

Applied Printed Electronics for Added Value Packages

Packaging functions

Printing electronics

Electronics to enhance packaging functions

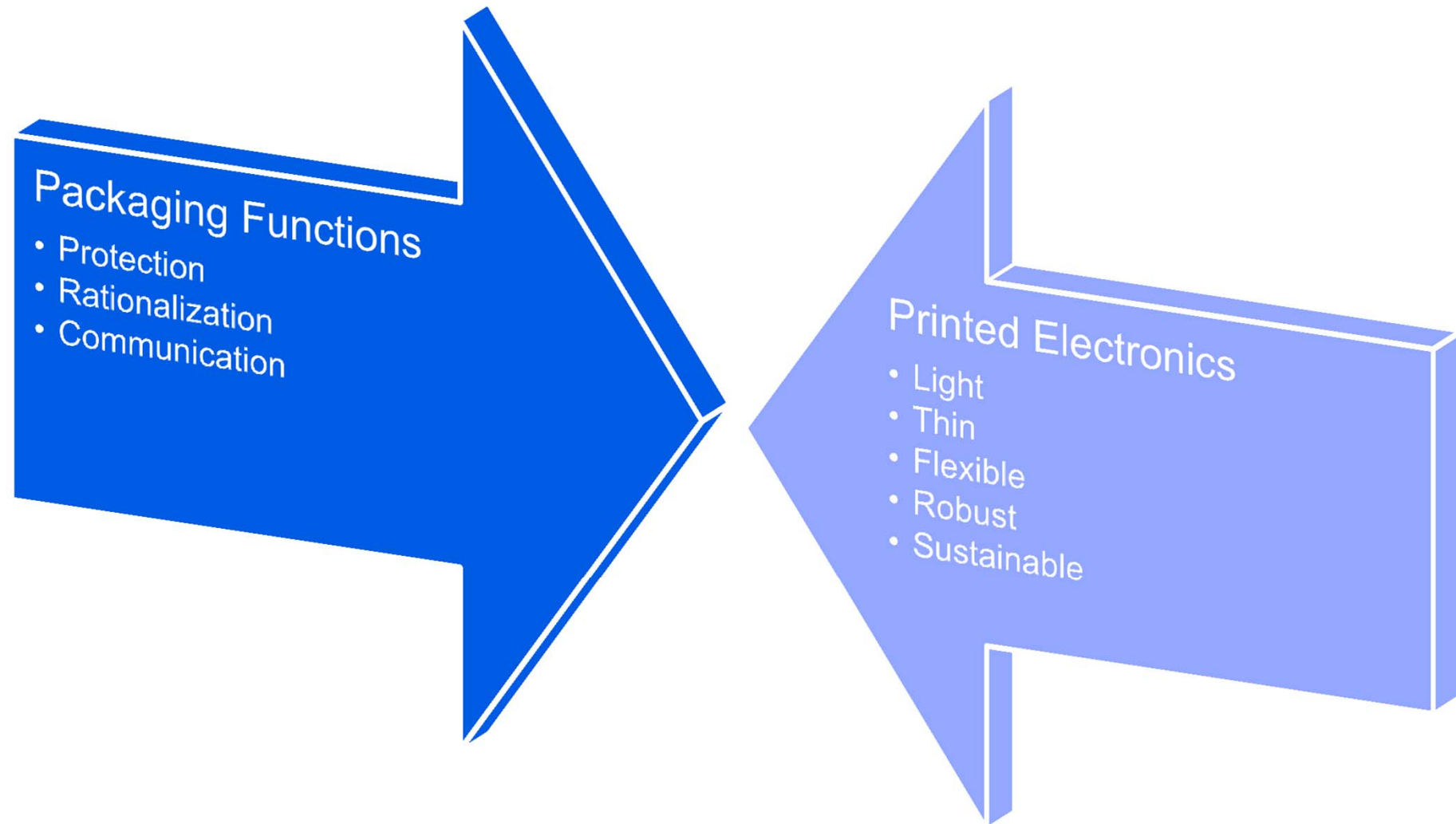
Chances for printed electronics in packaging

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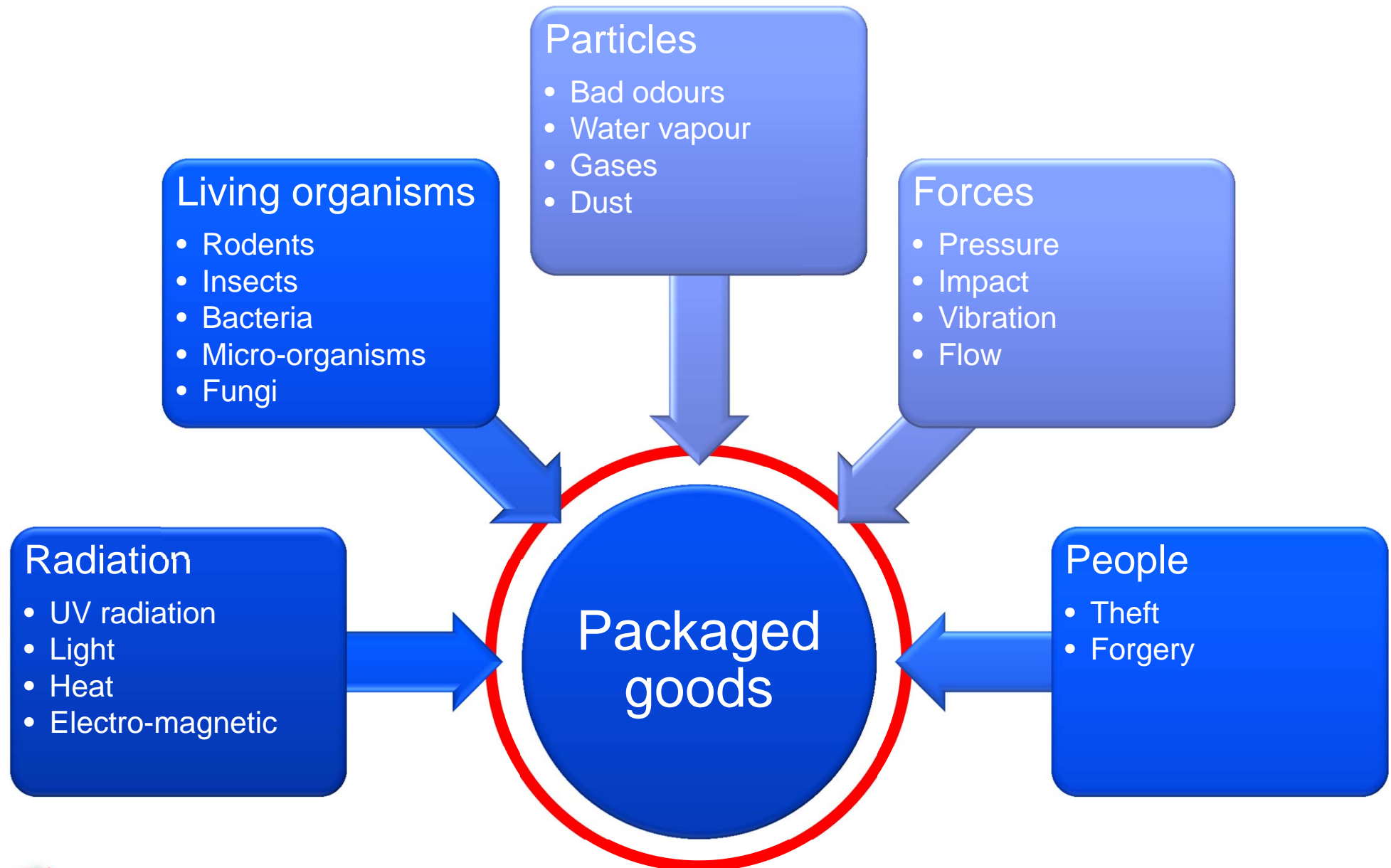


Introduction – Enhanced Packages by Printed Electronics



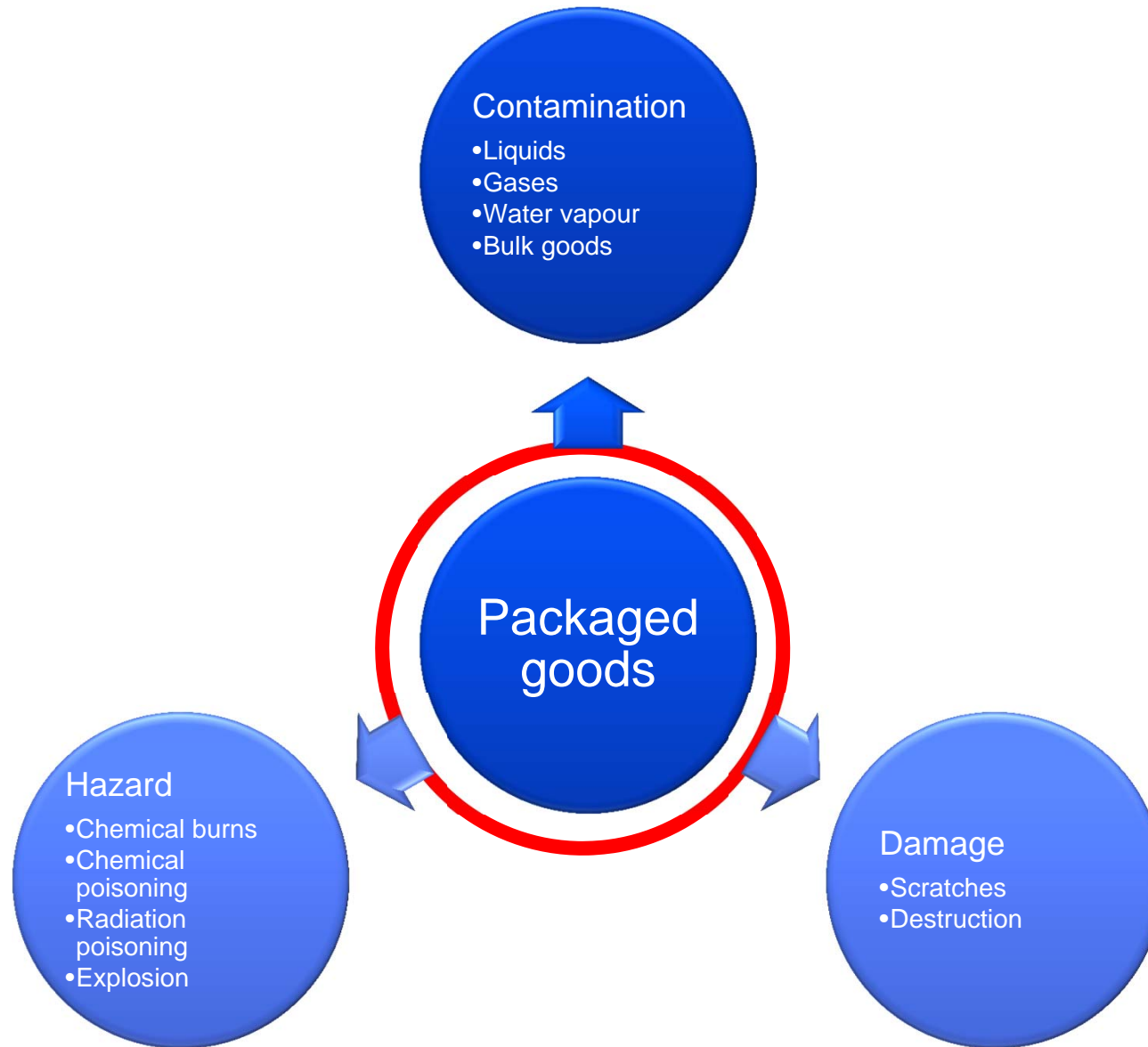
Packaging Functions – Protection

Protecting the packaged goods against environmental factors

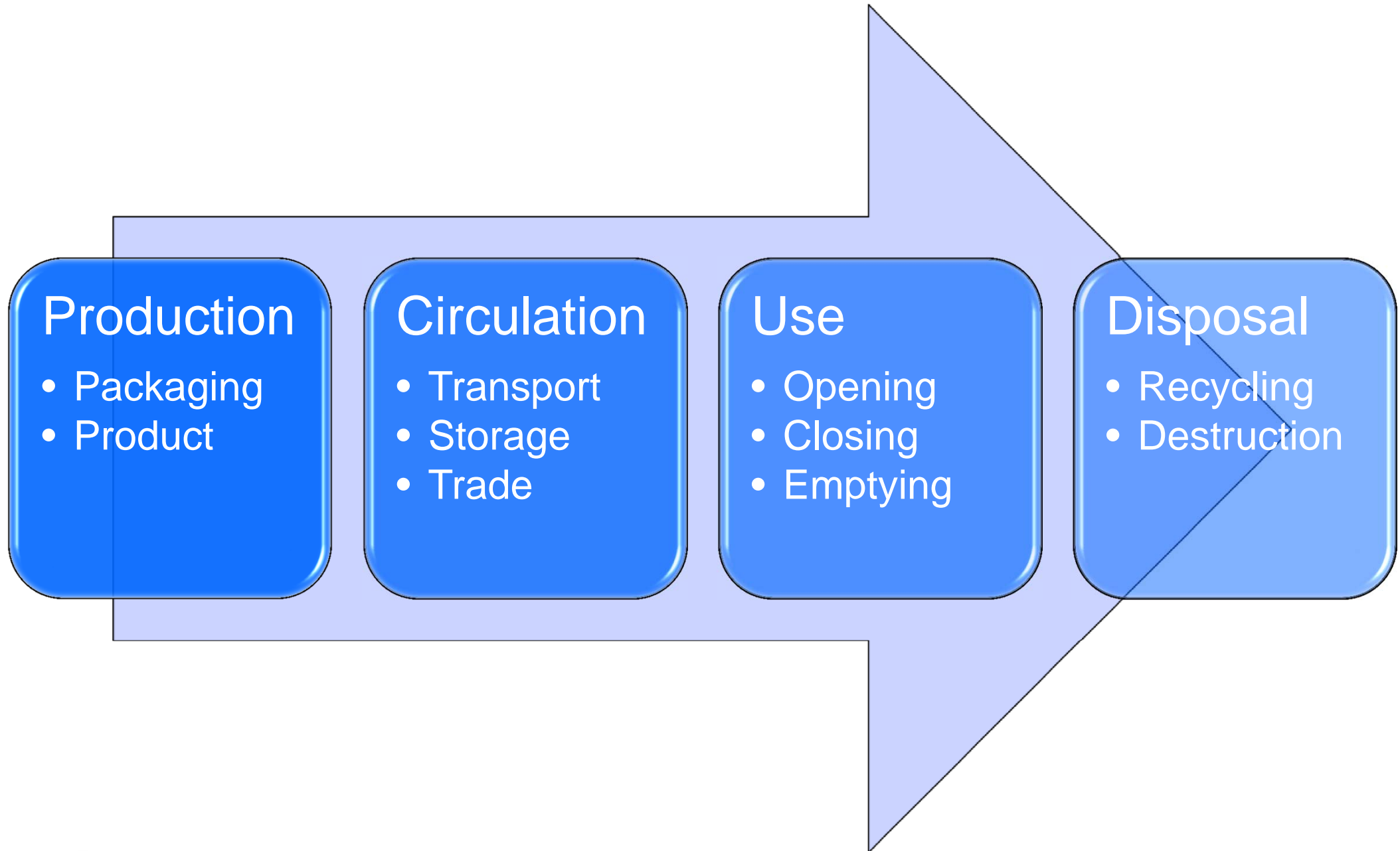


Packaging Functions – Protection

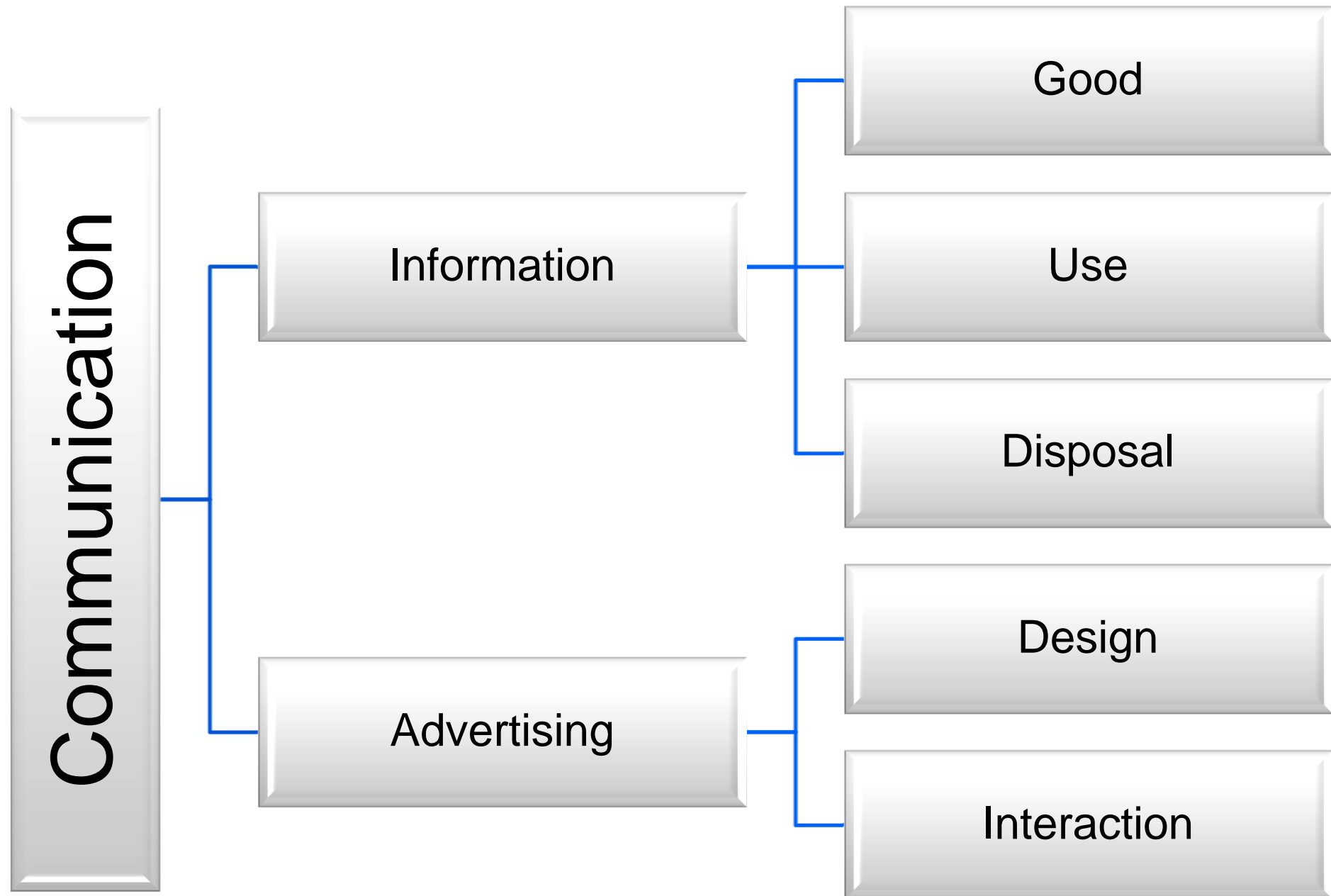
Protecting the environment against the packaged goods



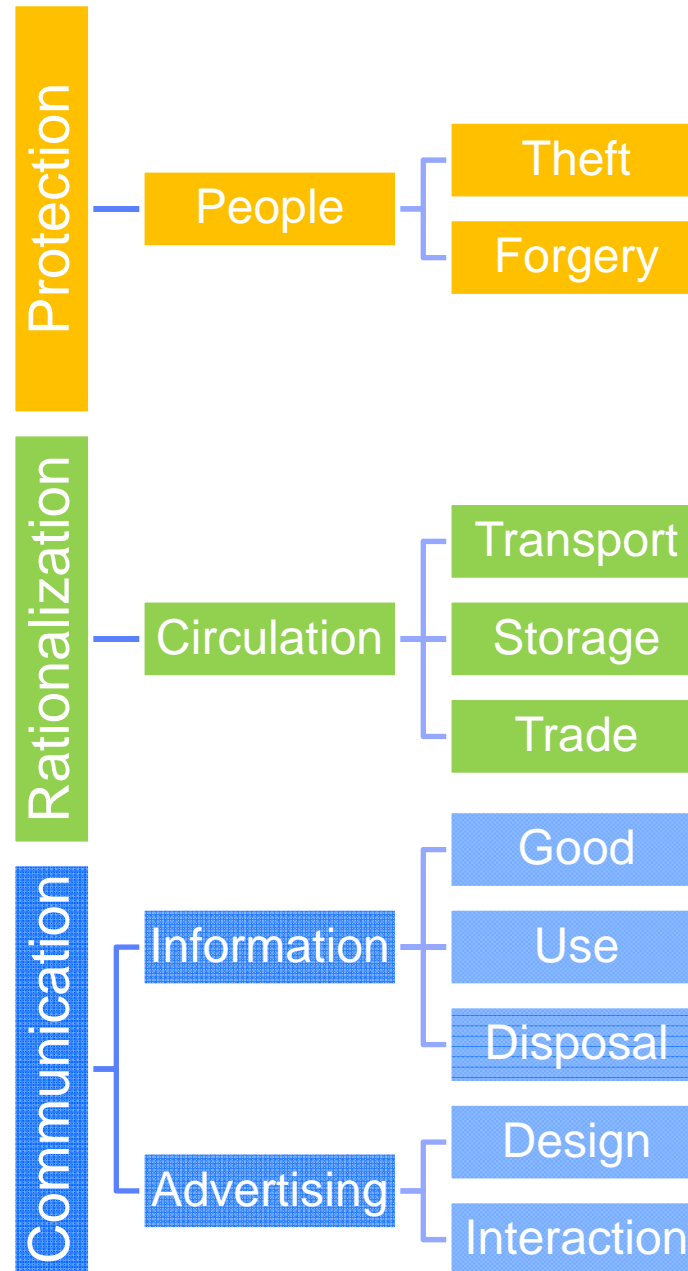
Packaging Functions – Rationalisation



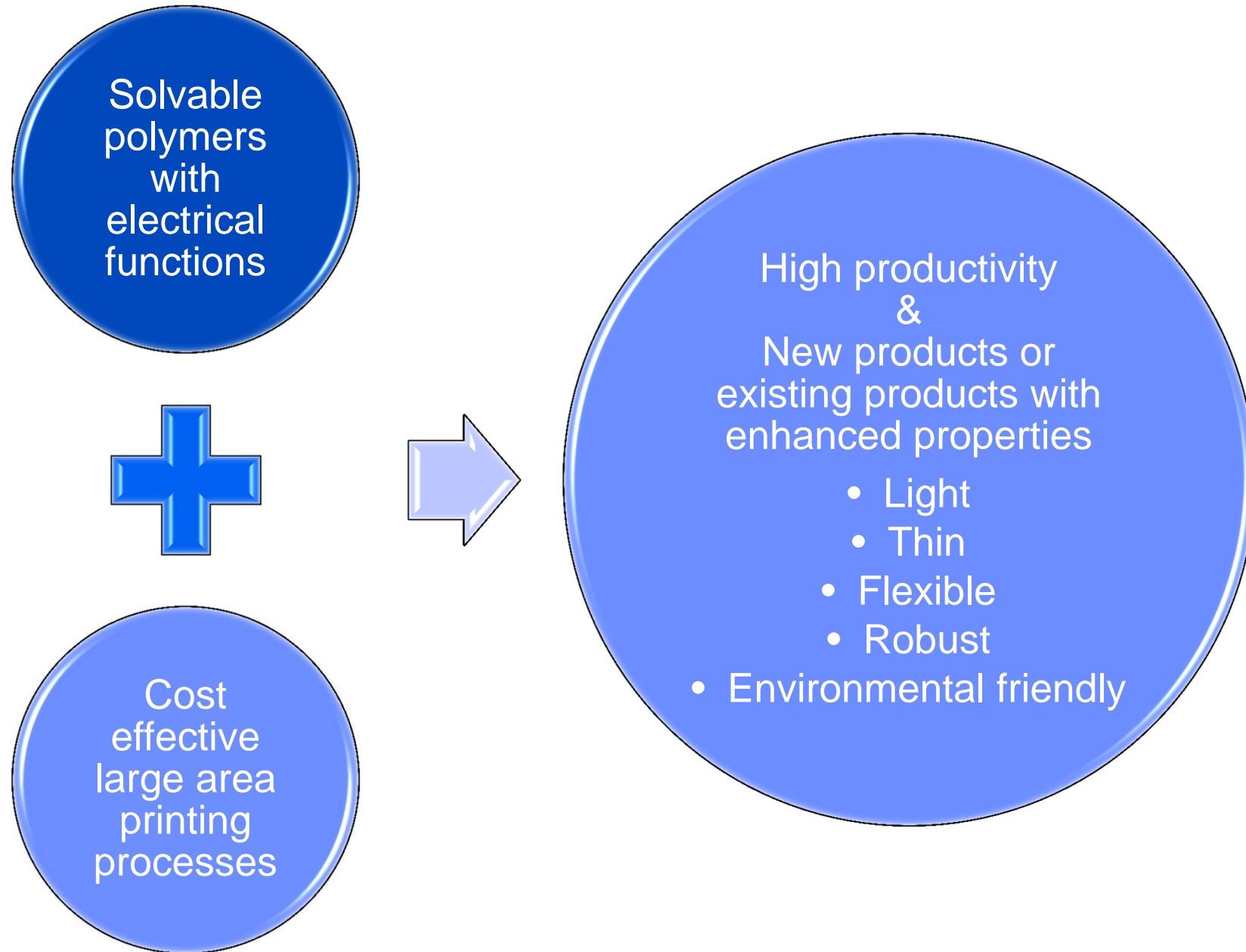
Packaging Functions – Communication



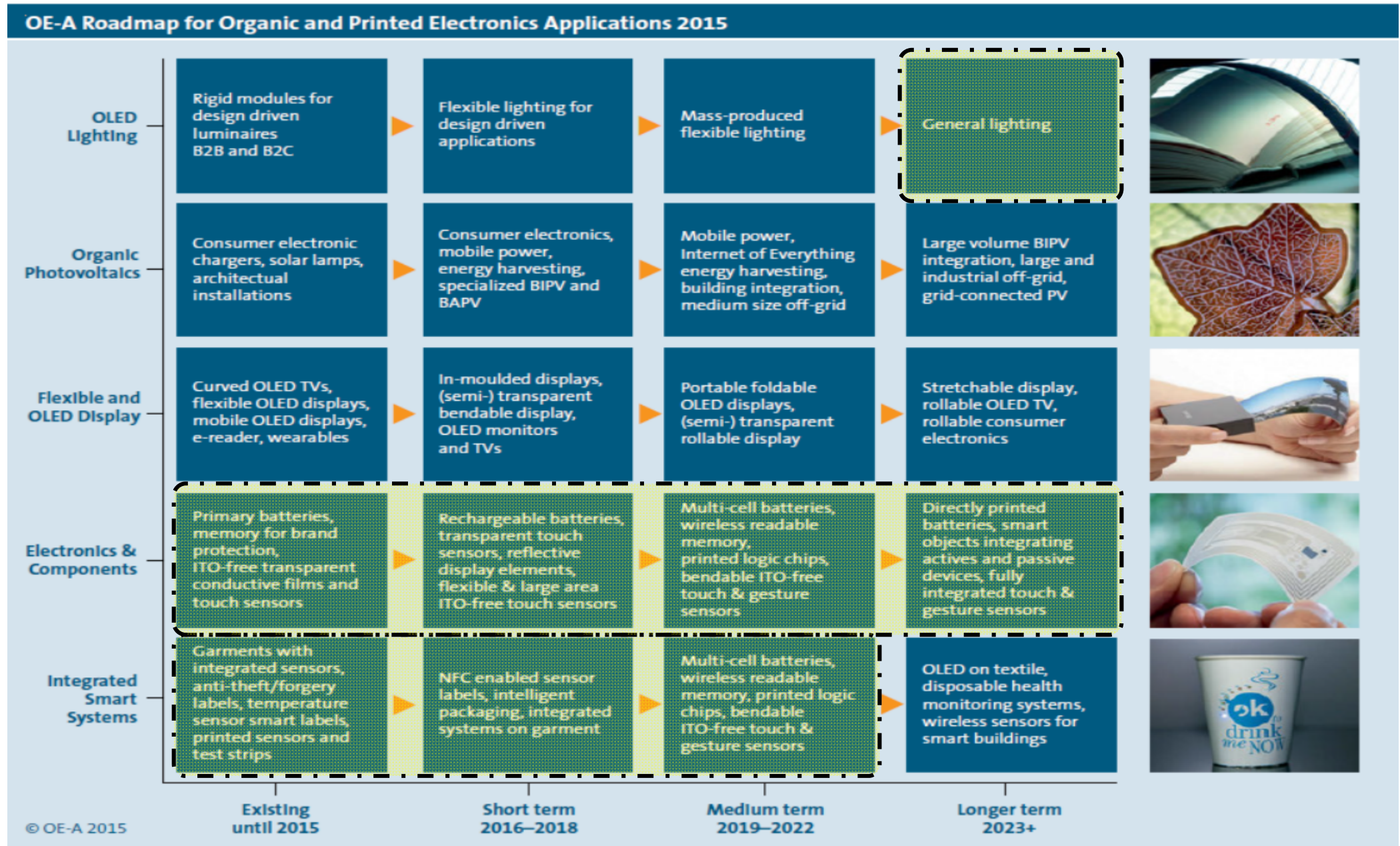
Function of a Packaging Enhanced by Silicon-Based Electronics



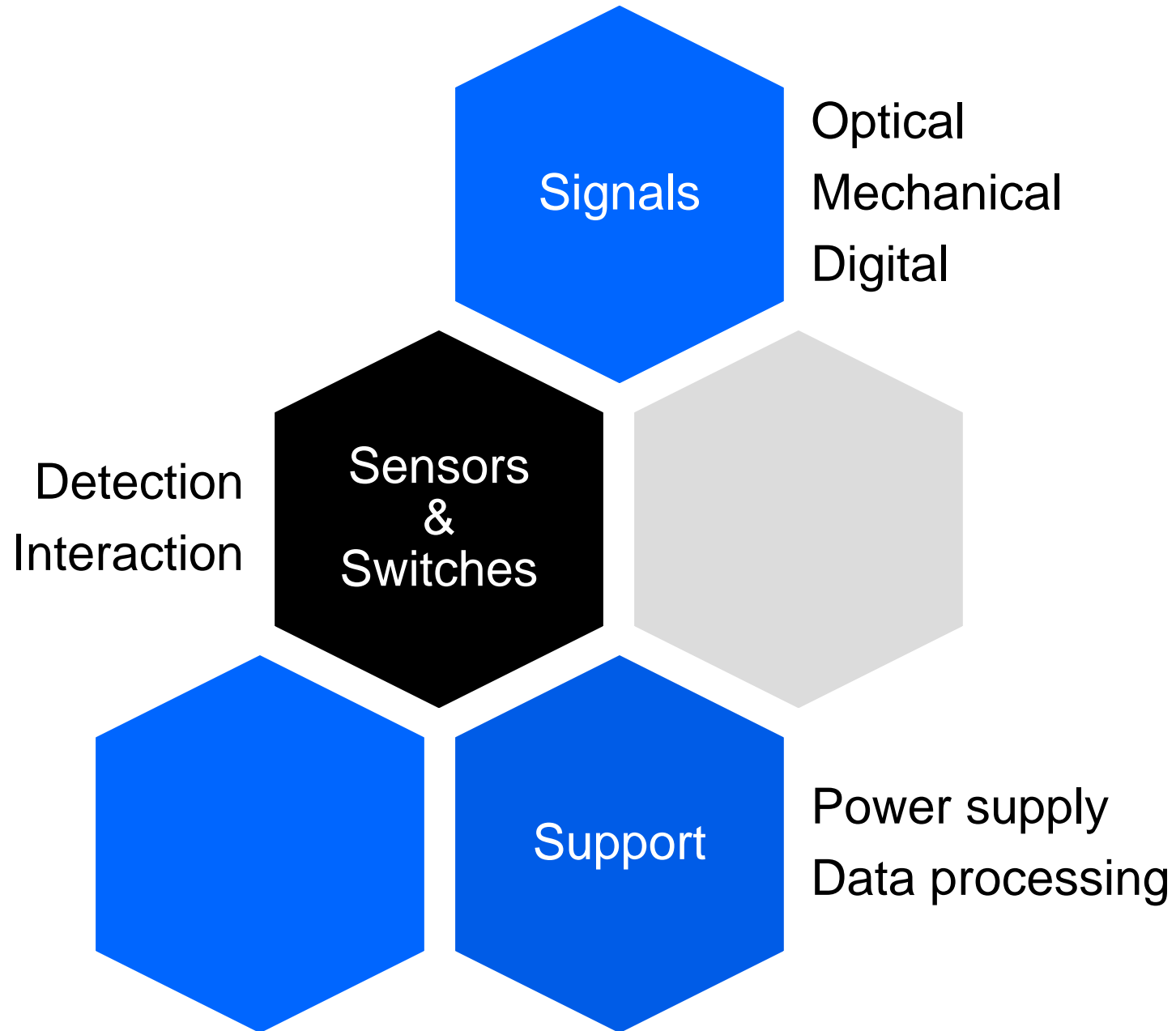
Motivation for Printed Electronics



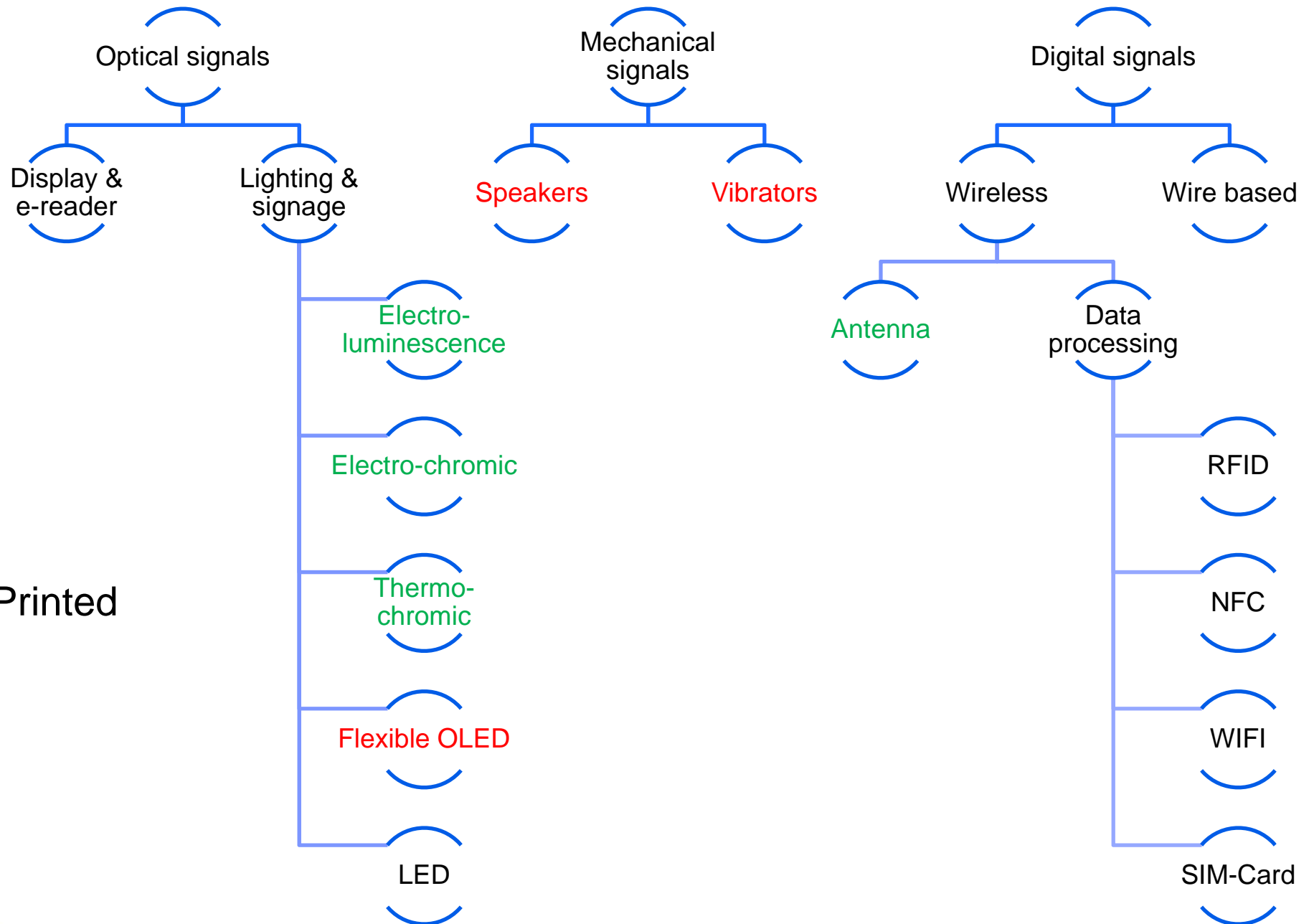
OE-A Roadmap: Application and Technologies (Yellow relevant for Packaging)



Electrical Categories to Upgrade a Package with Electrical Components



Electrical Components for Upgrading a Package



Pilot Printed
2015
2025



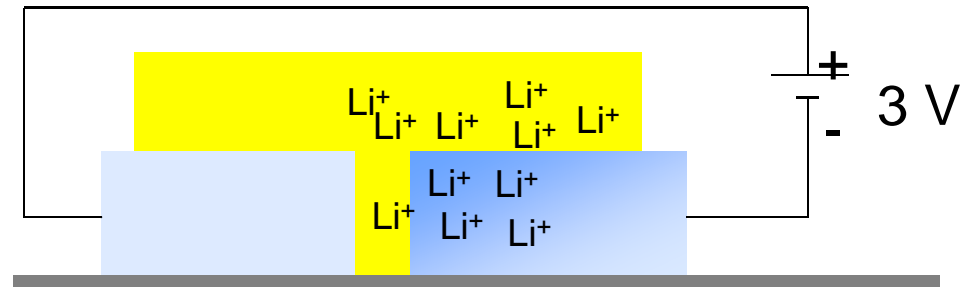
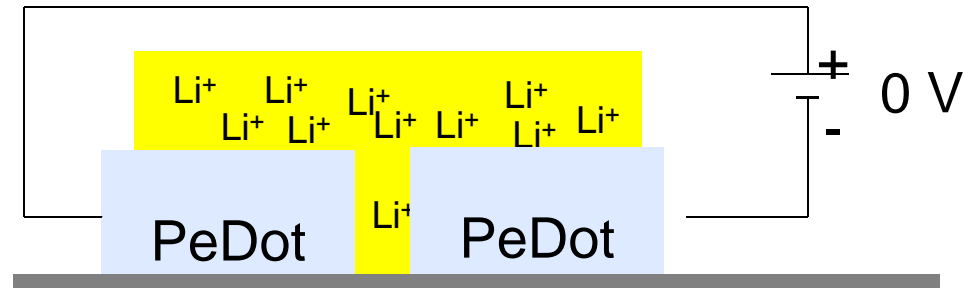
Electro-chromic Display

Features

- General
 - Disposable in domestic waste
 - Color changing display
- Production
 - Screen printing
 - PeDot
 - Electrolyte (Li^+)
 - Encapsulation
- Low material costs
 - External power source
- High reliability
- Easy to handle
- 1,5 – 6 V DC

Applying a voltage colors PeDot blue

- Mobility of Li^+ mandatory



Important Parts and Components: Electro-luminescence Display

Function

Light emitting
low brightness
flat
flexible

Energy

110 V 400 Hz AC
converter necessary
high energy consumption

Production

Screen printing
– Conductive Lines
– Isolator
– Active layer
– PeDot
Encapsulation



Important Parts and Components: OLED

Function

light emitting
high brightness
flat
almost flexible

Energy

3 – 9 V dc
low energy consumption

Production

Printing and/or
vacuum deposition
Encapsulation

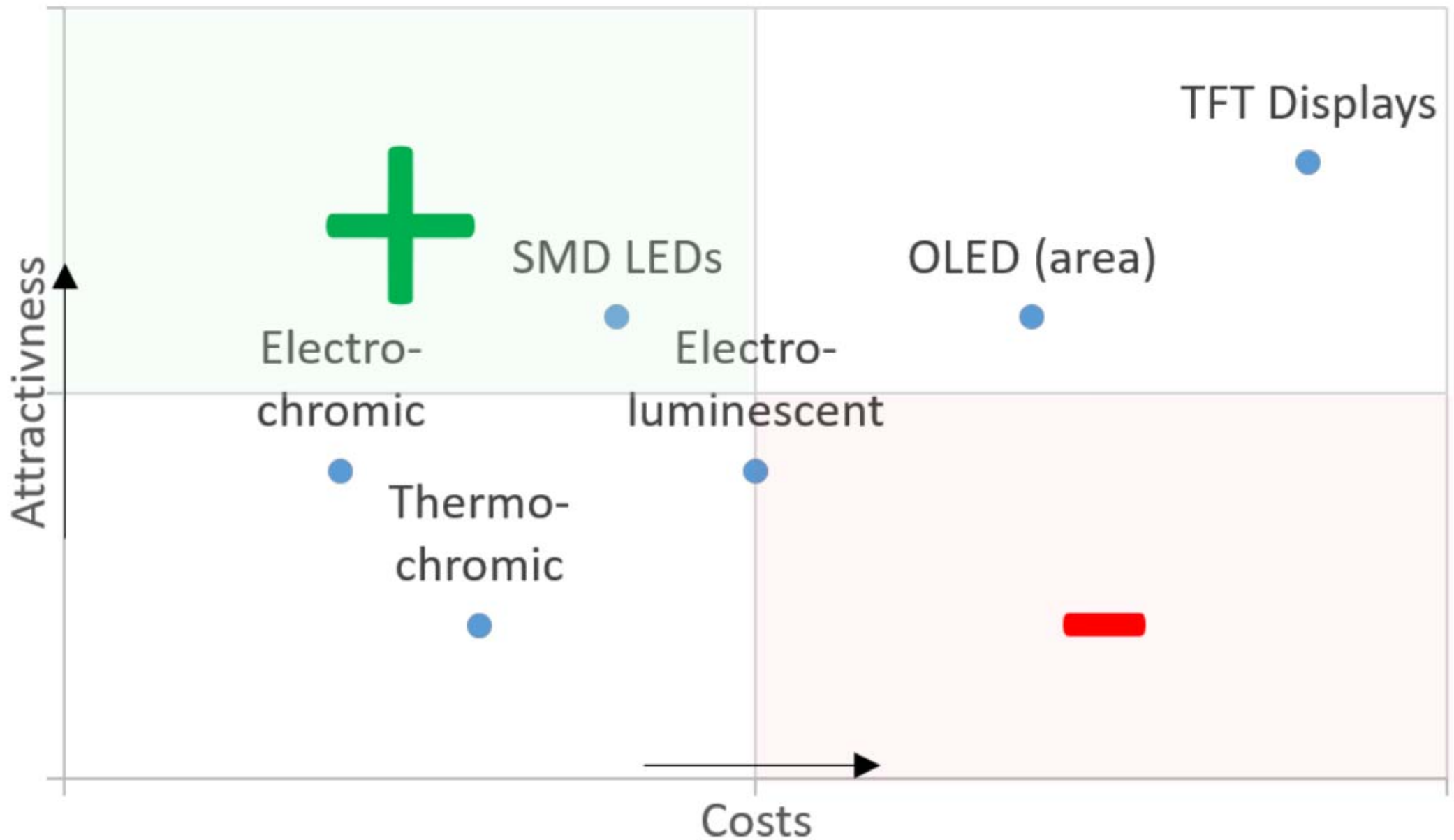


Comparison of Optical Signals

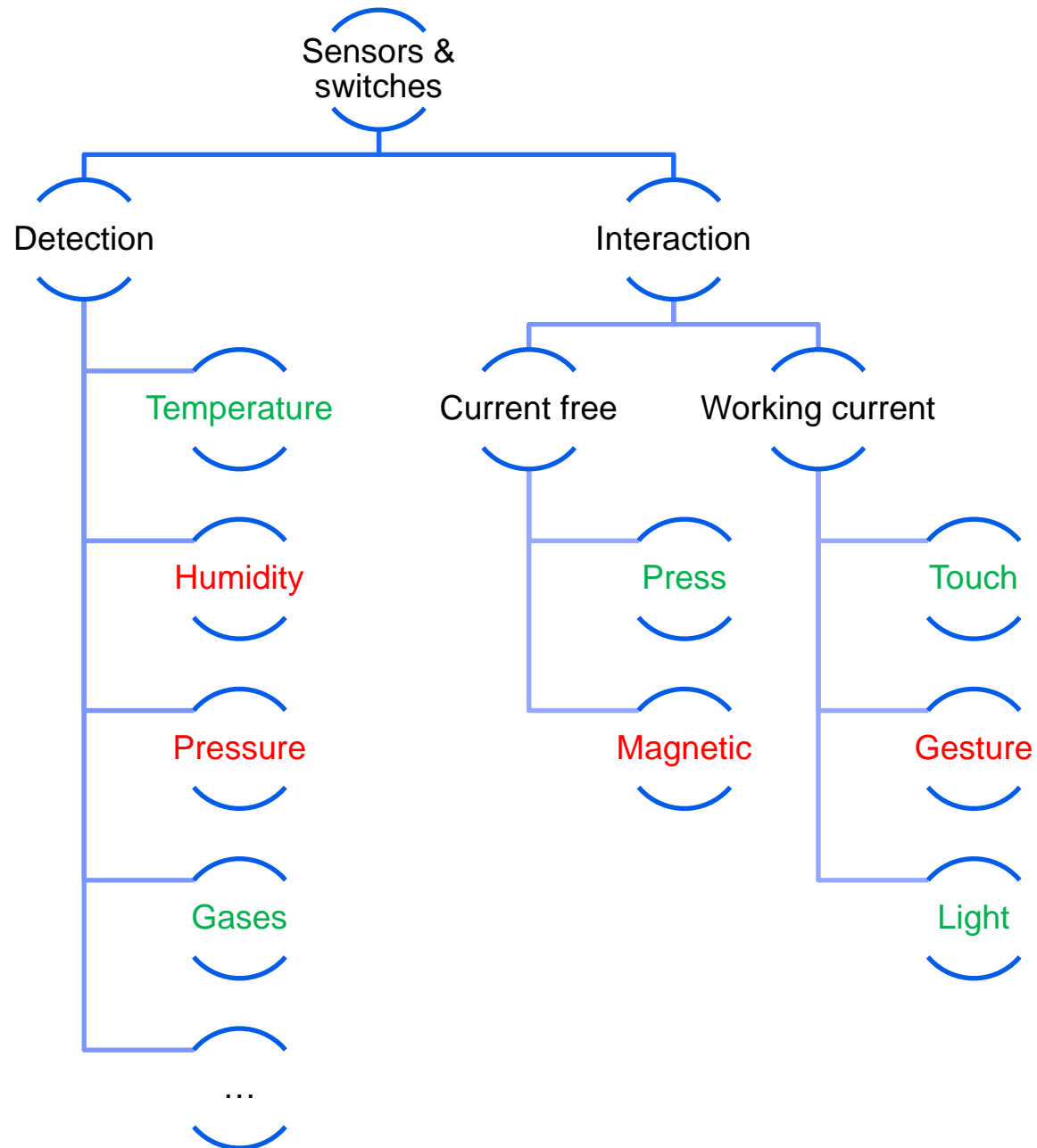
	Function	Attractiveness	Minimum Power Supply	Costs for a Small Display incl. support
Electro-chromic	Color change: transparent to blue	Medium Opacity change	Printed Battery 1.5V	Very low
Thermo-chromic	Color change: Variable colors	Low Color change	Block Battery 9 V	Very low
Electro-luminescent	Illuminated areas	Medium Low brightness	Two Mignon AAA plus DC/AC inverter	Medium (Inverter)
OLED (area)	Illuminated areas	Very high High brightness	Block Battery 9 V	High (Display)
SMD LEDs	Illuminated spots	High	Printed Battery 3 V	Low
Displays	Moving pictures	Very high Variable information	Block Battery 9 V	Very high (Controller)



Comparison of Optical Signals



Electrical Components for Upgrading a Package

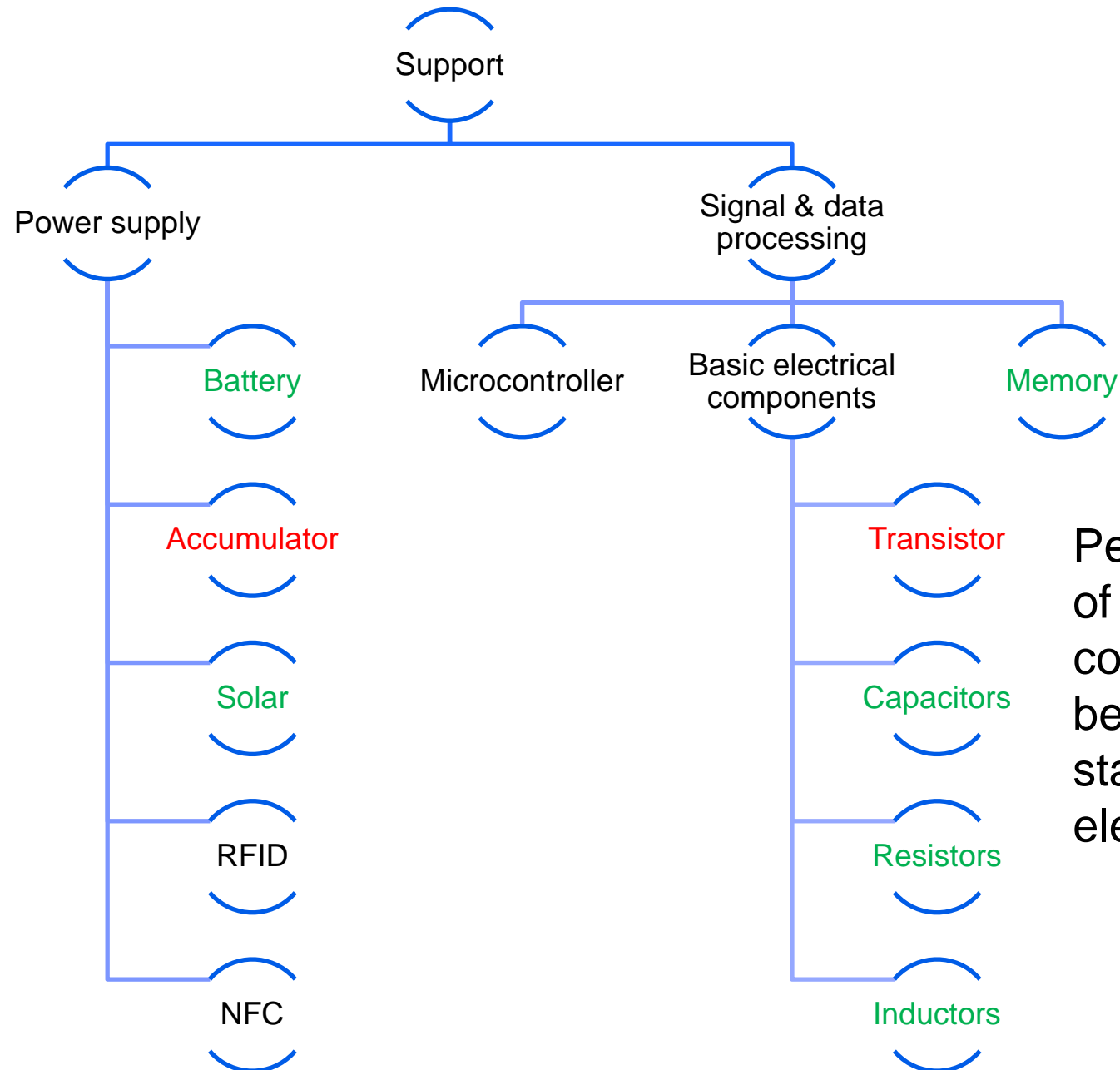


Additional
data
processing
required

Pilot Printed
2015
2025



Electrical Components for Upgrading a Package



Performace
of printed
components
below
standard
electronics

Pilot Printed
2015
2025



Functions of Packages Enhanced by Electronics

		Optical signals		Mechanical signals		Digital signals		Sensors & Switches	
		Display & e-readers	Lighting & signage	Speakers	Vibrations	Wireless	Wire based	Detection	Interaction
People	Theft	3	3	6	1	9	6	6	
	Forgery	9	3	3	1	9	9		
	Transport					9	1	9	
Circulation	Storage					9	3	9	
	Trade	6	1			9	3	6	
	Good	9	3	6		9	9		
Information	Use	9	3	6		9	9		
	Disposal	9	3	6		9	9		
Advertising	Design	9	9						
	Interaction	9	6	9	3	9	6	9	9

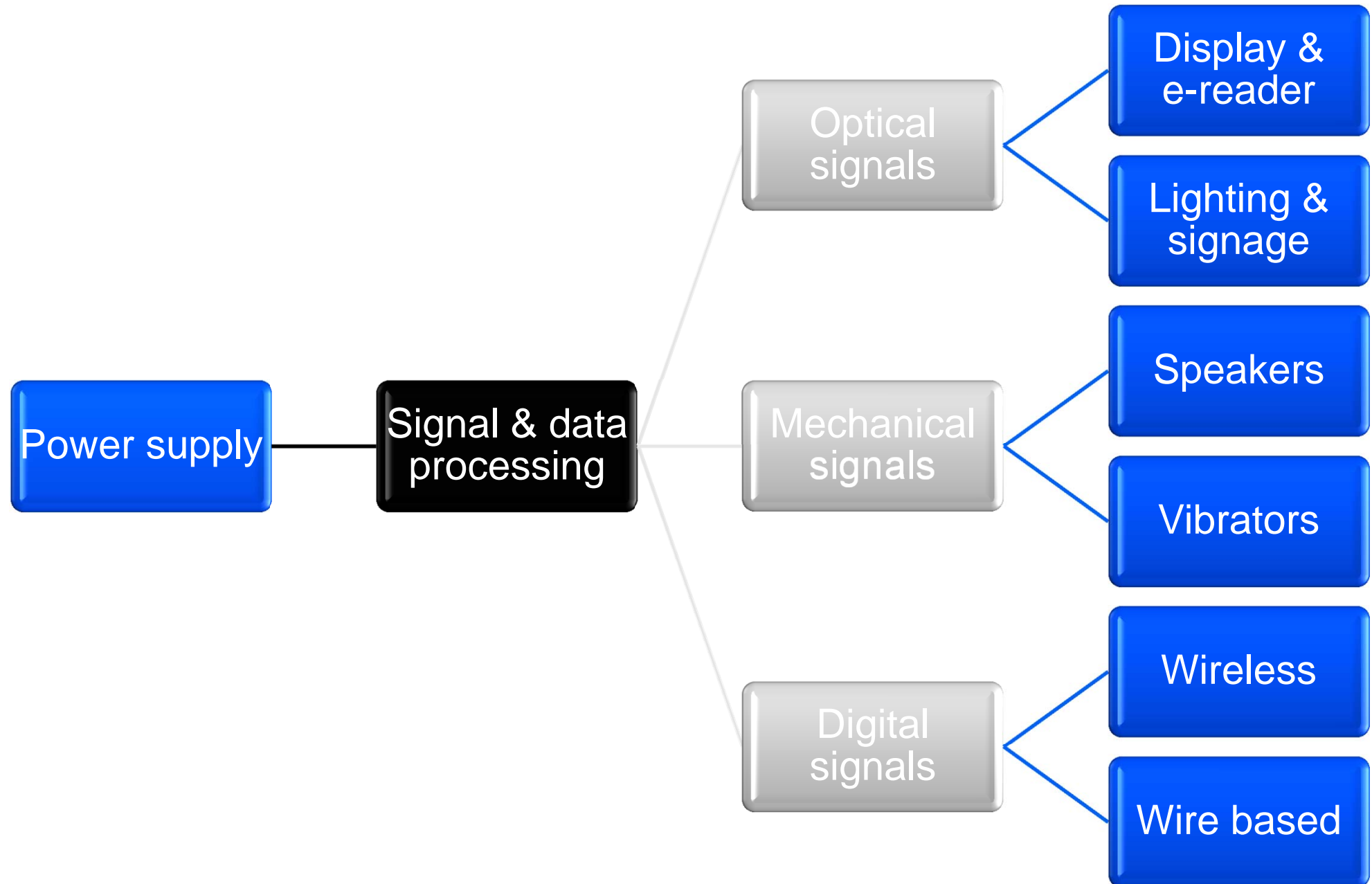
9 = Very high; 6 = high; 3 = medium; 1 = low; “ “ = none

Best function: display/e-readers + speaker + wireless connection

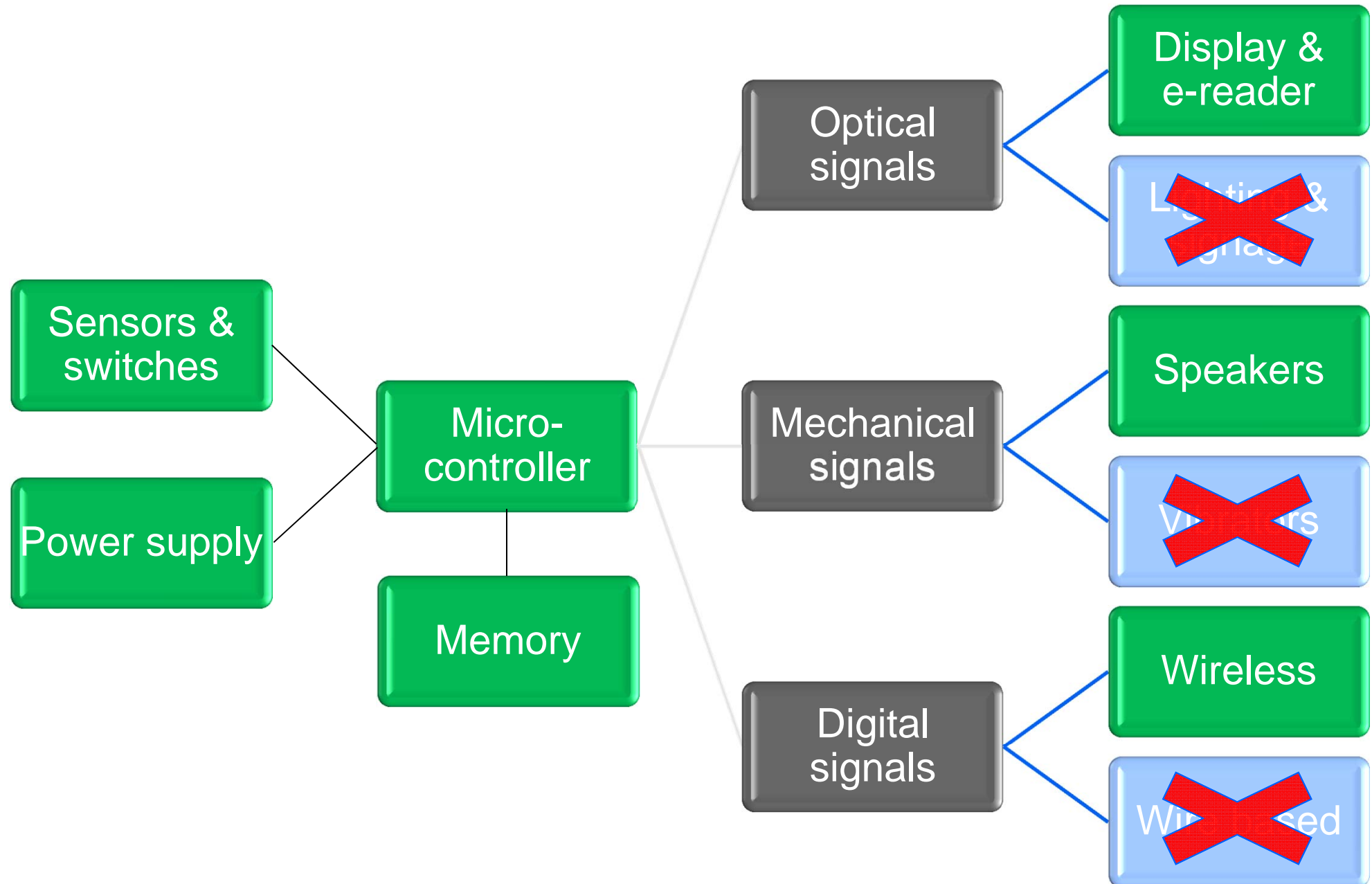
Strength of printed electronics to support the function - Lighting & signage by now
- Mechanical signals by 2025



Smart Objects for Upgrading a Package

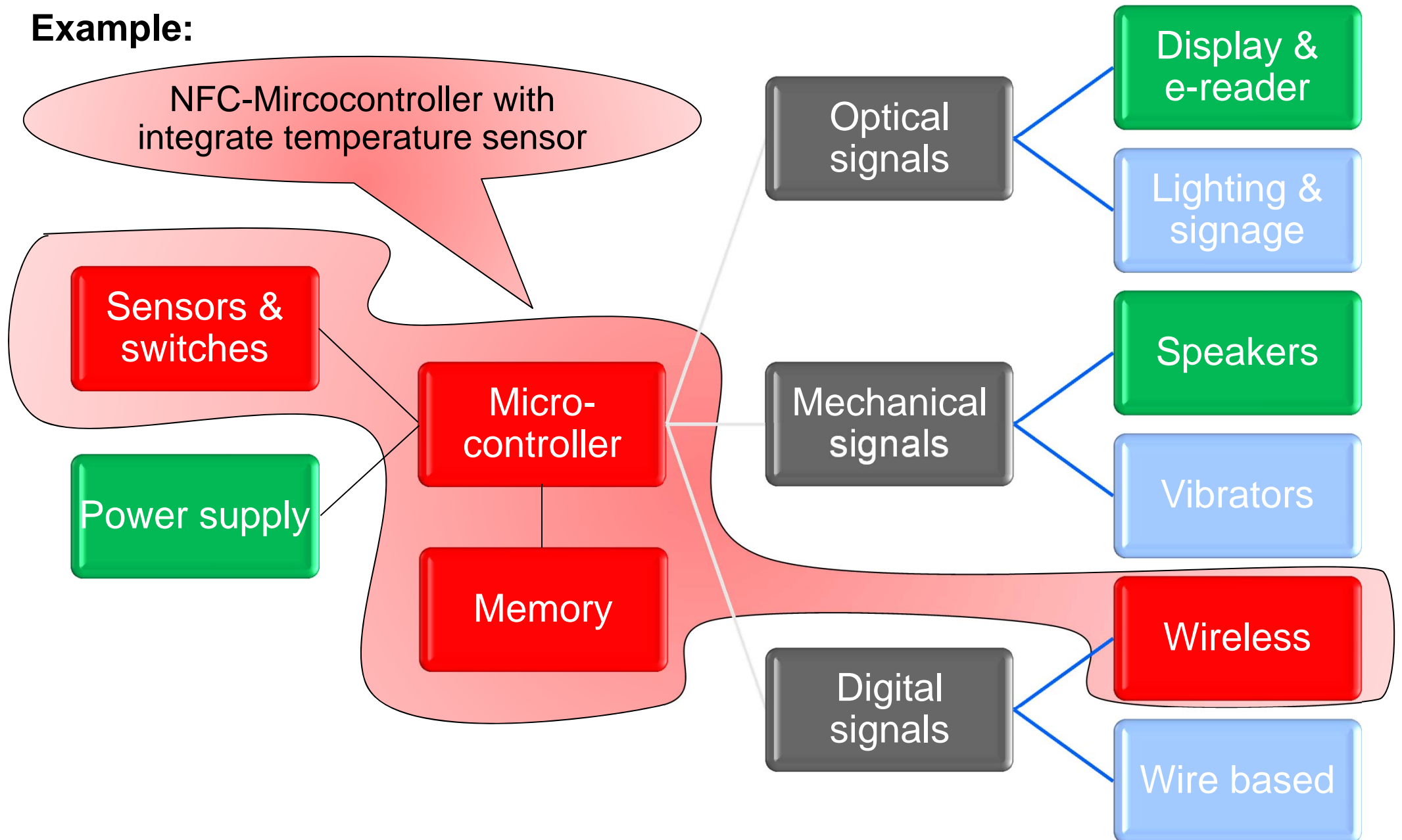


Intelligent Objects for Upgrading all Functions of Package

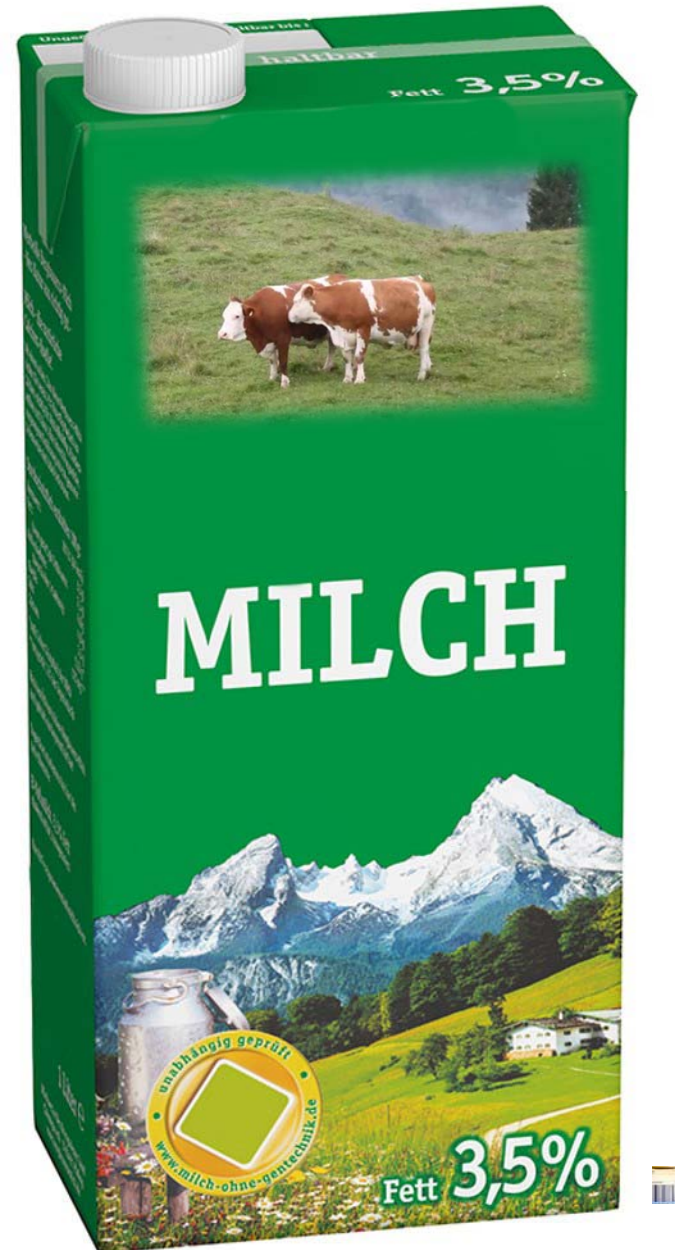
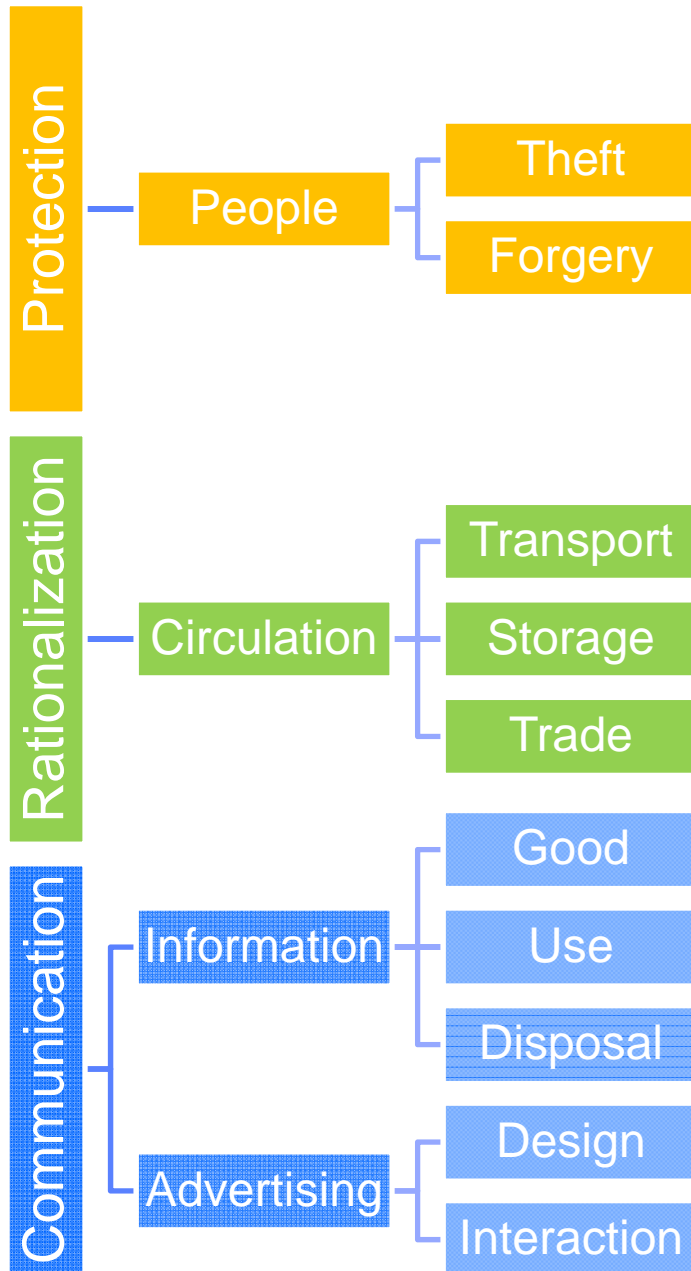


Intelligent Objects for Upgrading Functions of a Package

Example:



Intelligent Objects for Upgrading all Functions of a Package



Intelligent Objects for Upgrading all Functions of a Package

Sensors

- Control the quality of the packed product
- Identify costumer

Display and speaker

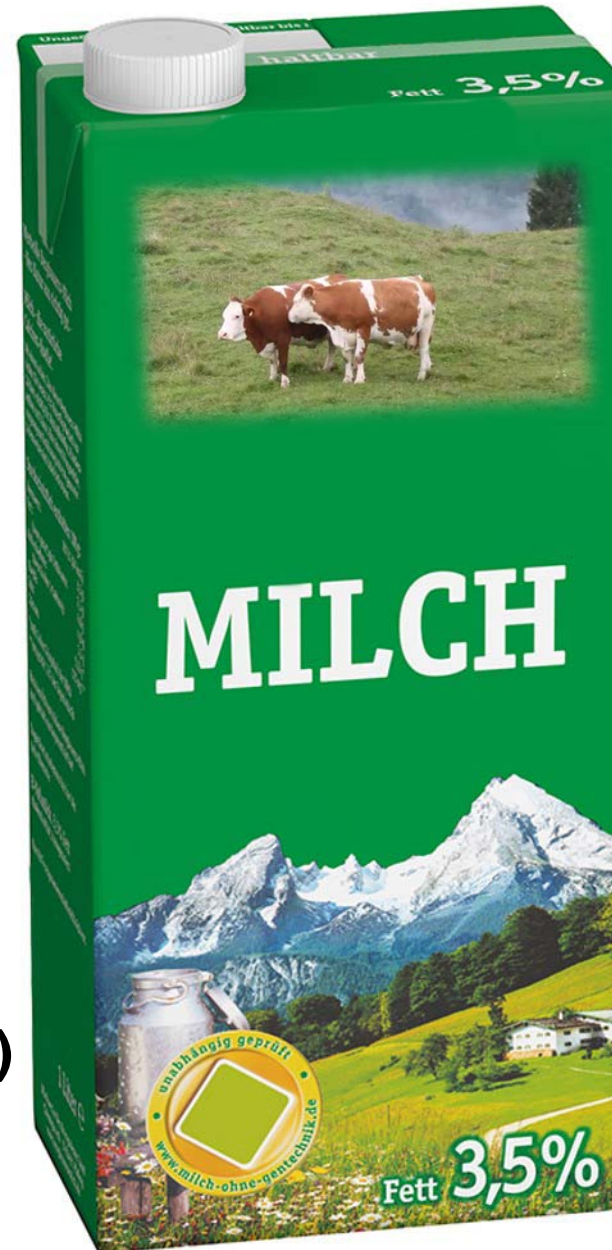
- Advertise the product
- Inform about the actual product quality
- Show the actual prizing

Wireless data exchange

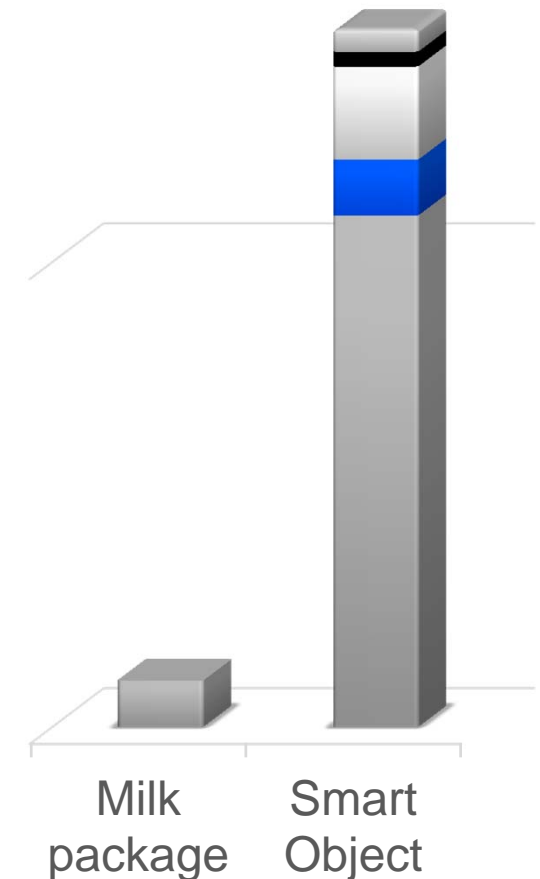
- Product quality information
- Update of advertising and prizing

Support (energy, data processing)

- Accumulator
- Microcontroller
- Memory



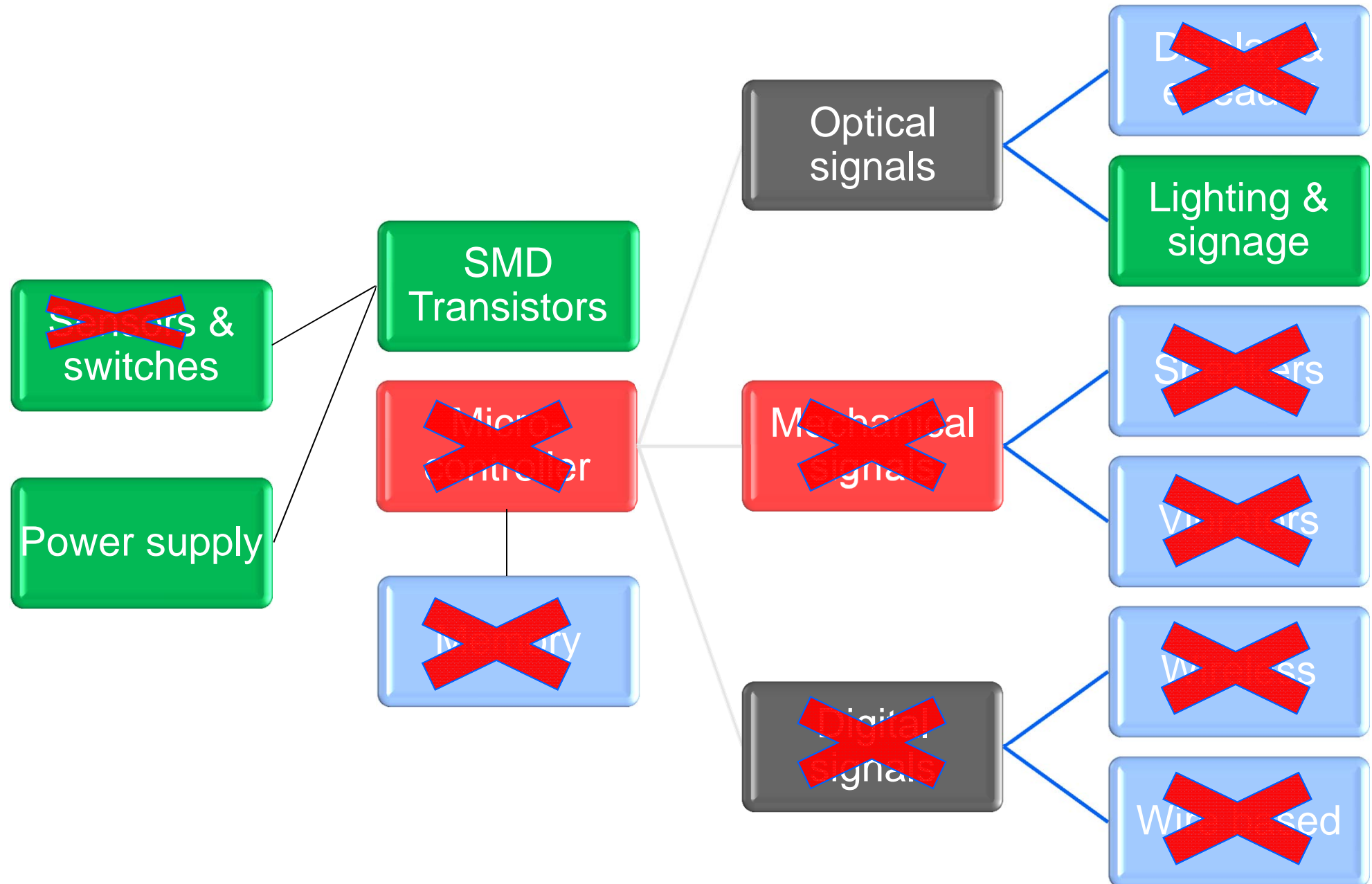
Costs



Feasible but
Added costs exceed
added value



Smart Objects for Upgrading Functions of a Package



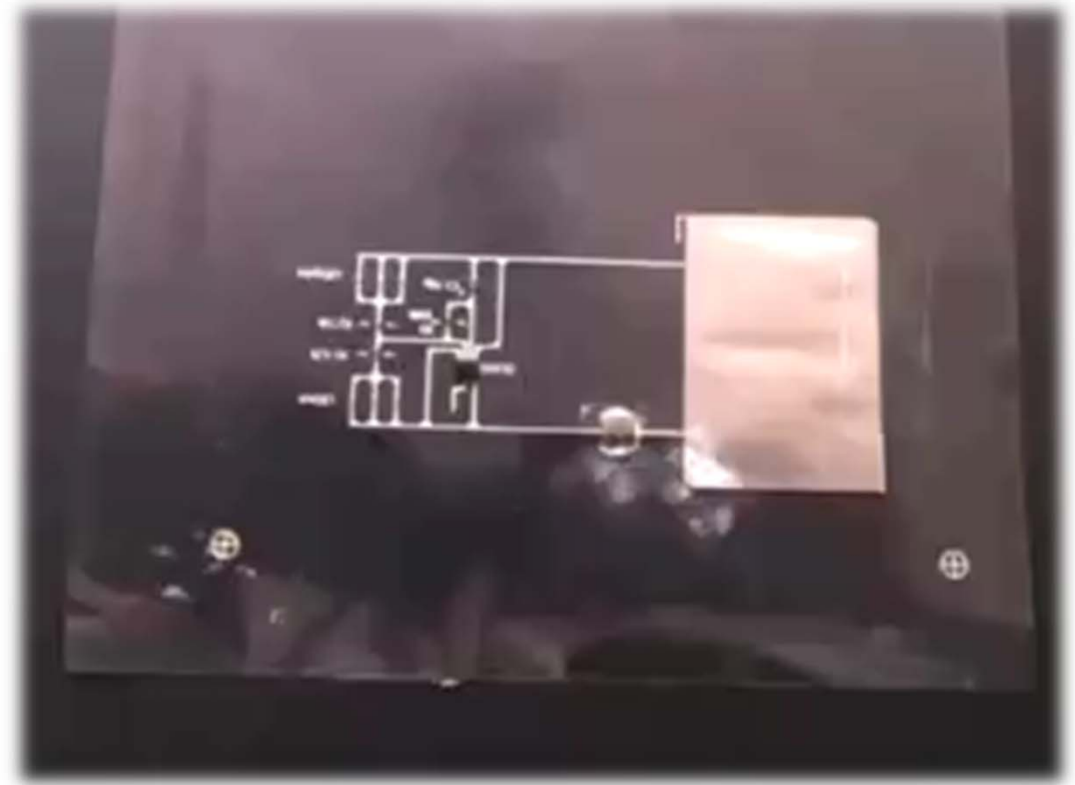
Smart Objects for Upgrading Functions of a Package

Function

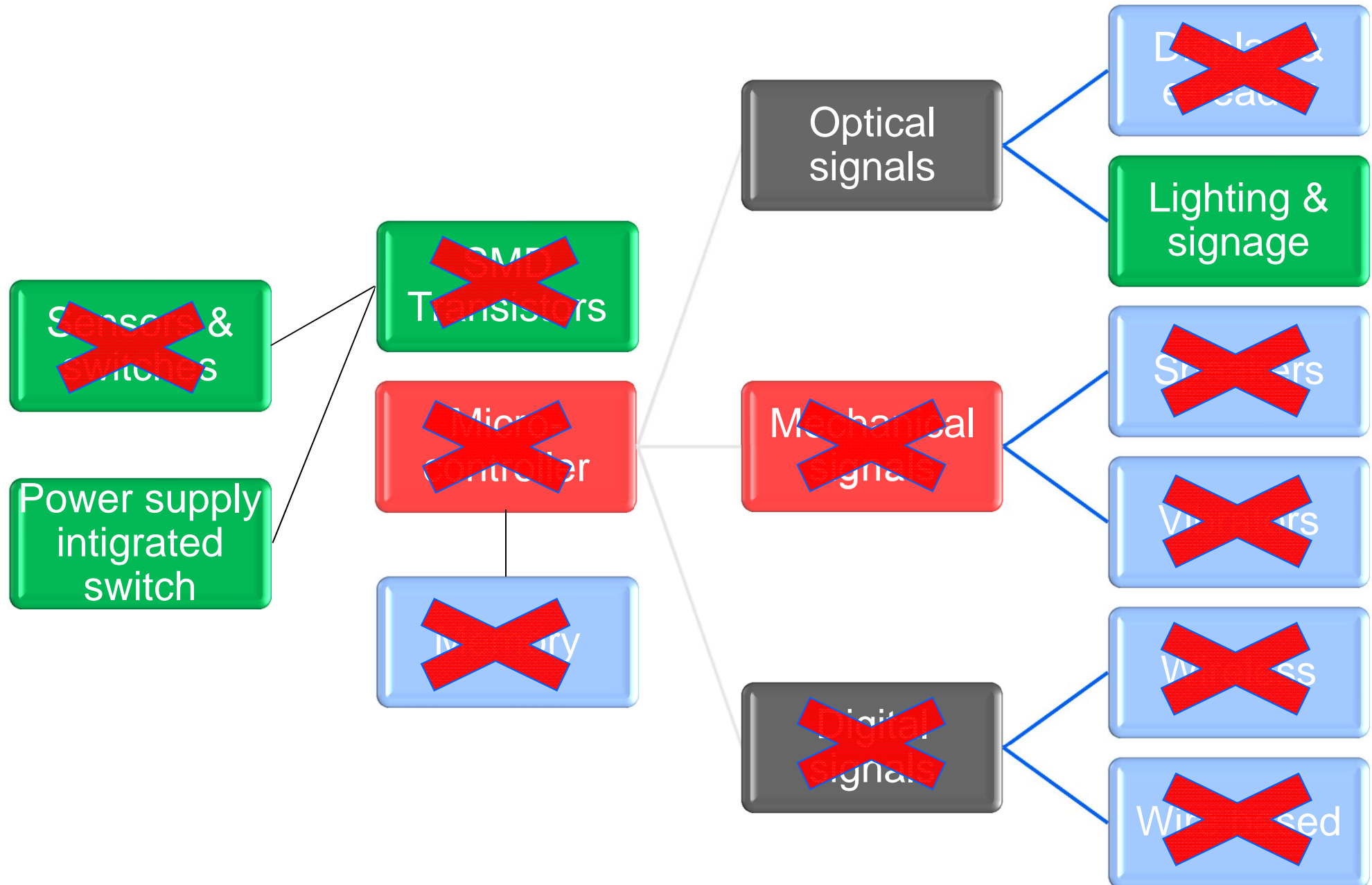
- Touching the package starts light or shows signage
- Blinking optional

Setup

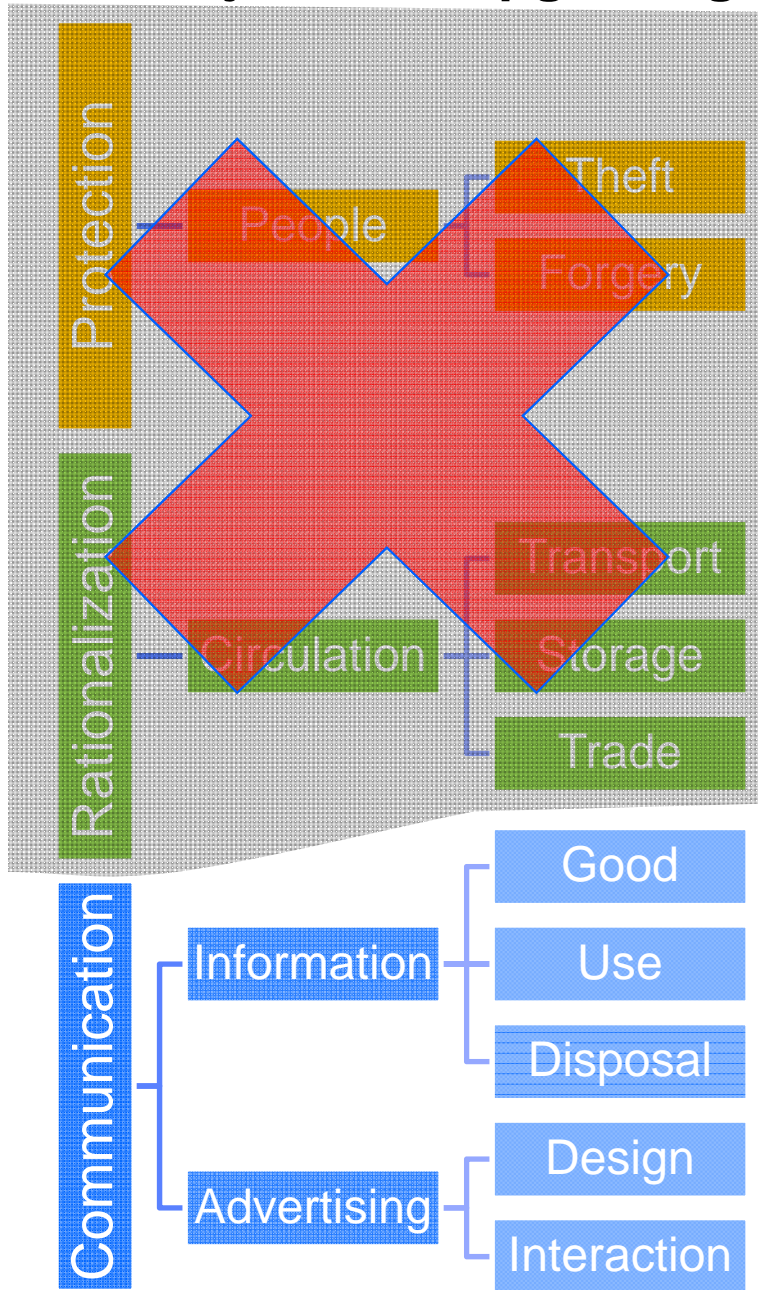
- Sensors
 - Touch sensor
 - Reed - Switch
- Light or Signage
 - LED
 - Electro-chromic display
- Support
 - Printed battery
 - Coin cell
 - SMD-Transistors
 - SMD-Resistors
 - Printed conductive lines



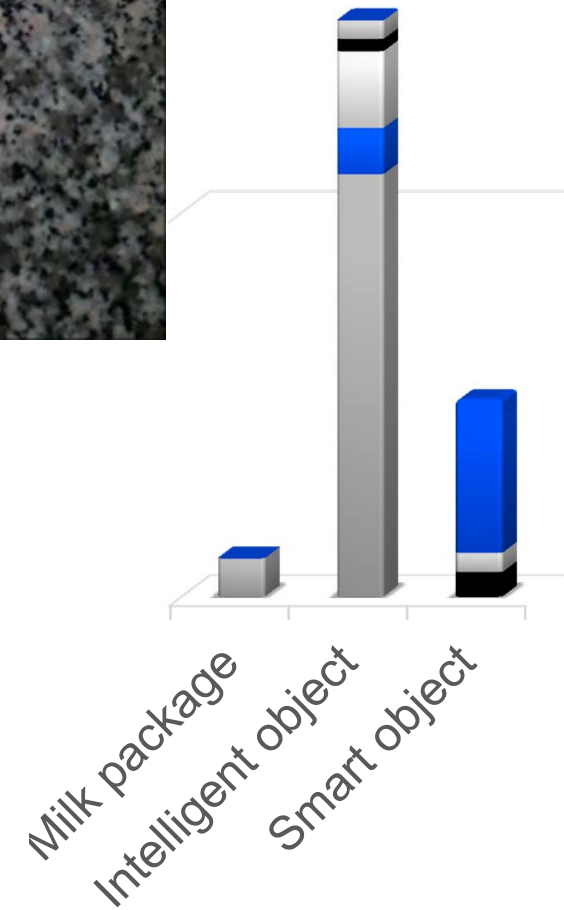
Smart Objects for Upgrading Functions of a Package



Smart Objects for Upgrading Functions of a Package



Costs



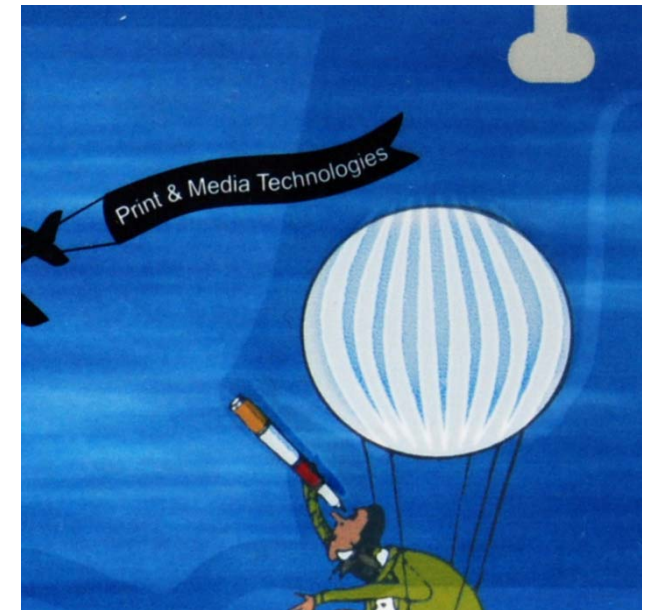
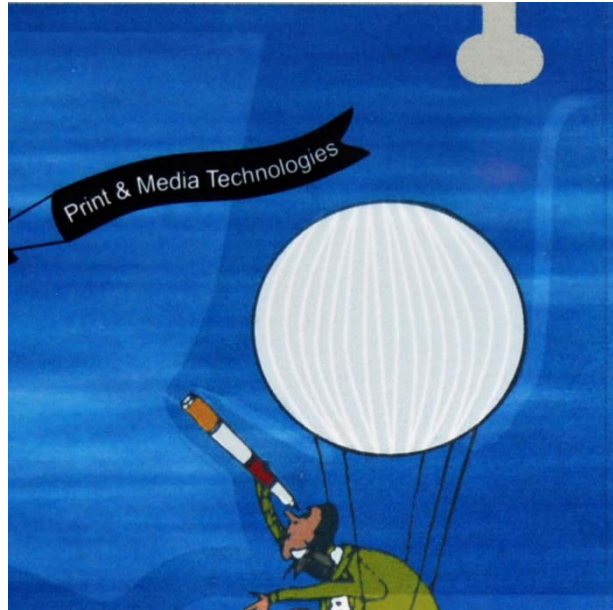
Package with Improved Advertising Function

Function

- Opening the package starts electro-chromic signage

Hybrid Setup

- Sensors
 - Magnetic - Switch
- Signage
 - Electro-chromic display
- Support
 - Printed battery
 - Coin cell
 - Printed conductive lines

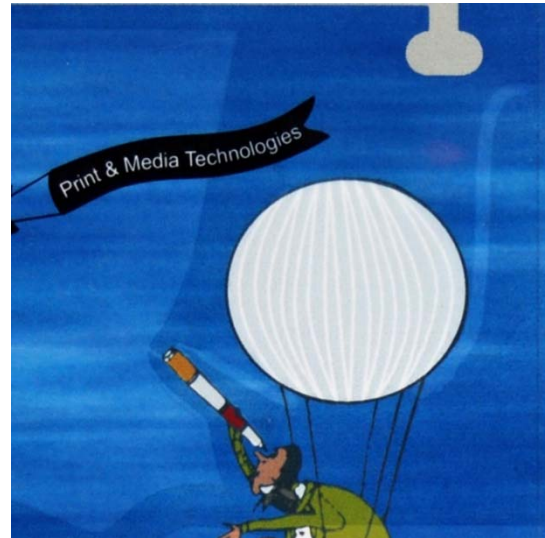
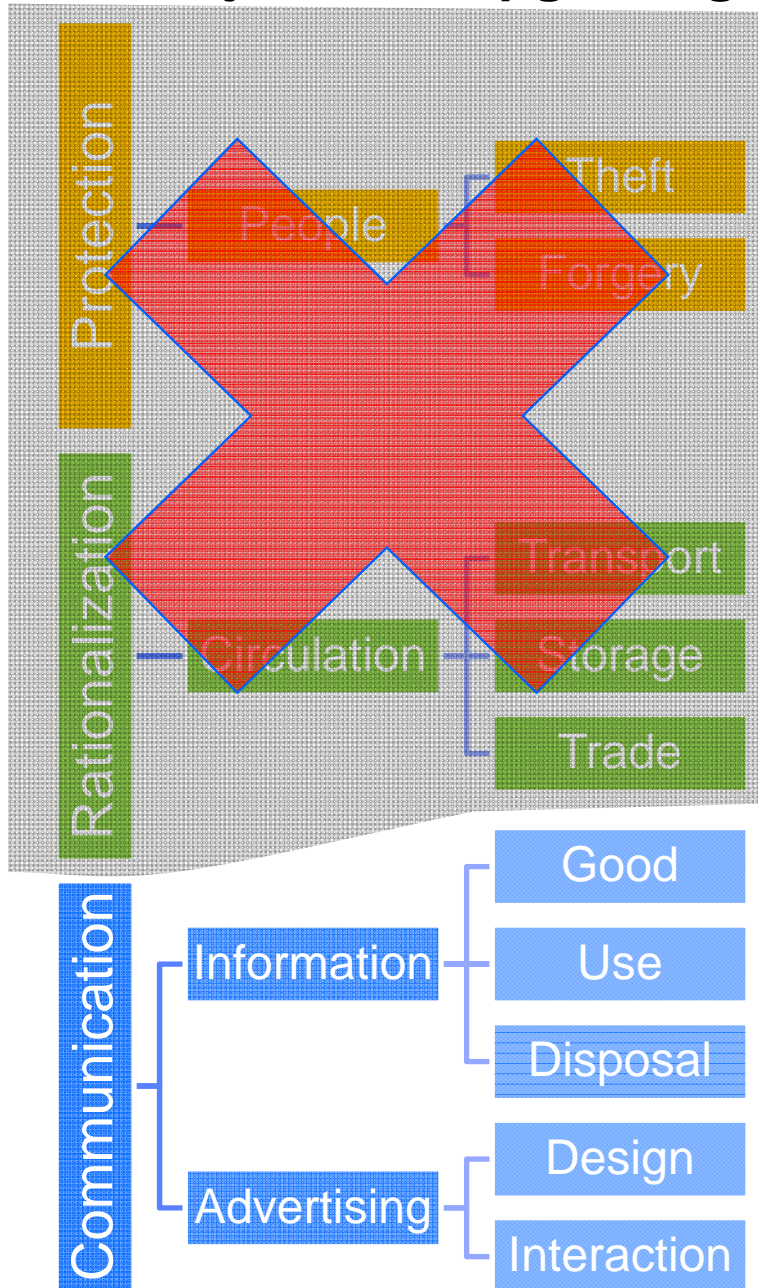


Cost

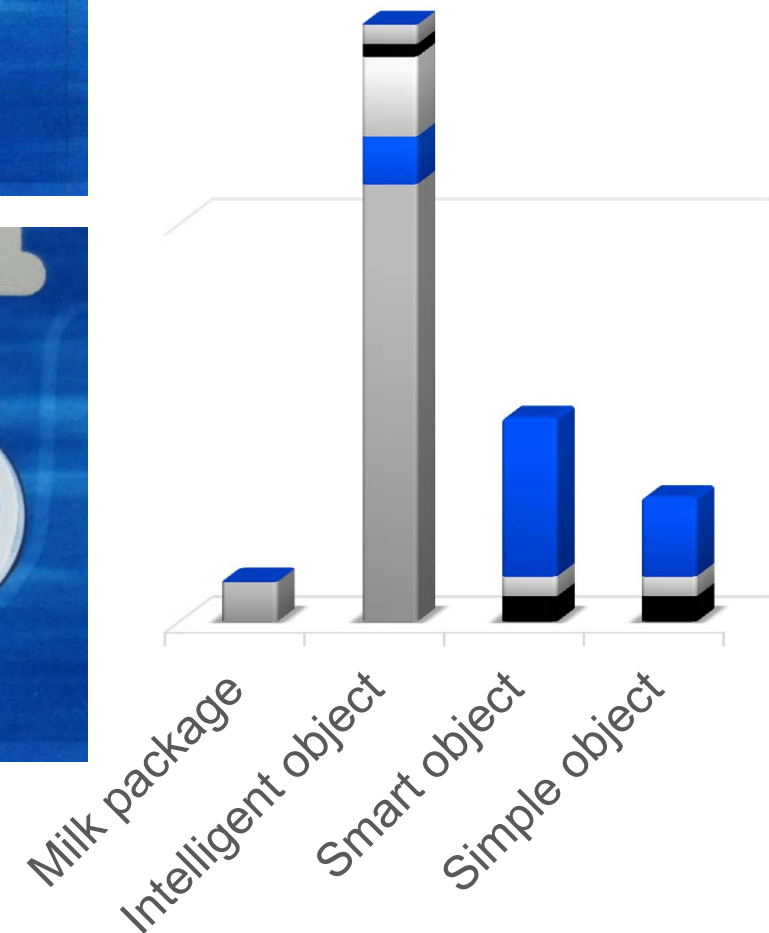
- Acceptable for higher end products



Smart Objects for Upgrading Functions of a Package

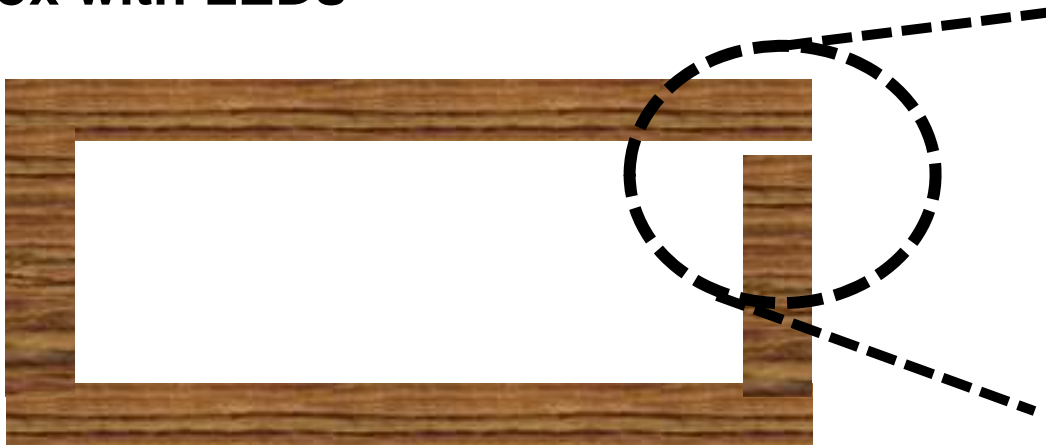


Costs



Battery as Magnetic Switch

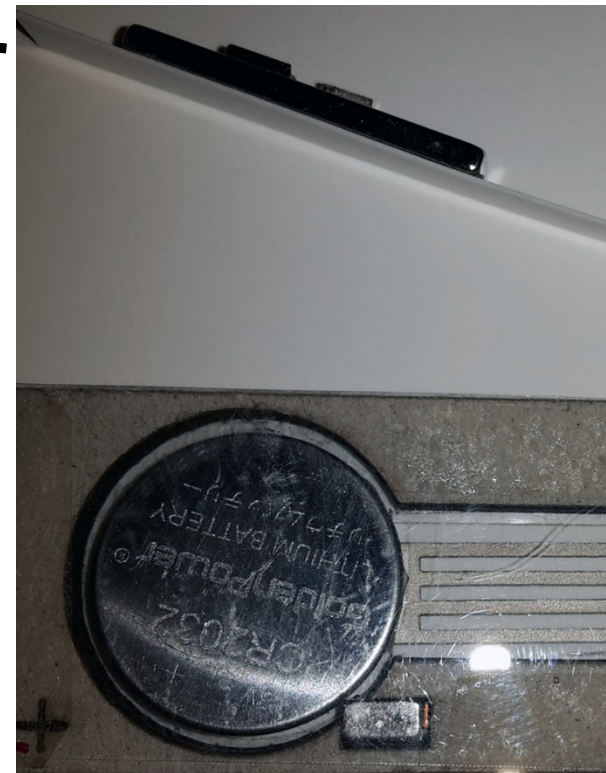
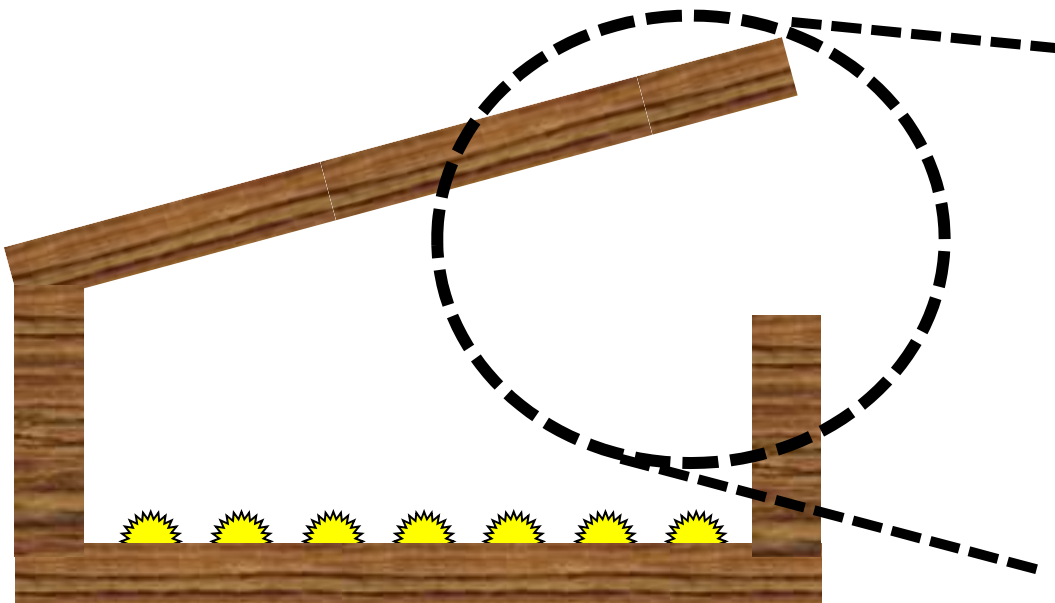
Box with LEDs



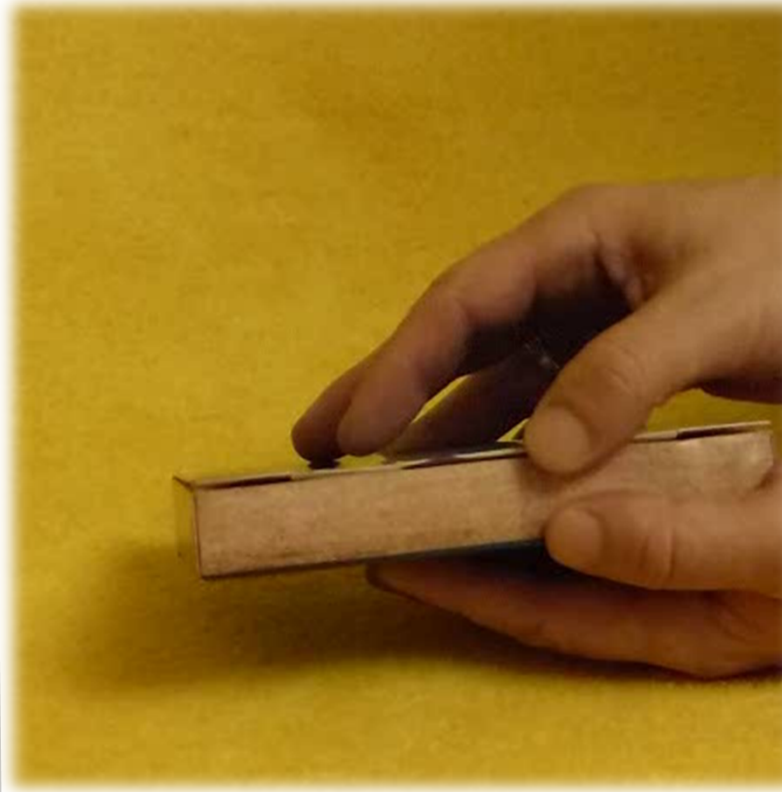
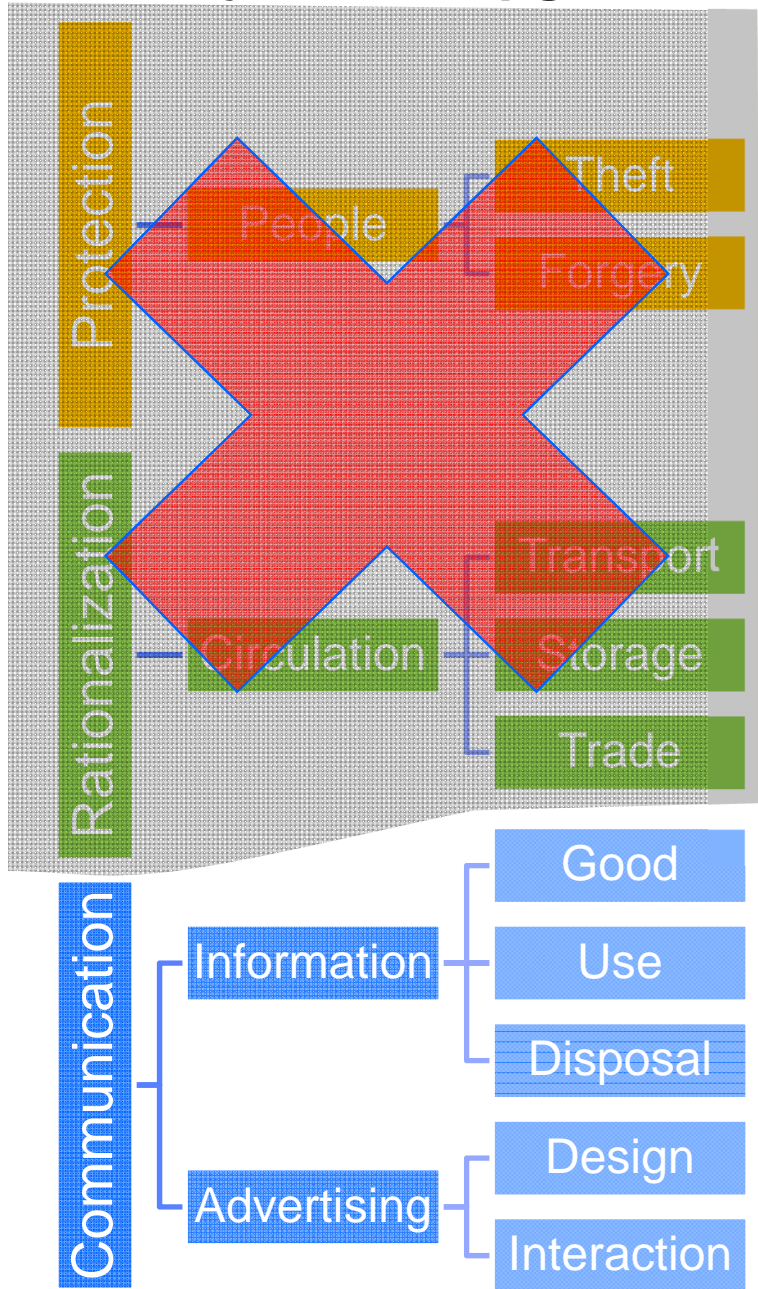
Magnet to disconnect

Conductive lines
Ag printed on PET

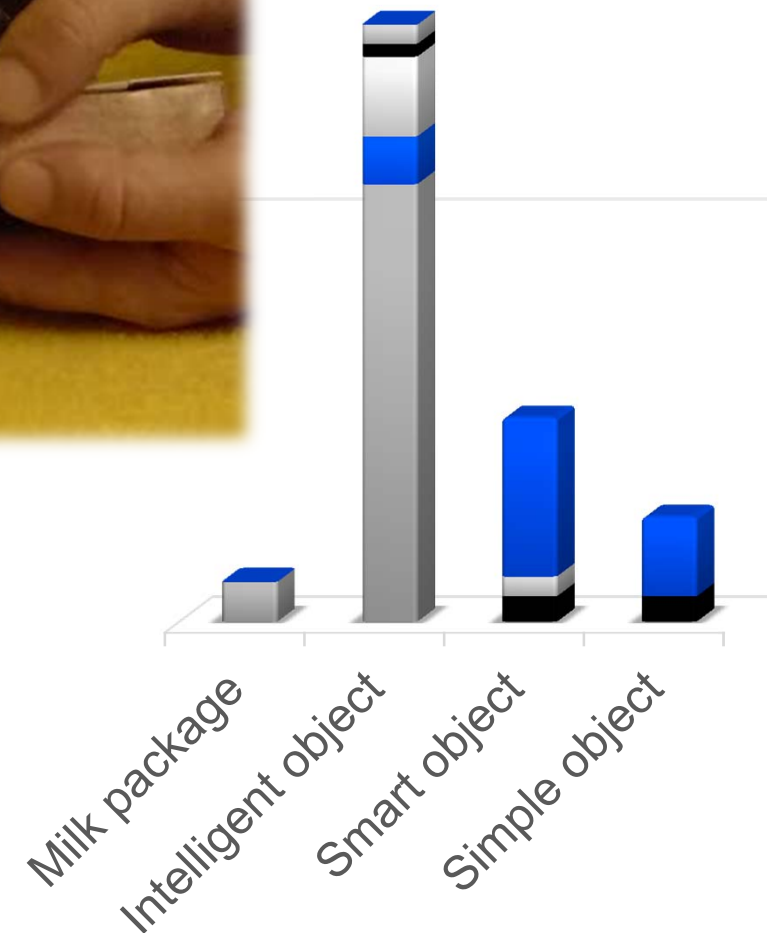
Magnet to connect



Smart Objects for Upgrading Functions of a Package



Costs



Summery

Electronics can improve the functions of a package.

Requirement: Low priced electronics

- Added value by electronics must exceed added costs

Printed electronics has advantages compared to standard electronics

- Light
- Thin and flexible
- Robust
- (Environmental friendly)

Strength of low cost printed electronics in package: Improve its communication function by

- Lighting & signage by now
- Mechanical signals by 2025

Best opportunities by hybrid electronics

- To select best of printed and standard electronic world

