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Data Protection and Data Regulation in Smart Home Environments – Consequences of the EU Data Act and the EU General Data Protection Regulation to the Modern Smart Home Data Economy

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Definition of terms: Embedded Systems; IoT; Smart Home

Term	Definition	Example
Embedded Systems	mechanical and electrical systems with integrated software	modern cars, cash-register systems, ATMs
Internet of Things (IoT)	interconnected Embedded Systems	Industry 4.0, car-to-car communication
Smart Home	IoT systems in home automation	vacuum- & mopping-robots, SmartTVs

Background and Motivation

- Increasing digitalisation & data-based business models
- Information (i.e. *data*) is collected, processed & sold

➢ **Data Economy**

- *Smart Home* as a source of a wide range of data

➢ High potential value for the *Data Economy*

- Smart Home Data is often private and sometimes personal

➢ Subject to consumer protection legislation (e.g. *GDPR*)

- Users often do not have access to data generated by them

➢ New legislation: *EU Data Act*

- Tensions between the two arise

Relevant Stakeholders and Interests in the Smart Home

SG1 – Gatekeepers

- Big Tech Companies such as Amazon and Google [Digital Markets Act]
- Privileged access to user data & technical know-how

SG3 – Aftermarket Service Providers

- Repair services, etc.
- Dependent on SG1 for data access
- Have resources to generate value

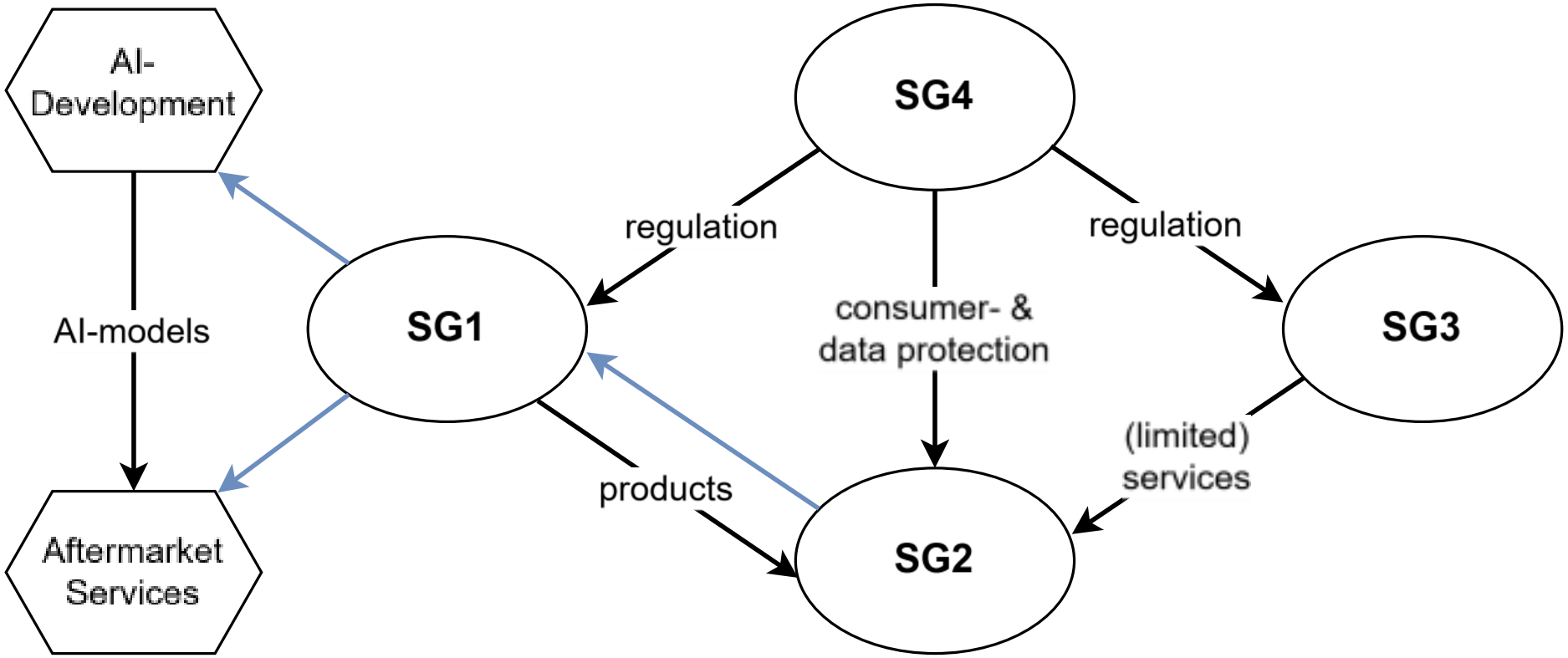
SG2 – Users

- Consumers that benefit from automation
- Limited data access & technical capabilities

SG4 – Legislators and Institutions

- Provide consumer & data protection
- Limited data access & dependence on SG3 for know-how

Relevant Stakeholders and Interests in the Smart Home – Relations



SG1 – Gatekeepers; SG2 – Users; SG3 – Aftermarket Service Providers; SG4 – Legislators; Data Relations in blue

EU Data Act – Overview

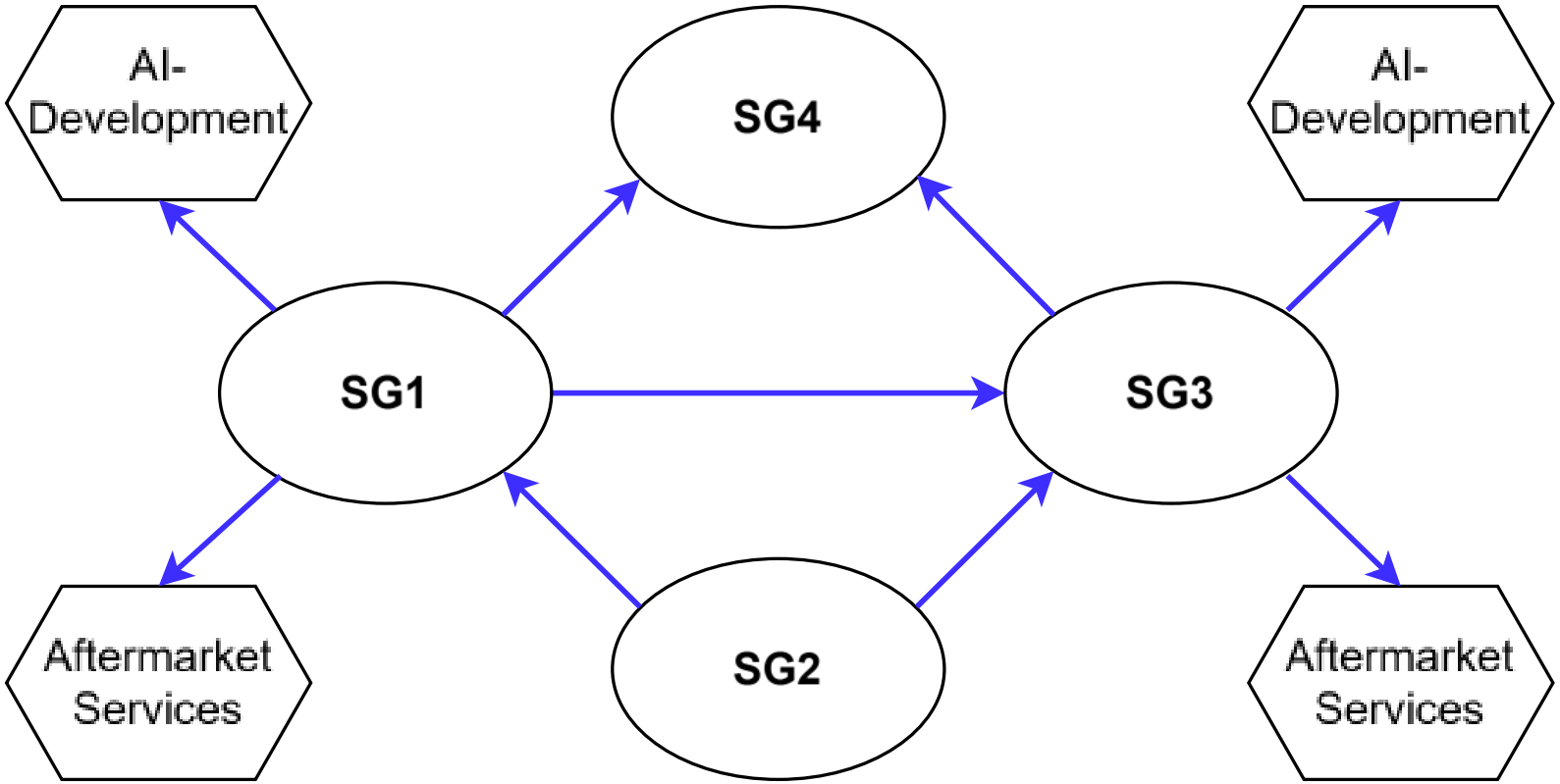
- Aims to to ensure fair access to and a fair distribution of data
- Data Owners (manufacturers and service providers) are obliged to grant users access to their own data [Art. 3]
- Gatekeepers (SG1) can only use data from devices, produced by them

- Data Exchange
  - By default
  - Easily
  - Securely
  - Free of charge
  - In a comprehensive structured, commonly used, machine-readable format

Grace period since: January 2024

Mandatory after: September 2025

EU Data Act
Modified Stakeholder-Relations



SG1 – Gatekeepers; SG2 – Users; SG3 – Aftermarket Service Providers; SG4 – Legislators; Data Relations in **blue**

GDPR – Overview

- Binding law since 2018
- Aims to protect **personal data**
  - *any information relating to an identified or identifiable natural person* [Art. 4]
- Data subjects have, for example
  - Right to Information and Access [Art. 13-15]
  - Right to Rectification [Art. 16] and Right to Erasure [Art. 17]
- “effective, proportionate and dissuasive” [Art. 84] Sanctions for non-compliance

EU Data Act vs. GDPR in the Smart Home

EU Data Act

- focuses on promoting a data-driven economy
- Users get access to data, generated by them
- Service Providers have to facilitate this access
- Must not affect the GDPR [Data Act Art. 1]

GDPR

- prioritises the protection of personal data and consumer protection
- Transfer, Processing etc. of personal data needs to be permitted by data subject
- Data subjects have to be able to exercise their rights (Rectification, Erasure, etc.)

EU Data Act vs. GDPR
Classification of Smart Home Data

Data Type	Alice	Bob	Shared
Personal Data	voice assistant queries, health data	TV preferences, fitness data	shared calendar, living room camera footage
Non-Personal Data	generic device usage statistics (e.g. light switches)	app update logs, battery charging cycles	energy consumption, network diagnostics

Potential Conflict

- Bob wants to receive their *TV Preferences* data
- Problem: Alice & Bob use the same TV
- ➢ Personal data of Alice & Bob are mixed (“mixed dataset”)

- According to GDPR: Provider **must not** grant access to Alice’s data
- According to EU Data Act: Provider **must** grant Bob access

- Service Provider must detect and resolve this problem
- Poses a considerable technical challenge

Relevance for the Smart Home I

- Blurred boundaries between personal and non-personal data, especially in shared or mixed-use contexts
  - Example: Energy Consumption Statistics
  - “indirectly” personal data through correlation
  - Multiple data-sources in the Smart Home
    → High risk of correlation
  - Unclear how such data such be handled under Data Act

Relevance for the Smart Home II

- Ambiguity in attributing data to specific individuals in multi-user environments
- Unclear responsibilities for data governance when data is co-generated or shared across devices and users
  - Rights of Data Subjects have to be regulated by individual contracts
- Conflicts between user rights under the Data Act (e.g. data portability) and the privacy rights of other users under the GDPR
  - Common in Smart Homes with multiple occupants

Conclusion

- Smart Home is increasingly relevant component of the data economy
- Currently: Power asymmetry between Stakeholder Groups
- EU Data Act remedies some of those asymmetries
- Conflicts with GDPR concerning mixed datasets
- Harmonising the two regulations will require technical innovation

Future Work

- Classification of *personal* vs. *non-personal data*
- Development of technical solutions for increased data protection and data sovereignty in the Smart Home
- Analysis of the economic and social impact of the EU Data Act
- Research on the adjustments required to fulfil the full set of legal requirements

Paper

- Full paper available in this year's issue
- Explores mentioned topics further
- Contains pointers for further reading

Consequences of the EU Data Act and the EU General Data Protection Regulation to the Modern Smart Home Data Economy

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***Abstract*—The entry into force of the European Union (EU) Data Act 2024 creates new opportunities for the European data market, but also new challenges. One such challenge is the parallel application of the EU General Data Protection Regulation (GDPR). It is therefore necessary to analyse these two regulations and their consequences for the players in the Smart Home sector. To this end, the Smart Home sector and its relevant players are analysed and potential conflicts between the EU Data Act and the EU GDPR are identified. One such conflict arises in the management of personal data from multi-user environments. In the Smart Home in particular, several users share different devices, such as smart TVs, and thus generate mixed data sets that are not compliant with the regulation. If a member of the user community wishes to transfer their data to a third party in accordance with their rights guaranteed by the EU Data Act, the third party must be able to ensure that the transferred data are not also the personal data of another user.**

Keywords-eu data act, gdpr, contradiction, smart home

I. Introduction

Increasing digitalisation and the steady expansion of data-based business models have placed the so-called data economy at the heart of economic and technological developments. Data are regarded the new oil of the 21st century [1] and are essential for value creation in areas such as machine learning, whose economic potential through generative models has recently been estimated at several trillion dollars [2, p. 3]. This makes the regulation and utilisation of data a key sanctions for violations [5, Art. 1 para. 5]. This leads to legal uncertainties, particularly in the Smart Home, where mixed data sets are often created. With the EU Data Act becoming applicable law in September 2025, this issue is becoming increasingly relevant and requires technical solutions to take into account both regulatory requirements and the technical innovation potential.

The urgency of this study arises from that recent entry into force of the EU Data Act, which significantly reshapes the regulatory landscape for data access and sharing in Europe. Particularly in Smart Homes, where multiple users often interact with interconnected devices and generate mixed datasets, the practical application of the Data Act introduces tensions. This study examines these tensions, focusing on the legal and technical challenges of managing personal data in multi-user environments and ensuring regulatory compliance. The specific designs and implementations of the technical and legal solutions to these challenges are beyond the scope of this study.

After this introduction, the key stakeholders and challenges in the Smart Home sector are discussed in Section II, focusing on their interests and the inherent problems in this environment. Also in Section II, the concept of the Smart Home is defined, and the roles of relevant stakeholders are explored. Section III then examines the challenges posed by the data economy in Smart Homes, particularly data protection

Thank you!

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