Accelerates need for smaller MLCCs with larger capacitance

High-reliability in-vehicle MLCCs are increasingly demanded among MLCCs.
--> MLCC manufacturers will be selected that can guarantee the technologies and supply capabilities required for automotive applications.

Direction of Future Development of In-vehicle MLCCs

Quantities of MLCC used

(pcs)

	Conventional	Low-end	Mid-class	High-end	Ultra High-end
	Pure ICE	ISS	Micro HEV	Mild, Strong HEV, PHEV	EV
PowerTrain	450～600	600～800	800～1,000	1,900～2,300	2,700～3,100
ADAS	2,000~2,400				
Safety※	450～700				
Comfort	500~800				
Infortainment	400~700				
Others	1,000				

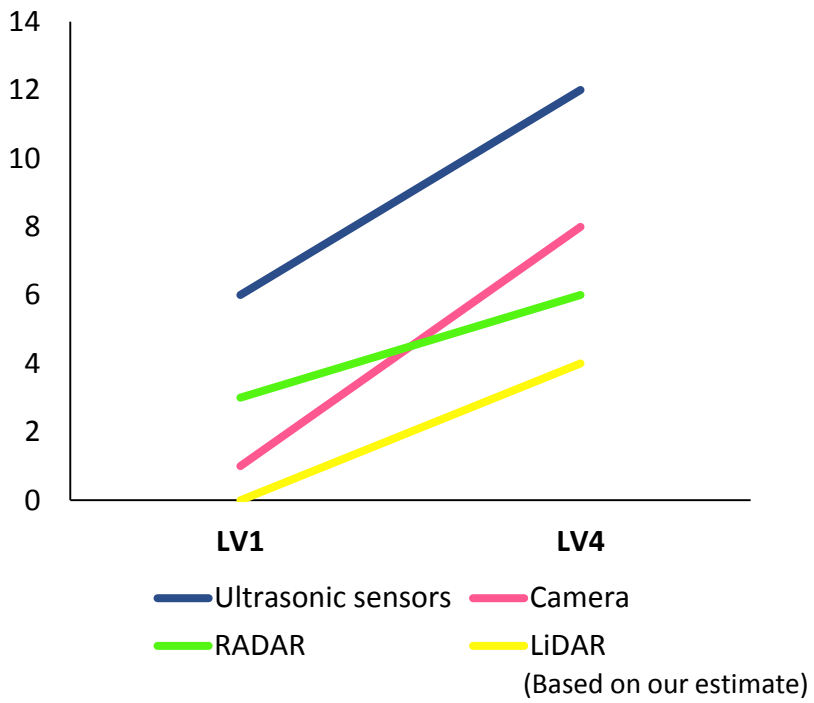
※Safety=AIRBAG,ABS,TPMS etc

(Based on our estimate) *as of FY2018

The progress in electrification will result in a rapid increase in the number of MLCCs to 3,000-8,000 per vehicle!

MLCC at autonomous driving level

ADAS / Autonomous driving,
Average numbers of hardware at different levels

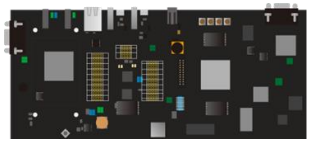


(Based on our estimate)

Image processing to allow for autonomous driving

Fast processing of data from various sensors results in higher power consumption.

--> Greater MLCC capacity and a larger number of MLCCs used per vehicle.



MLCC demand forecast by level

(pcs/set)

Lv.1	Lv.2	Lv.3	Lv.4
2,000	3,000	4,000	Over 4,000

In-vehicle Capacitor Lineup

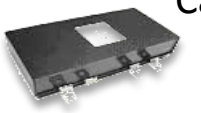
xEV Technology Trend

Ceramic Capacitor Module
(For DC-LINK Snubber)

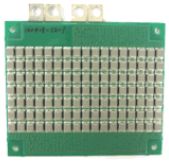
Safety Capacitor
(For OBC Y-Capacitor)

Silicon Capacitor
(For Snubber)

Metal Terminal Capacitor



High Temperature Film Capacitor(Module)
(For DC-LINK)



Ceramic Capacitor Module
(For Resonance Capacitor)

High Temperature Film Capacitor(Single)
(For Smoothing)

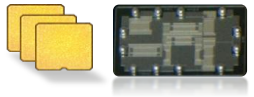
EV/PHV
Electric Vehicle, Plug-in Hybrid Electric Vehicle

HEV
Hybrid Electric Vehicle (inc. 48V)

WPT
Wireless Power Transfer

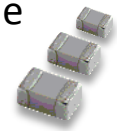
Auto Drive Technology Trend

Silicon Capacitor & IPD
(For Photo Diode & Laser Diode)



Information Gathering
Sensor, Camera, Radar, LiDAR, V2X, etc..

Automotive Grade High Q MLCC
(For V2X)

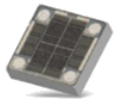


Automotive Grade MLCC

Data Analysis
Application Processor, A/I, etc..

Automotive Grade Low ESL MLCC
(For Application Processor)

Silicon Capacitor
(For Application Processor)



Strengthening MLCC Production System

MLCC production bases

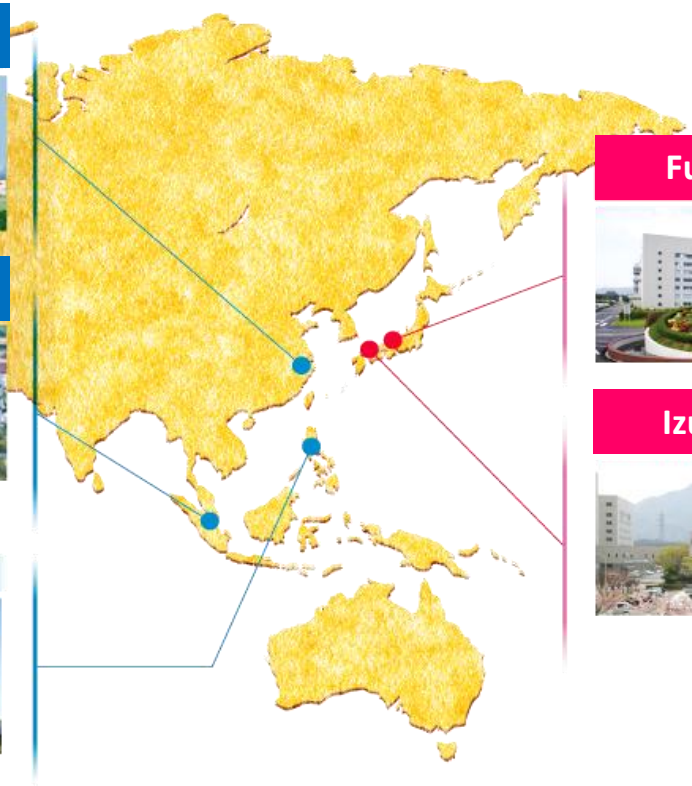
A new production building will be completed in December 2019

China Wuxi

Singapore

A production building was constructed in FY 2017

Philippines



Fukui Murata

A new production building will be completed in December 2019

Izumo Murata

A new production building will be completed in November 2019

To meet vigorous demand, we will strive to increase production capacity, mainly for small MLCCs with high capacitance as well as high-reliability ones!

Examples of Development of In-vehicle Products

High Temperature Film capacitor for smooth application (under development)
Self-recovery function, 125°C guaranteed

xEV (electrification)

Reliable MLCCs(greater heat resistance)
Film capacitors

Bi-Directional DC-DC Converter (under development)
High power, Low profile, Light weight

・Reliable MLCCs (higher voltage applied, and higher large-current capability)

・EMI Suppression Filters
・Power inductors (higher large-current capability)

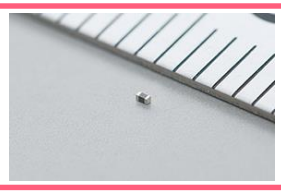
・Timing devices

Ultrasonic sensor (under development)
Improved short distance detection performance (10 cm or less)

Connected Car

Advanced safety system

0603 size GHz band-compatible noise filter for vehicles



WiFi Modules
V2X Modules

MEMS sensors
Ultrasonic sensors

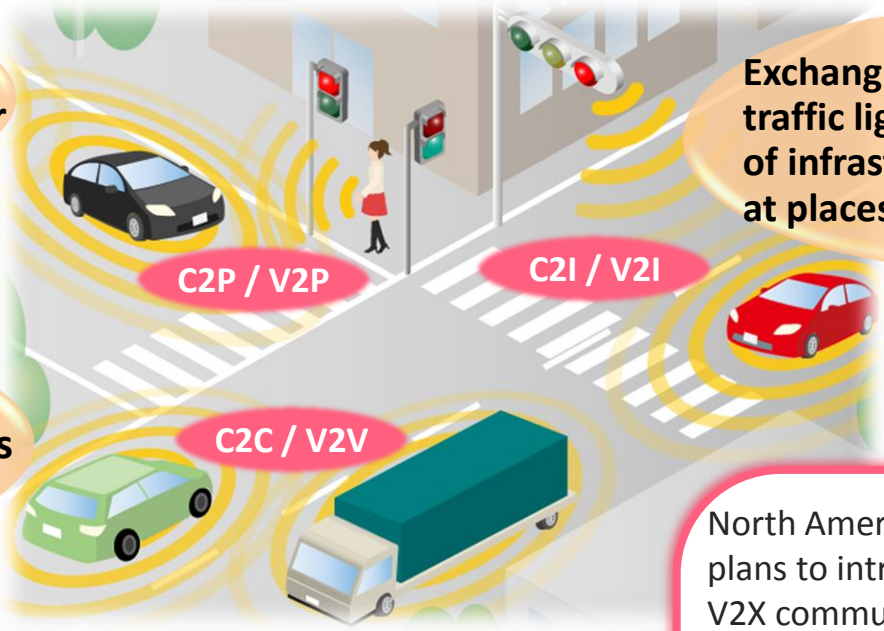
6DoF-compatible MEMS sensor (under development)
All-in-one packaged,
Conforming to AEC-Q100

Not only in-vehicle MLCCs but also other various products are under development based on in-vehicle trends!

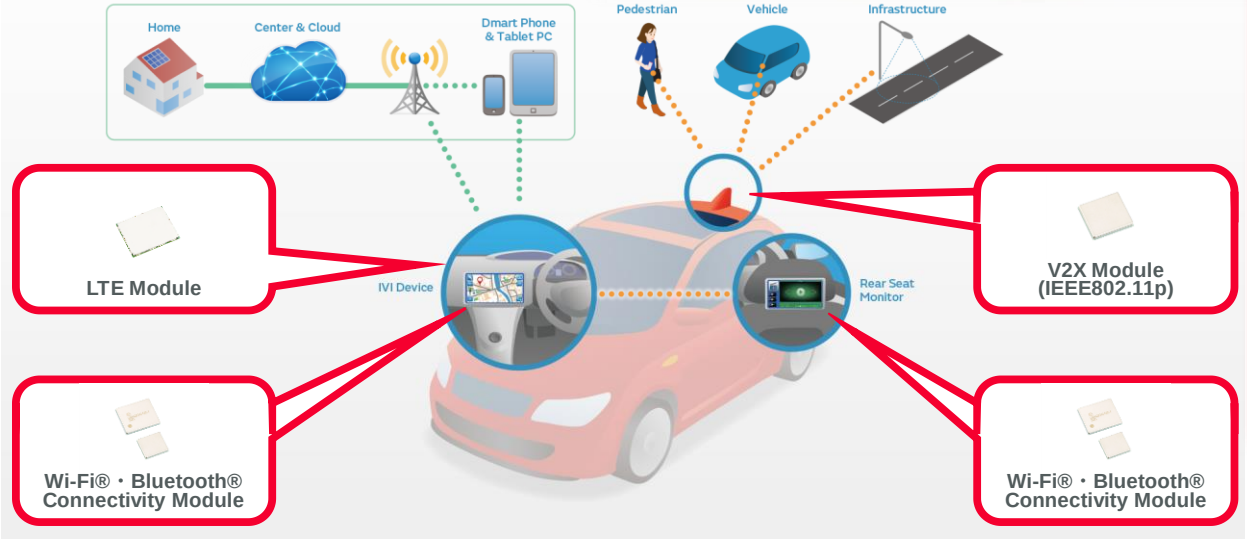
Connected Car (C2X/V2X)

Exchanging information with pedestrians to alert the driver

Vehicles mutually exchange information on their locations and speeds to avoid collision



Exchanging information with traffic lights and other elements of infrastructure to ensure safety at places with poor visibility



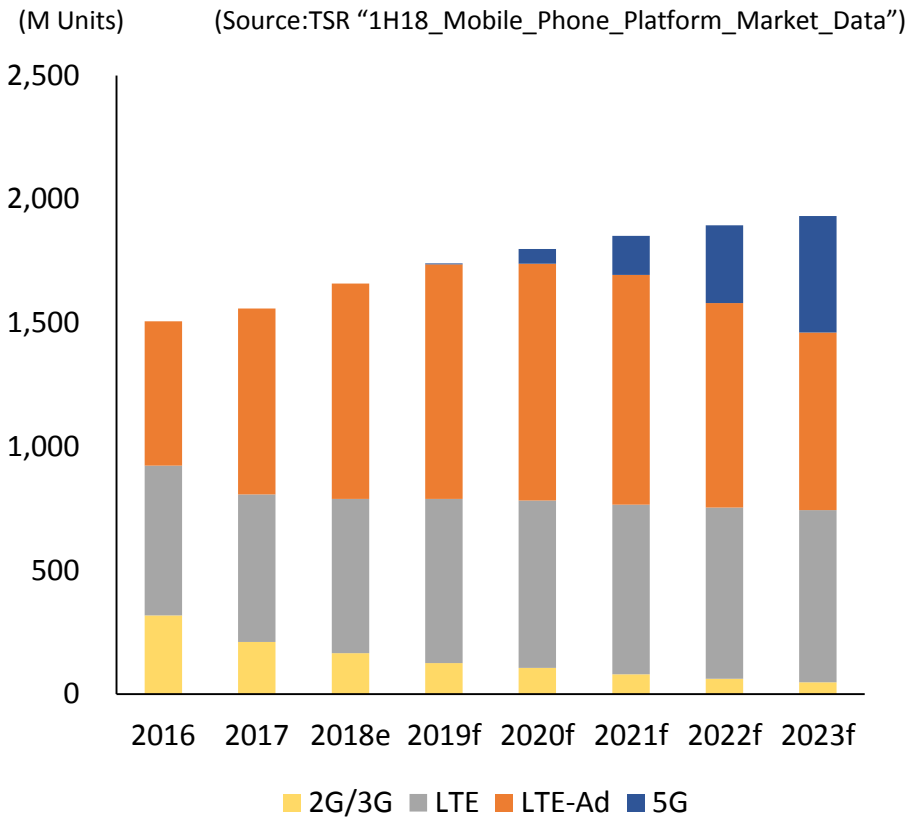
North America and Europe have plans to introduce the IEEE 802.11p V2X communication method starting in 2021.

--> V2X wireless communication modules and software are now being developed at Murata.

- Stable characteristics at high temperatures
- Competitive software support services allow us to get involved in the early phase of customers' design/development process.

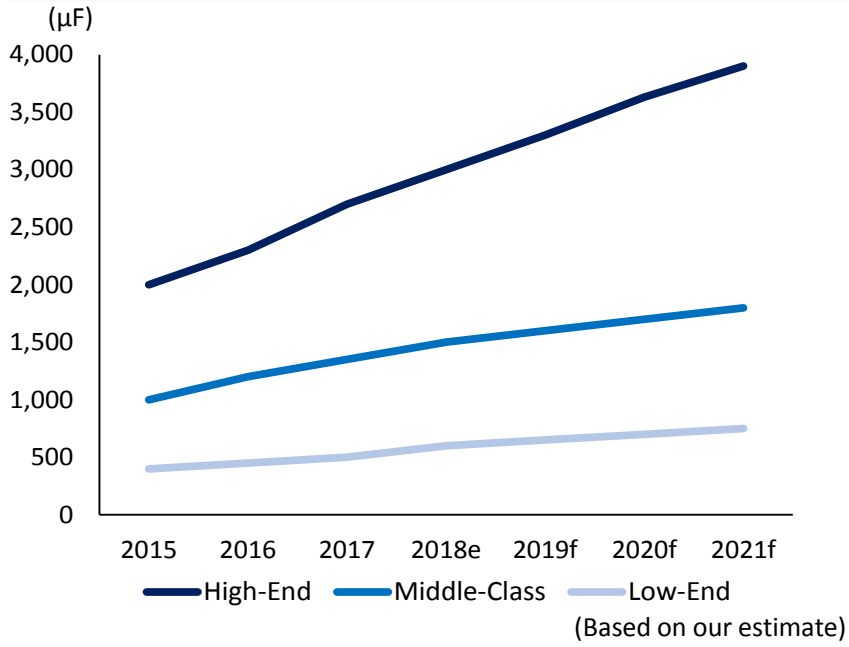
Growth of the smartphone market

Outlook for smartphone unit sales growth



Although the growth in the total number is slowing down, the proportions of LTE-Advanced and 5G-compatible terminals are increasing.

MLCC capacitance history



Trend in MLCCs for smartphones

- **Improved IC performance**
- **Use of more sensors per phone**
- **Use of multi-cameras**
- **Use of larger batteries**

Power consumption is still increasing, maintaining demand for smaller MLCCs with larger capacitance.

Availability for high temperature and high voltage applications as well as low profile design are increasingly demanded toward 5G!

RF Module Solution

Evolution of modules for different models

	LTE/LTE-Advanced					5G	
	Tx-MOD	FEMiD+ MMMBPA	PAMiD	Sub-Module	4×4 MIMO	Sub-6GHz	mmWV
High End			■	■	■	☆	?
Middle Class		■	■	☆		☆	
Low End	■						

■ : Installed ☆ : New function

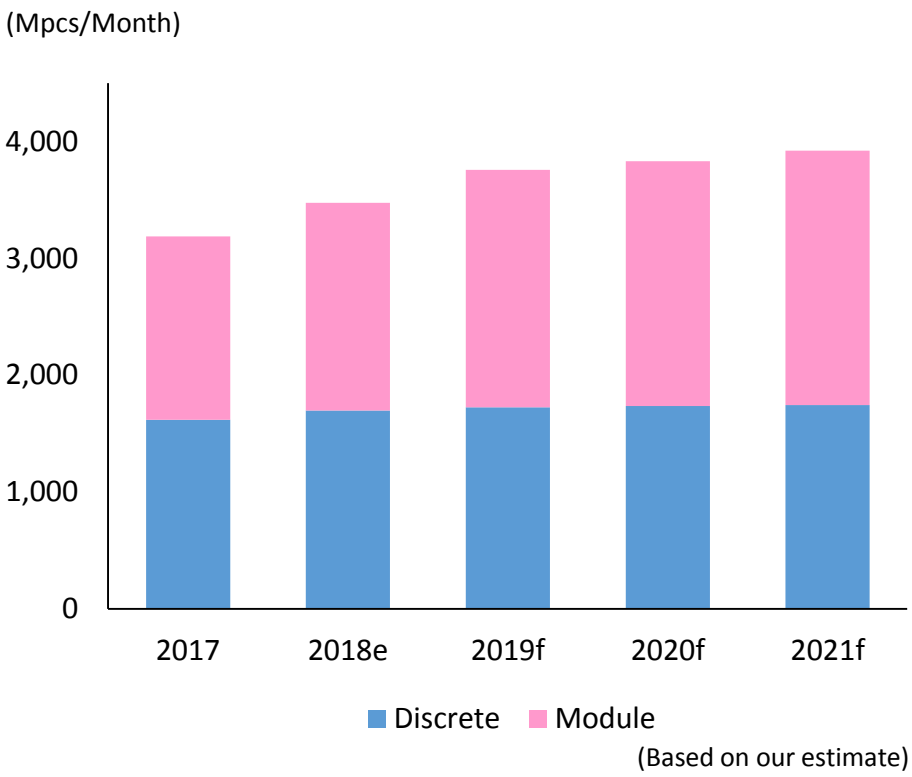
<< RF module trends>>

- **Demand is expanding for receiving modules which bring high areal benefit**
- **Smaller and lower-profile modules are used for effective use of space on boards**

The filter, which is one of key parts, becomes more important!
In-house production of small components brings more benefits than before!

Strategies for SAW Filters

Projected demand for filters



(Based on our estimate)

SAW filter business strategy

- **Response to the increasing demand for filters including those for modules**
- **Use of high-frequency, composite, small filters toward 5G**

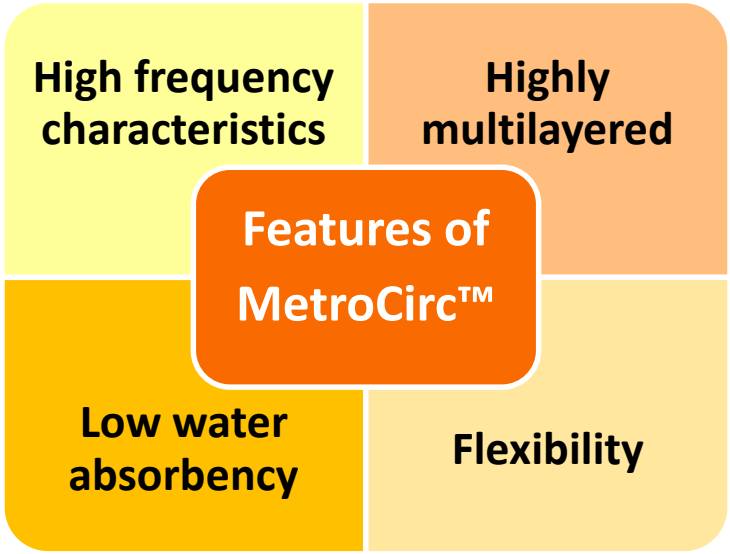
Efforts to improve productivity	· Improve productivity and yield by rationalizing facilities
Promotion of downsizing	· Expand the advantage over competitors by downsizing
Collaboration with module business	· Realize superior characteristics · Expand the market share of filters for modules

The total demand for filters is expected to increase mainly for those for modules.

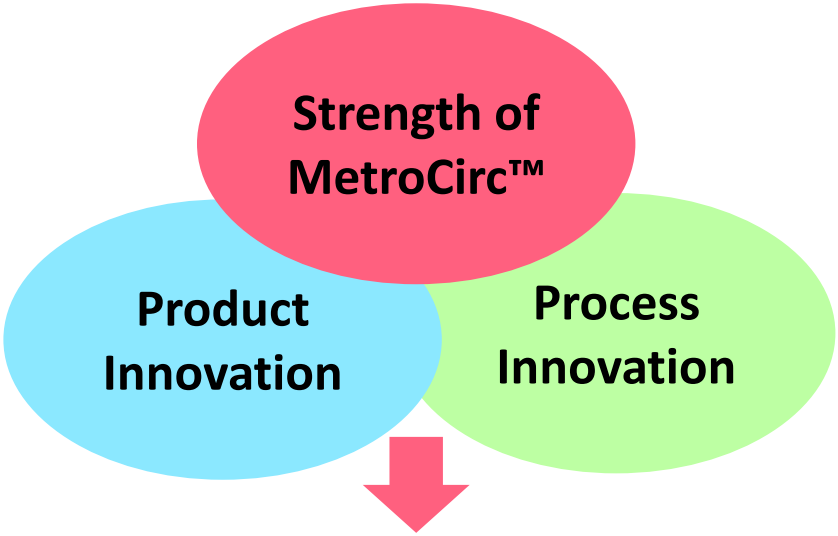
We will expand the conventional SAW/I.H.P. SAW product lineup to expand the filter business.

Future Development of MetroCirc™

Features of MetroCirc™

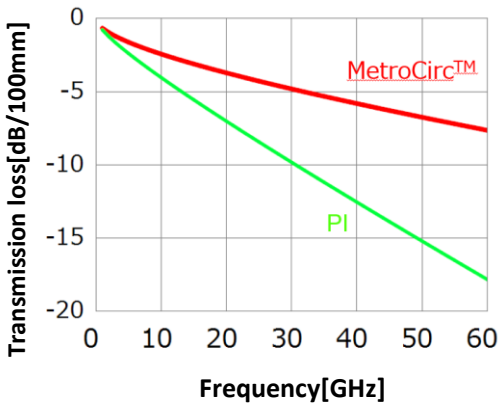


Strategy for MetroCirc™



Creation and realization of customer value

High frequency characteristics of MetroCirc™

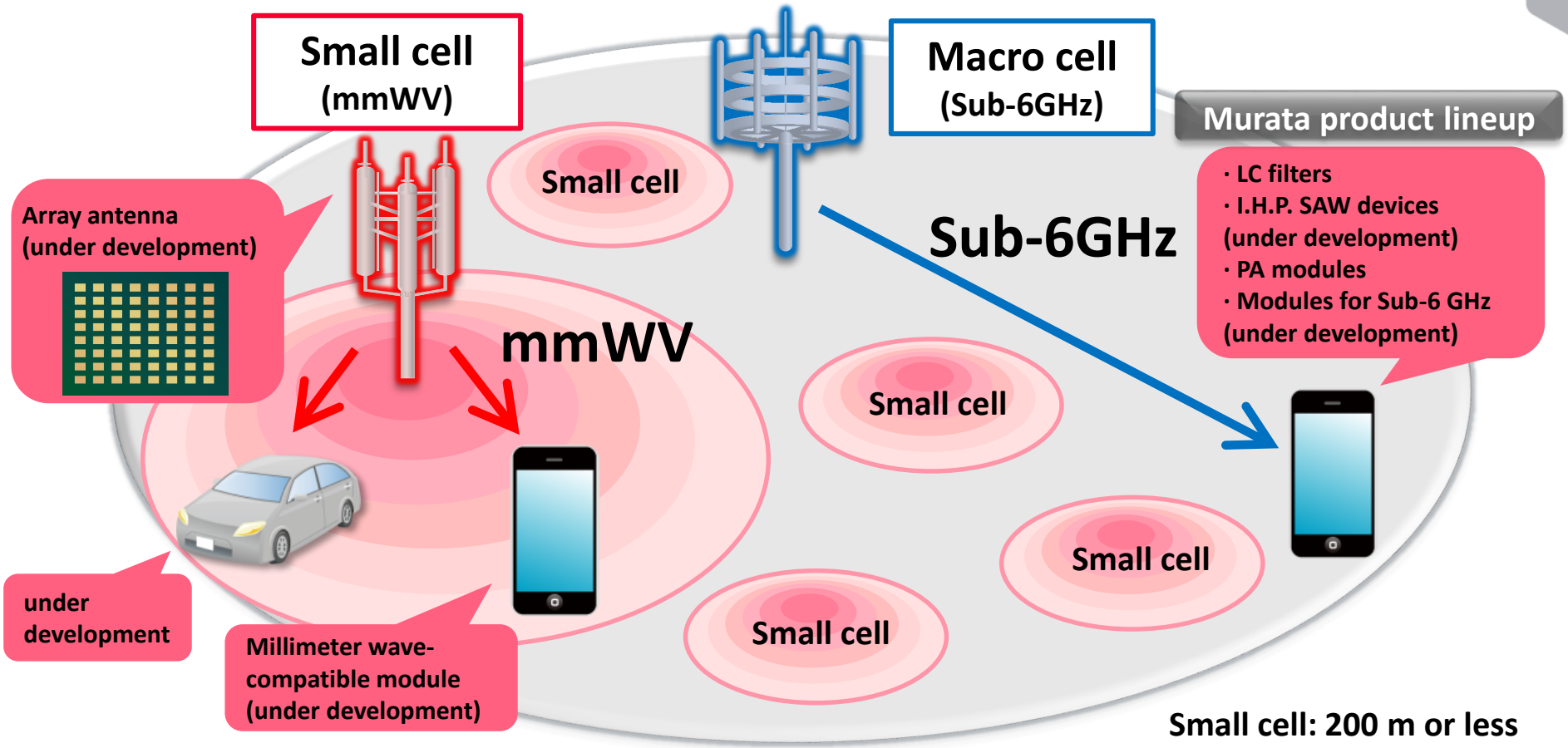


Having superior characteristics in the millimeter wave band, MetroCirc™ can differentiate itself from other products.

- ✓ We will further improve technologies, including improvement of high frequency characteristics and realization of various 3D structures.
- ✓ We will promote innovation of our production system and realize quick customer response.

--> Create and realize customer value, aiming for continuous growth and expanded profitability!

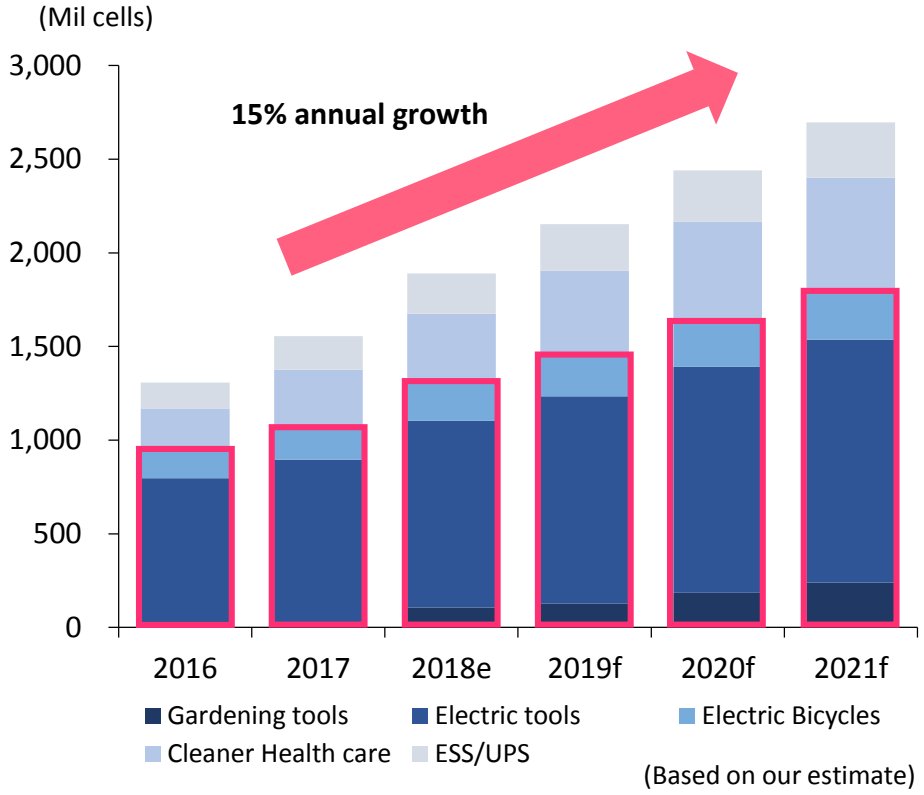
Work on 5G Technology



- ✓ The lineup for Sub-6 GHz is being expanded.
- ✓ The frequency used for 5G (mmWV) has a strong directivity, and therefore Small cell base station will increase.
  --> We will accelerate development aiming for dissemination after 2020.

Priority Initiatives in Battery Business

Future prospects for cylindrical batteries



- **Focus on growing markets (gardening tools / electric tools)**
- **Gain competitive advantage with reliability and high power**
- **Enhance capacity systematically**

Improvement of mobile laminate

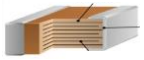
Production process review

- Process improvement
- Facility rationalization
- Productivity improvement

Response to new technologies and markets

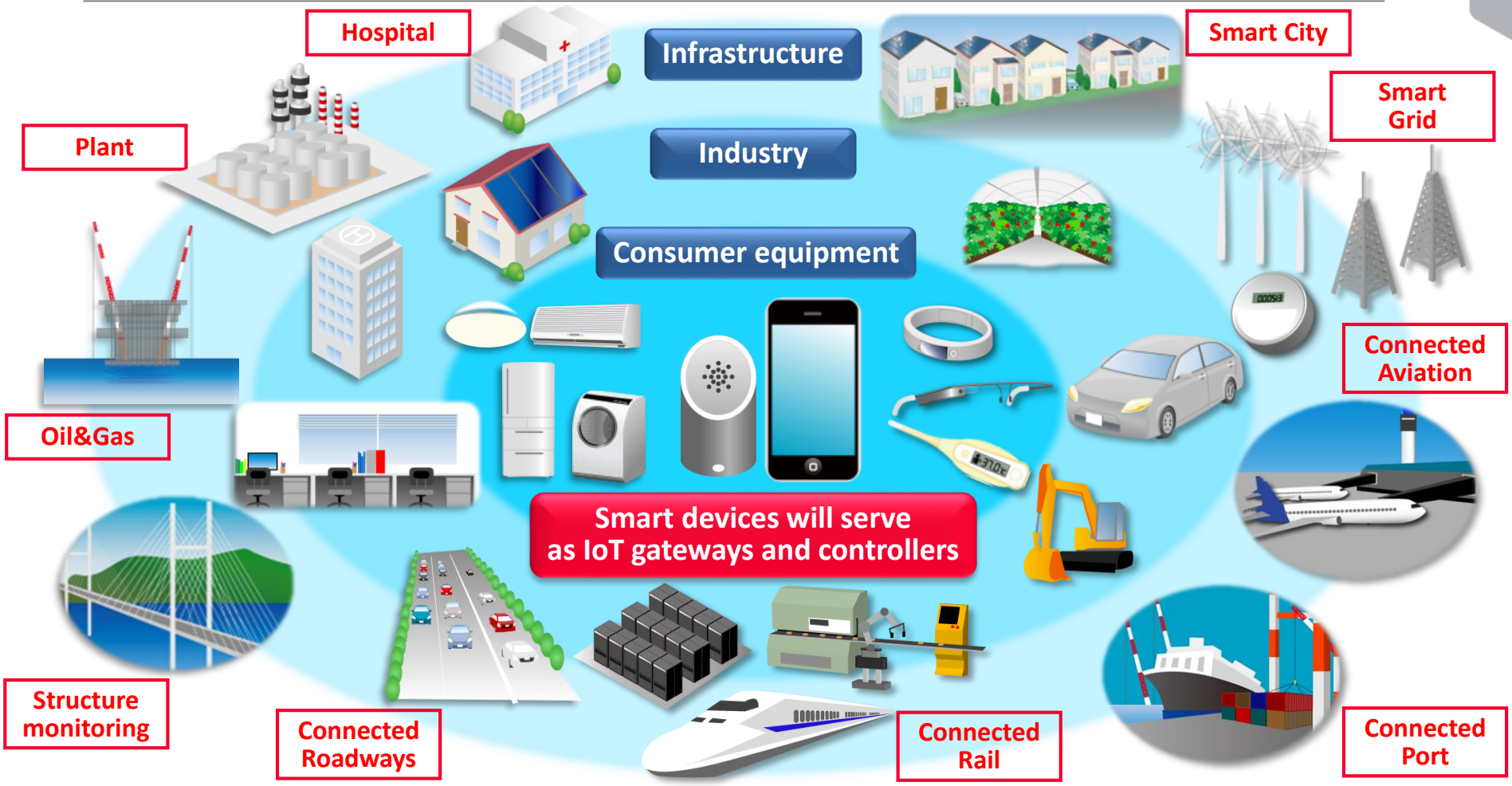
- Strengthening chemical technology
- Development of laminating technology
- 5G compatibility
- Wearable/Hearable

Efforts on all-solid-state batteries

Structure/ appearance	Feature	Pros	Cons
Solid eletrolyte  External terminal Electrode	·Uses an incombustible solid material	·Non-ignitable and incombustible ·Simply structured --> Contains not too many components	·Difficult to upsize ·Makes it difficult to generate high currents

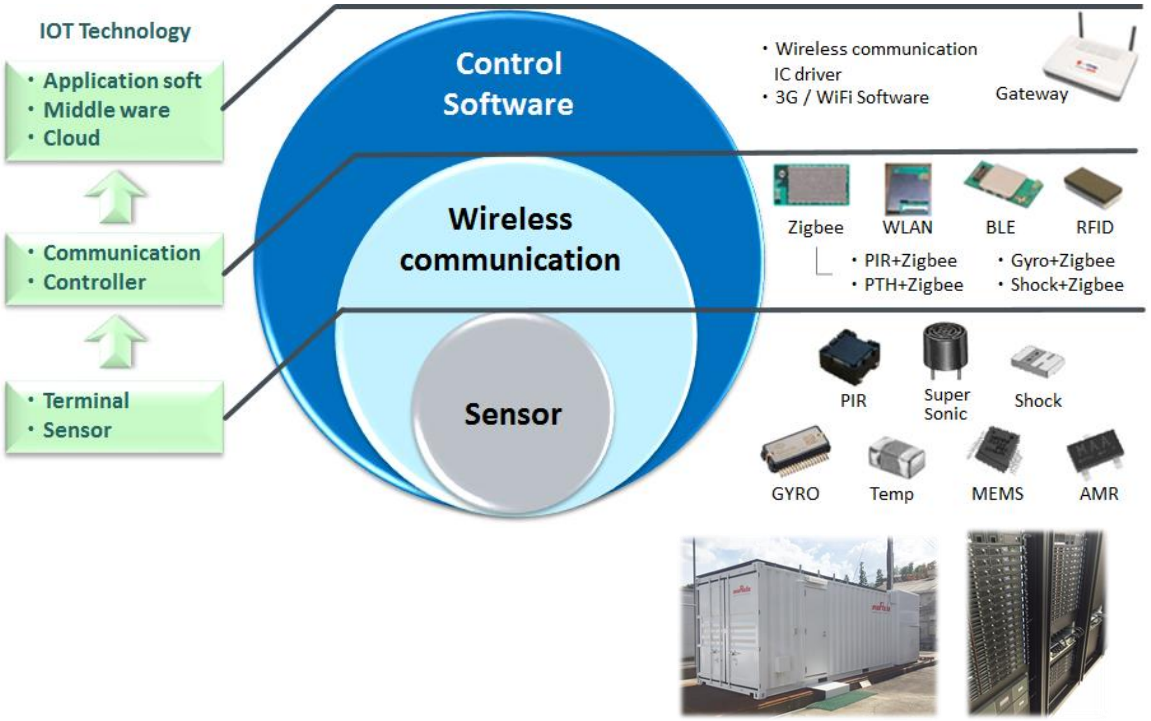
- **Affinity to MLCCs in terms of structure and production process**
- **Commercialization for wearable applications in FY 2019**

The Connected World



All things are digitalized and mutually connected via the Internet:
From “a closed world” to “a connected world”

Spread of IoT Business



Business opportunities for Murata

Development of communication networks	Securing energy
• LPWA • NB-IoT, Cat.M1 • Base stations	• HVDC for data centers • Backup power supplies
Offering solutions	**Intelligent home appliances**
• Sensors • Gateways • Collaboration with third parties	• AI speakers • Passive components

Wireless communication: Ensuring a connection with a target without crosstalk in a network comprised of multiple devices.
Sensors: Murata is a comprehensive component manufacturer with strong components.
Software: Software technology developed in the markets for mobile phones and Wi-Fi.

Murata will provide total solutions combining sensors, wireless technology and software to help build infrastructure for the "Internet of Things"

Various Initiatives on IoT Technology

<Case 1> Sensor Data Platform “NAONA”

Visualize and provide spatial information, such as the atmosphere of a place and the intimacy among people.

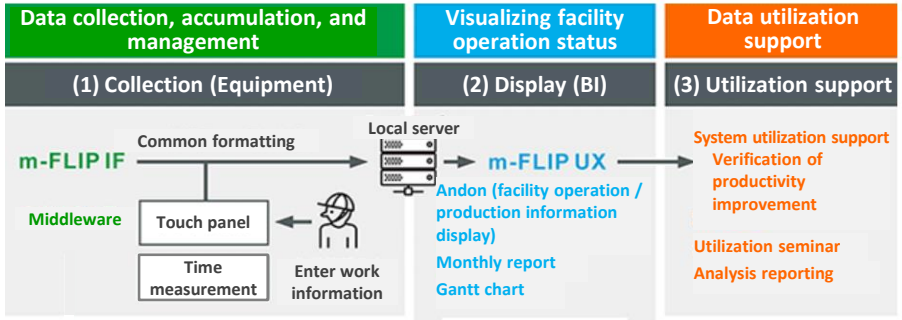
Demonstration experiment

· “Visualization of meeting quality”
--> Analyze and visualize the quality of conversation and communication in meetings based on voice characteristics and volume.

· Support nursery school teachers at nursery schools
--> Demonstration experiments are being carried out to grasp remotely the situation of a room with children.

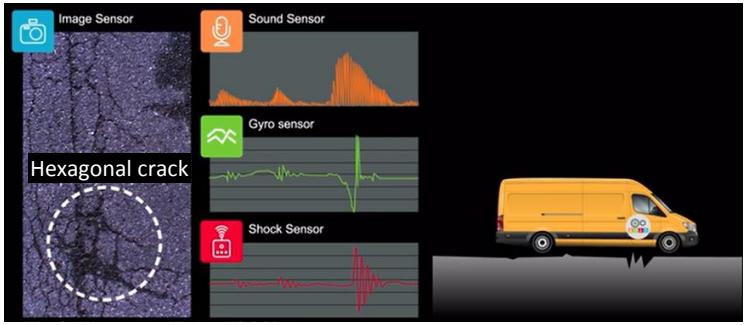
<Case 2> Operation rate improvement solution (m-FLIP™)

Provides solutions that maximize the operation rate of manufacturing equipment by utilizing IoT technology and our know-how in improvement activity.



<Case 3> Road surface detection system

Provides solutions that utilize for road conservation information obtained from vehicles with sensors.
A demonstration experiment is in progress in Kyoto.



We will provide the “information” obtained as a service to help customers solve problems.

Healthcare & Medical

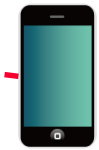
A chest sensor collects vital sign information

Bedside Monitor

Solutions

Central Station Monitor

WiFi / Cellular



App

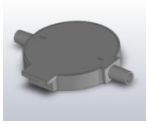
Data compaction using a special algorithm enables the collection and analysis of vital sign data with low power consumption.

Services have been provided in India since 2017.
Under trial at a medical institution in the US.

We aim for business expansion leveraging synergy effects of Murata's technical capabilities and M&A companies' solution technologies.

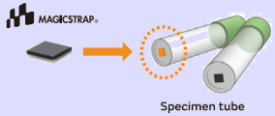
Capacitors for Medical Devices

Components



Microblower

Metal mesh Devices



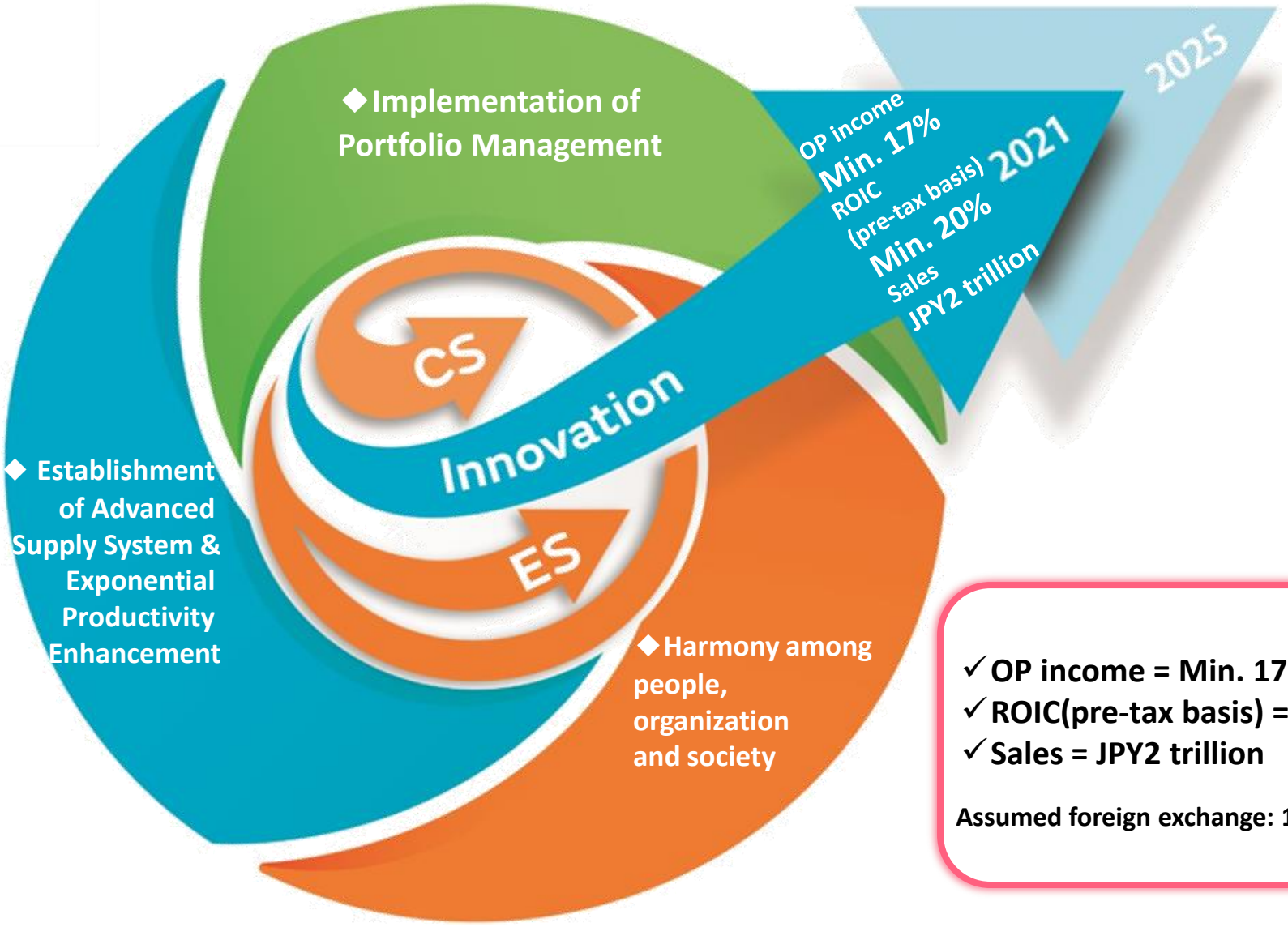
RFID

Electronic moxibustion

Medical equipment

Auto Control Cuff Pressure

Mid-term Direction 2021

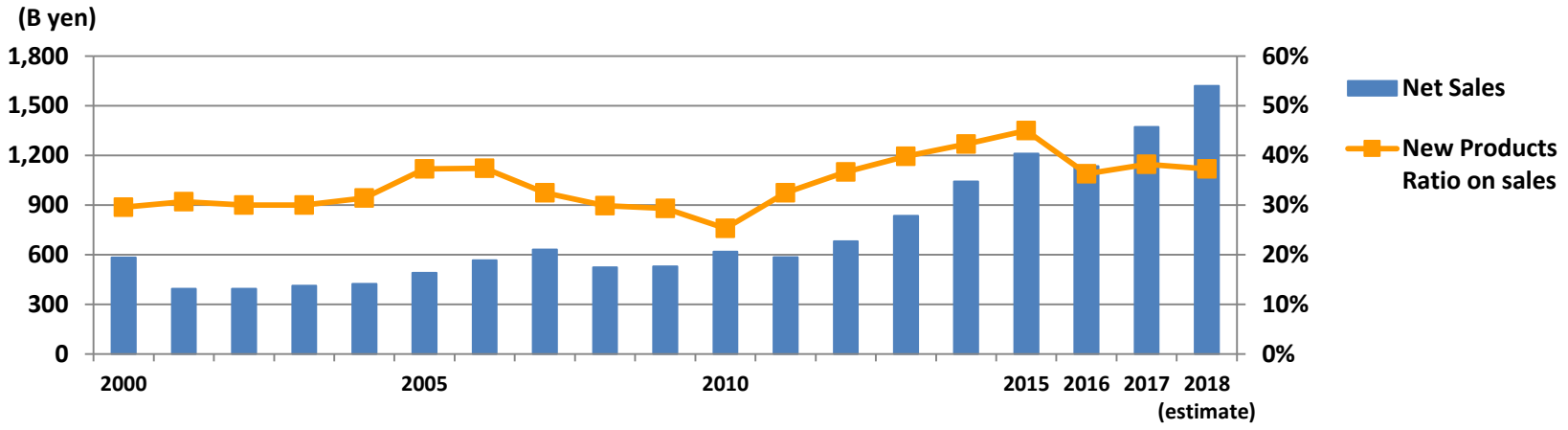


✓OP income = Min. 17%
✓ROIC(pre-tax basis) = Min. 20%
✓Sales = JPY2 trillion

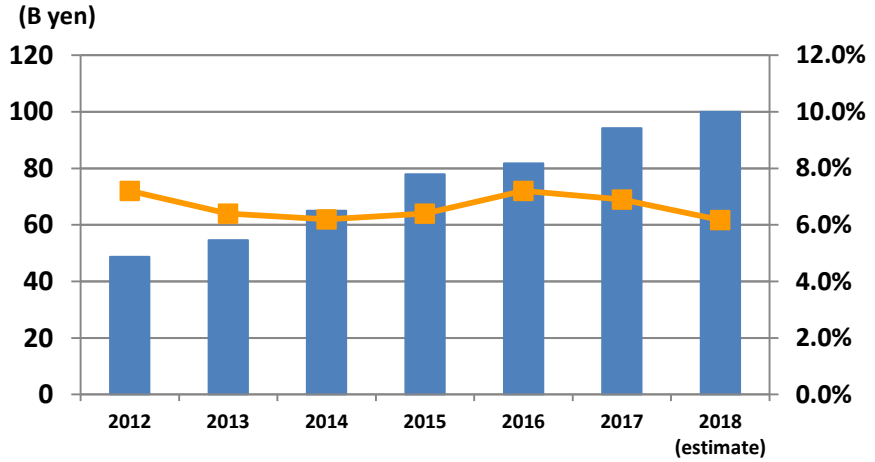
Assumed foreign exchange: 110 YEN / USD

Net Sales and New Products Ratio on sales/ R&D expense and R&D ratio on sales

Net Sales and New Products Ratio on sales



R&D expense and R&D Ratio on sales



Fiscal year 2017
- R&D expense : 94.2 billion yen
- R&D Ratio on sales : 6.9 %

Fiscal year 2018 (estimate)
- R&D expense : 100.0 billion yen
- R&D Ratio on sales : 6.2 %

M&A / Business Alliance

muRata
INNOVATOR IN ELECTRONICS

2014

- Toko,Inc.became a consolidated subsidiary of Murata
- ***Coils***

- Acquisition of Peregrine Semiconductor
- ***RF solutions incl. RF swiches***

2016

- Joint venture establishment with Shizuki Electric Co., Inc.
- ***Film Capacitor***

- Acquisition of IPDiA S.A.
- ***Silicon Capacitors***

- Acquisition of Primatec Inc.
- ***LCP (liquid crystal polymer) electronic materials***

2017

- Acquisition of Arctic Sand Technologies, Inc.
- ***Design and sale of Low-power semiconductors***

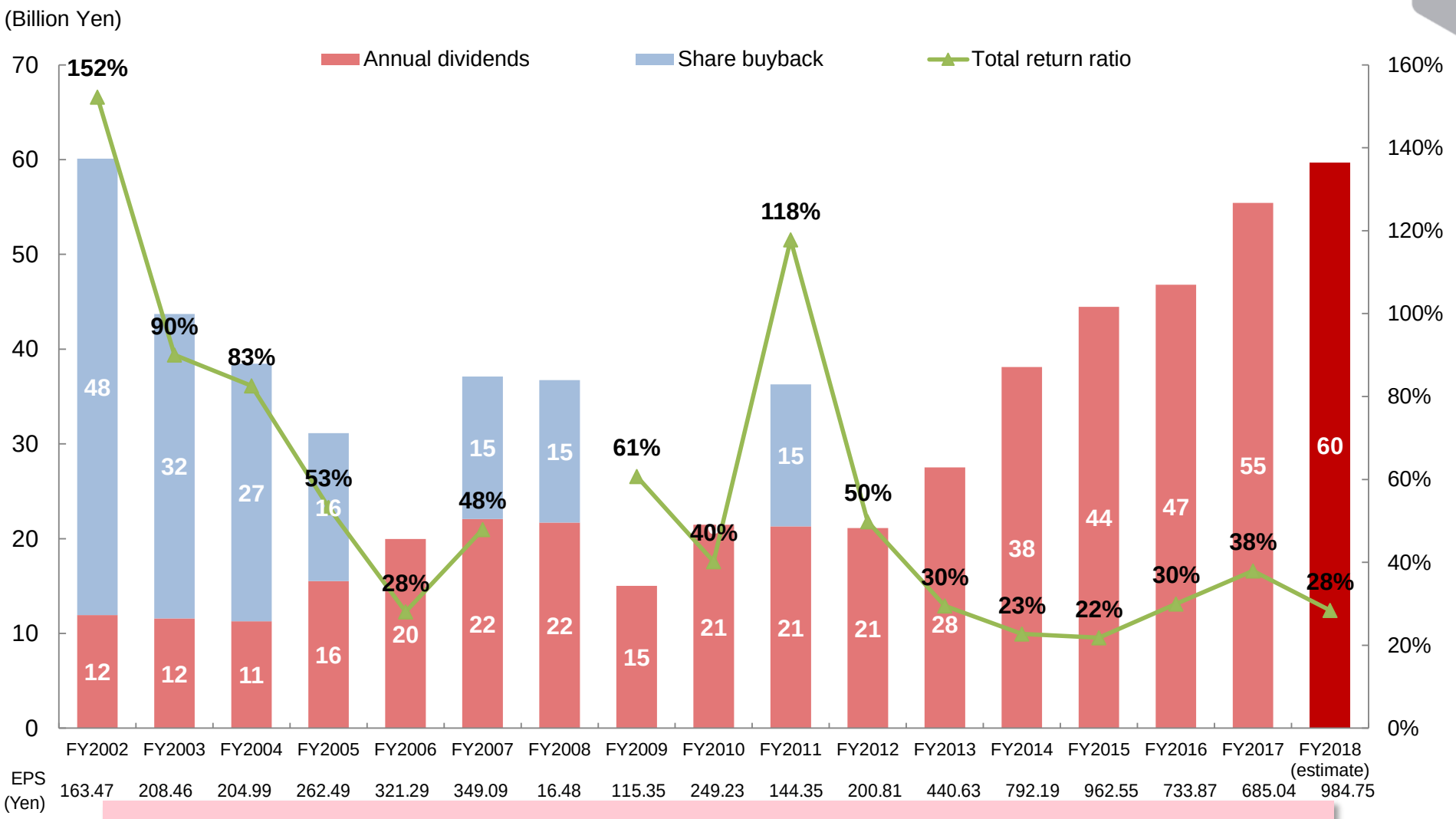
- Acquisition of ID-Solutions S.r.l.
- ***RFID system integration***

- Acquisition of Battery Business from Sony Corporation
- ***Lithium-ion Secondary Batteries***

- Acquisition of Vios Medical, Inc.
- ***Development of chest sensors, and development and provision of software and cloud services needed to monitor the sensors***

Mergers & acquisitions of energy, medical, and wireless communication businesses for further growth

Return to Shareholders



Our basic policy of profit distribution to shareholders is to prioritize the sharing of gains through payment of dividends, and to steadily raise them by increasing profit per share.

This report contains forward-looking statements concerning Murata Manufacturing Co., Ltd. and its group companies' projections, plans, policies, strategies, schedules, and decisions. These forward-looking statements are not historical facts; rather, they represent the assumptions of the Murata Group (the “Group”) based on information currently available and certain assumptions we deem as reasonable. Actual results may differ materially from expectations due to various risks and uncertainties. Readers are therefore requested not to rely on these forward-looking statements as the sole basis for evaluating the Group. The Company has no obligation to revise any of the forward-looking statements as a result of new information, future events or otherwise.

Risks and uncertainties that may affect actual results include, but are not limited to, the following: (1) economic conditions of the Company's business environment, and trends, supply-demand balance, and price fluctuations in the markets for electronic devices and components; (2) price fluctuations and insufficient supply of raw materials; (3) exchange rate fluctuations; (4) the Group's ability to provide a stable supply of new products that are compatible with the rapid technical innovation of the electronic components market and to continue to design and develop products and services that satisfy customers; (5) changes in the market value of the Group's financial assets; (6) drastic legal, political, and social changes in the Group's business environment; and (7) other uncertainties and contingencies.

The Company undertakes no obligation to publicly update any forward-looking statements included in this report.

Thank you