# An Efficient Synchronizer Solution for the Transmissions of the Future – An Industry Game Changer

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# Key Challenges & Innovation Drivers in the Automotive Industry

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## $CO_2$ EMISSIONS


Regulations with challenging targets for future $CO_2$ emissions are forcing OEMs to reduce fuel consumption.

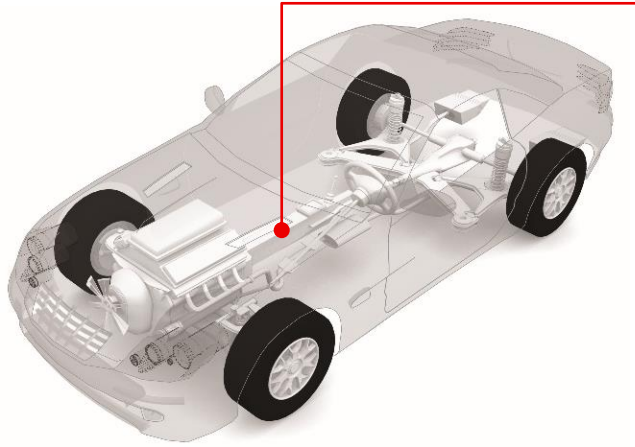
## E-MOBILITY

Increasingly dense urban traffic and monetary incentives are triggering demand for hybrid electric vehicles.

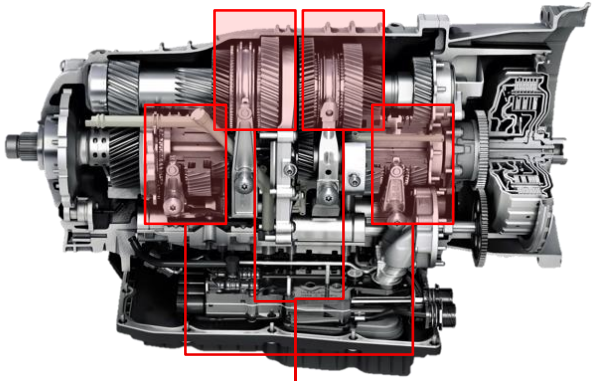
## COST REDUCTION


Continuous pressure from OEMs for cost efficient solutions.

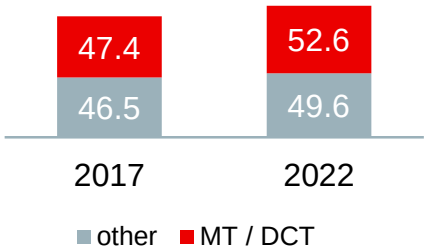
# What Is a Synchronizer?



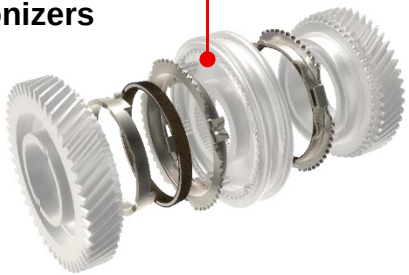
**Manual transmission (MT)/Dual clutch transmission (DCT)**



**Transmission volume (mn)**




**Synchronizers**



Data from IHS - Global Light Vehicle Powertrain Summary; June 2017

# The Innovative $S^3$ Synchronizer – Our Answer to the Challenges Facing the Market

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Conventional synchronizer system


Coverage of **all performance** requirements with **fewer components** thanks to innovative design that eliminates physical limits

Segmented synchronizer system

# Customer Benefit – Weight Reduction

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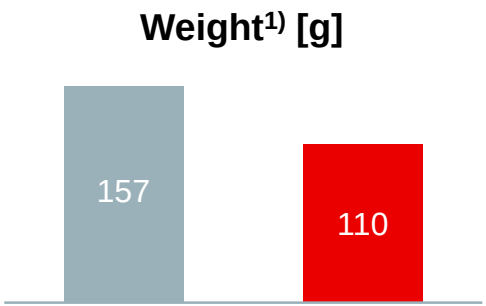
## Conventional synchronizer system

- 3 steel rings
- 3 friction linings

## Weight reduction

**of up to 30 %**




## Segmented synchronizer system

- 2 steel rings
- 1 friction lining

1) Example: triple cone synchronizer ∅ 80 versus ***S³***.

# Customer Benefit – Space Reduction

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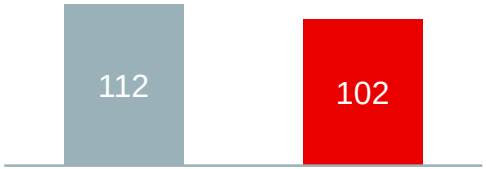
## Conventional synchronizer system

- 3 steel rings
- 3 friction linings

**Axial and radial space reduction**

**of up to 10 %**

**Diameter[1] [mm]**




## Segmented synchronizer system

- 2 steel rings
- 1 friction lining


1) Example: triple cone synchronizer ∅ 80 versus ***S³***.

# Customer Benefit – Power Loss Reduction

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## Conventional synchronizer system

- 3 steel rings
- 3 friction linings

**Reduction of power loss**

**of up to 40 %**

**Power loss[1] [W]**


## Segmented synchronizer system

- 2 steel rings
- 1 friction lining

1) Example: triple cone synchronizer ∅ 80 versus ***S³*** measured on component test rig at 2 000 rpm.

# Potential Drag Loss Reduction in Various Driving Scenarios

**CASE STUDY:**
The benefits of replacing a conventional triple cone synchronizer with ***S³*** in the first, second and third gear positions of a 7-speed DCT (500 nm)

**Autobahn (200 km/h)**

Power loss reduction in W

284

**Freeway/motorway** 120

Power loss reduction in W

167

**Highway** 80

Power loss reduction in W

111

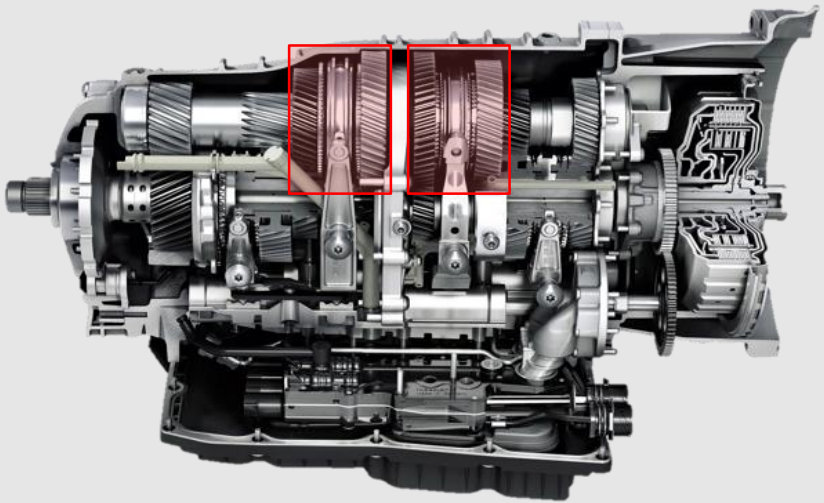
**City** 50

Power loss reduction in W

55

# Our Technology Meets Customer Expectations in Many Ways

**CASE STUDY:**
The benefits of replacing a conventional triple cone synchronizer with ***S³*** in the first, second and third gear positions of a 7-speed DCT (500 nm)



Weight (0.5–1 %) — **500 g**

Length (2–4 %) — **20 mm**

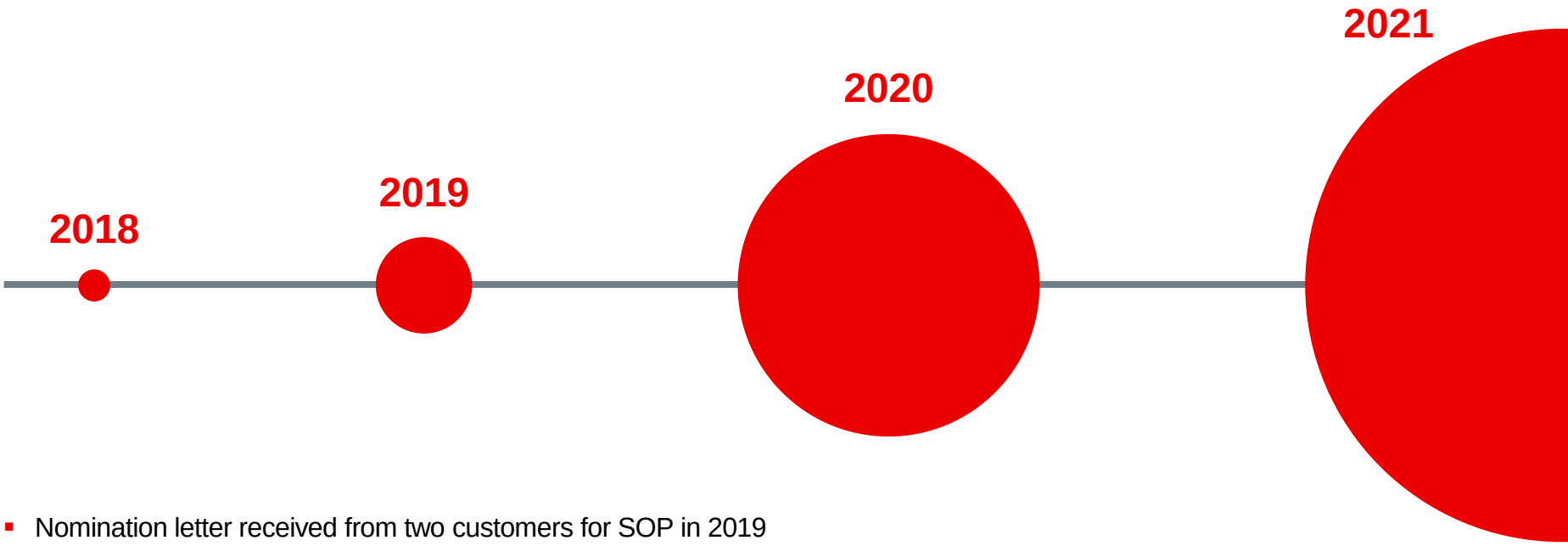
Power loss (2–4 %) — **170 W**

Cost (0.5–1 %) — **CHF 10**

# Key Project Drivers from the Customer's Perspective From Development to Nomination

| OEM | Transmission type | Status | SOP | Key project drivers | | |
|---|---|---|---|---|---|---|
| | | | | Cost | Efficiency | Space/weight |
| A | 7-speed DCT | Nomination | 2019 | ✓ | ✓ | ✓ |
| A | 6-speed MT/DCT | Final validation | 2019 | ✓ | ✓ | ✓ |
| B | 6-speed MT | Nomination | 2019 | ✓ | ✓ | ✓ |
| C | 7-speed DCT | Testing | 2021 | ✓ | ✓ | ✓ |
| D | 7-speed HDCT | Testing | 2020 | ✓ | ✓ | ✓ |
| E | 6-speed MT | Testing | 2020 | ✓ | ✓ | ✓ |
| F | 6-speed MT | Testing | 2021 | ✓ | ✓ | ✓ |
| C | 8-speed HDCT | Design study | 2022 | ✓ | ✓ | ✓ |

# Start of Production is a Crucial Milestone on the Growth Path




- Nomination letter received from two customers for SOP in 2019
- Concept studies and testing with several customers
- The first SOP will trigger further customer interest and accelerate implementation

# Well Protected, Unique Technology


**IP protection**
- Ten patent families
- With 56 patent applications
- In our key markets

The *S³* design requires **high performance friction linings** like Oerlikon‘s EF8000 Carbon.

**Drop-in replacement** for conventional synchronizers makes it possible to upgrade existing transmissions.

The only design that provides **weight, space and cost reduction** while also **increasing efficiency.**

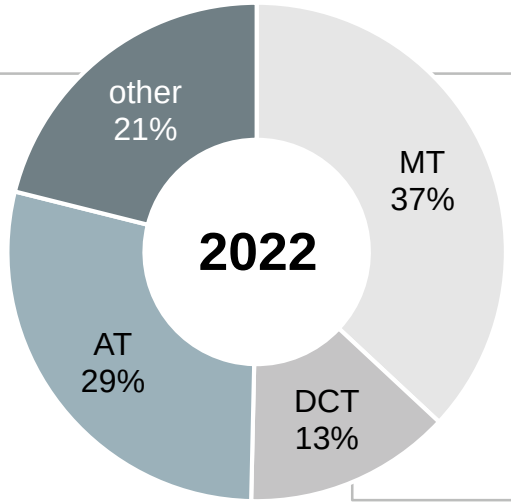
# Key Applications – From Conventional to Advanced Hybrid Transmissions

**Dedicated hybrid transmissions (DHT)**

- Packaging ✓
- Fuel efficiency ✓

**Upgrading existing manual transmission (MT)**

- Cost reduction ✓
- Fuel efficiency ✓




E-mobility as an opportunity

meets the synchronizer requirements for conventional transmissions and also allows for e-mobility with improved packaging.

**102 MN TRANSMISSIONS**
(> 321 MN SYNCHRONIZERS)

**Conventional dual clutch transmission (DCT)**

- Cost reduction ✓
- Fuel efficiency ✓

**New hybrid DCT**

- Packaging ✓
- Fuel efficiency ✓

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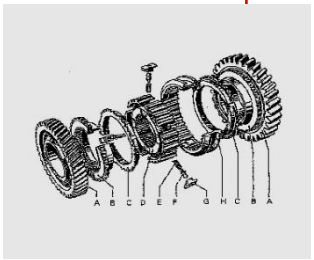
# $S^3$ – Another Milestone in Synchronizer Development from Oerlikon

- $S^3$ technology is the answer to the key challenges facing the automotive industry – $CO_2$ reduction and e-mobility – and offers substantial benefits to the customer.

- E-mobility with special packaging requirements is an opportunity to advance $S^3$ technology.

1928 | 1940 | 1953 | 1963 | 1983 | 1988 | 1990 | 1992 | 1999 | 2016



**Borg-Warner** type synchronizer

Thermal sprayed molybdenum coating

Woven carbon fiber

Two-layer carbon

Segmented synchronizer system $S^3$

1) Synchronizer innovations by Oerlikon or acquired companies.

# Thank you.