Reuse and Quality Enhancement via Computation and Distribution of Component Derivative Rewards

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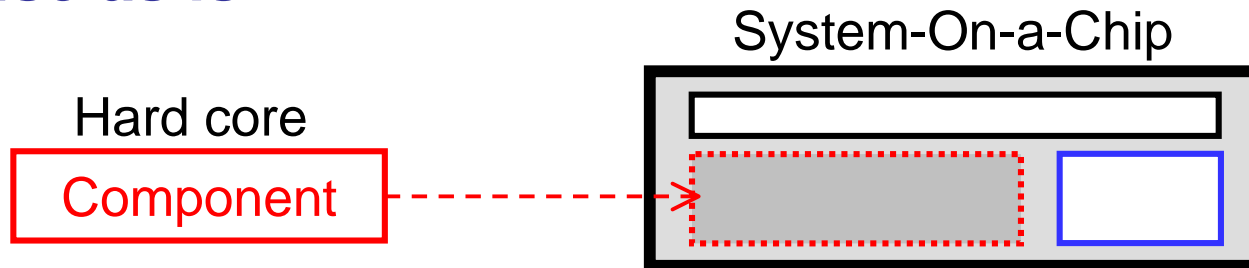
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April 16, 2002

Motivation

◆ **Tight cost, time-to-market, performance constraints**
- ■ **Must evaluate potential for components to be implemented with existing components**
- ■ **Must incorporate reusability in own components**

◆ **Component reuse solution difficult to apply**
- ■ **Must satisfy schedule development commitments**
- ■ **All parties in reuse transaction must benefit**
- ■ **Corporate entity as a whole must profit**

◆ *Is it possible to reconcile these requirements?*

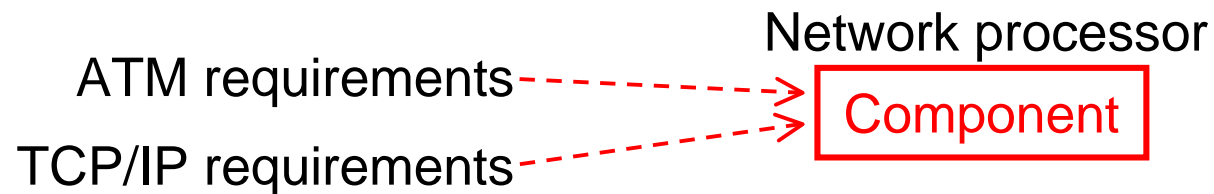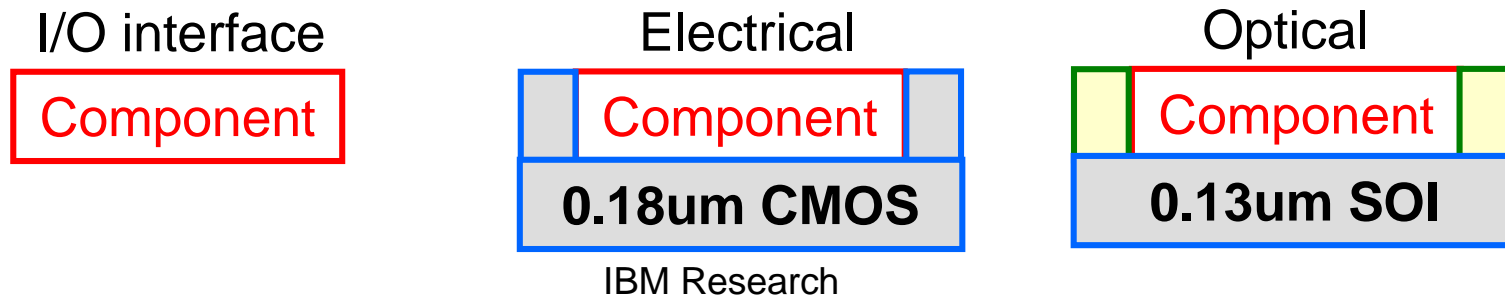IBM Research

Types of Component Reuse

- **Reuse as is**

  System-On-a-Chip

  Hard core

  Component

- **Amalgamate requirements**

  Network processor

  ATM requirements

  TCP/IP requirements

  Component

- **Adapt to application (our focus)**

  I/O interface

  Component

  Electrical

  Component

  0.18um CMOS

  Optical

  Component

  0.13um SOI

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The Component Reuse Problem

Producer of component   **Consumer of component**

Function/performance
Technology
Reusability

Technical compatibility

Requirements

"Adaptation" cost
Resources (PYs, $)
Schedule constraints

Economic compatibility

DE cost w/o reuse
DE cost with reuse
Schedule

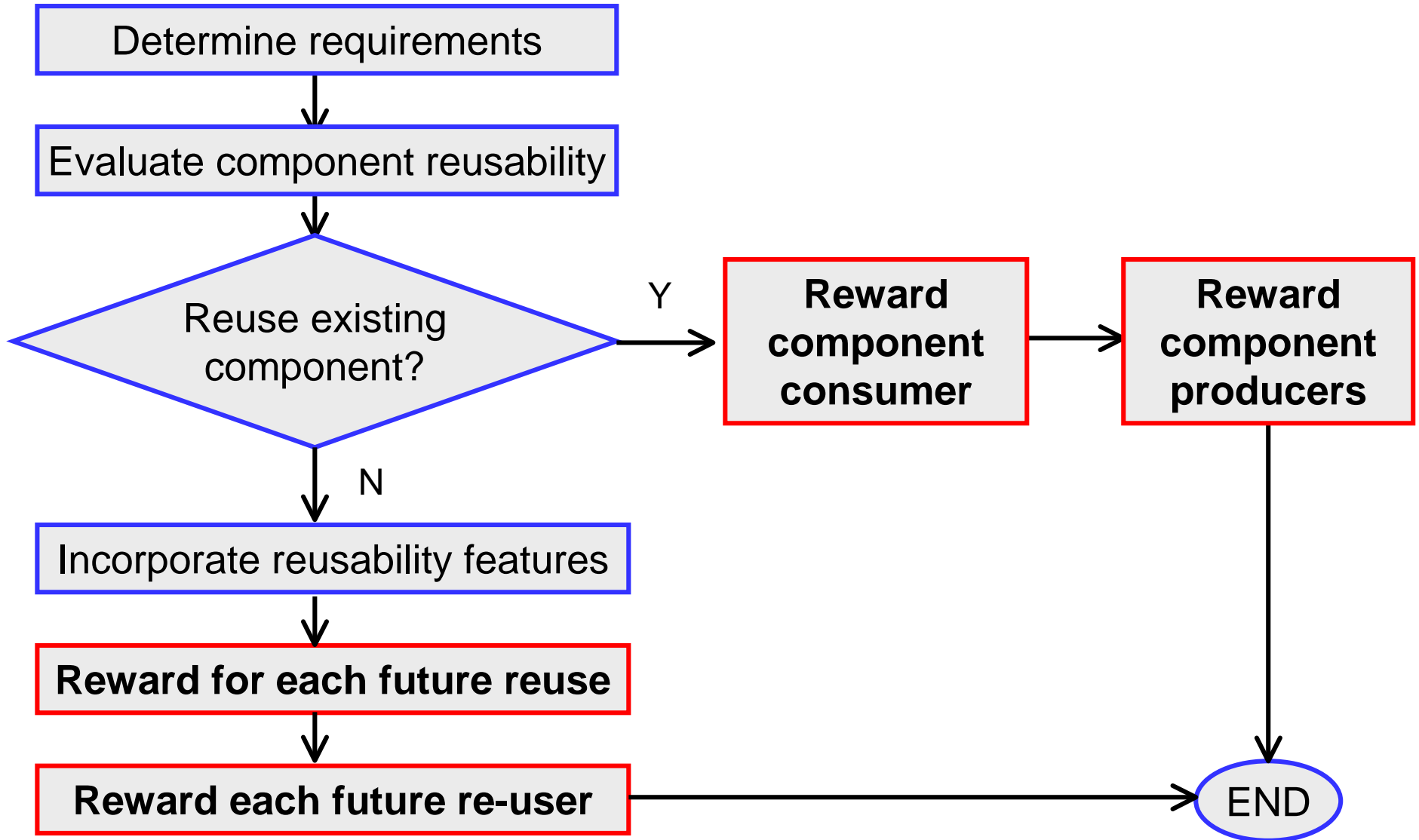**"Supply"** ←————————→ **"Demand"**

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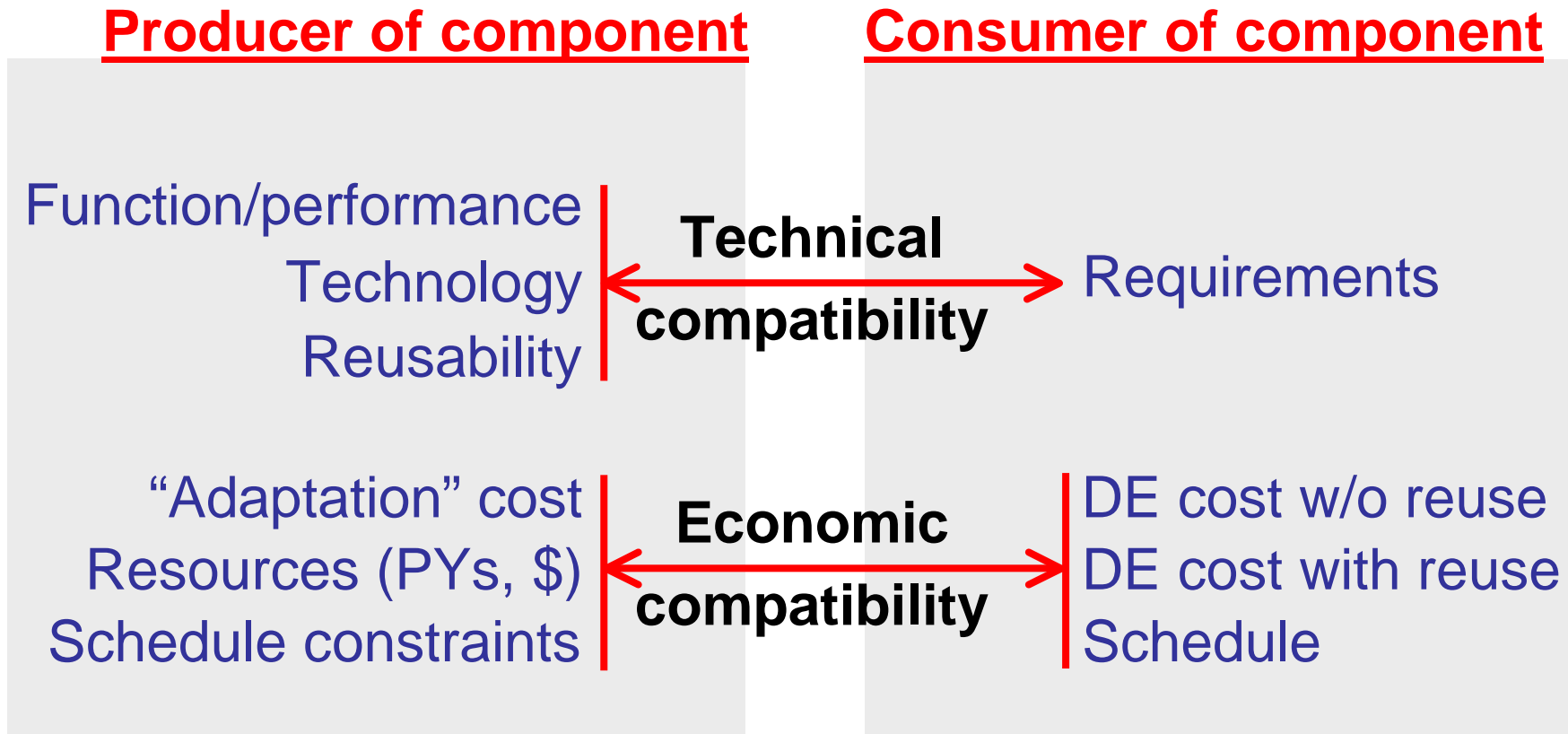
Prior Work

◆ **Hardware reuse approaches**
- ■ **Design support and protection aspects**

◆ **Software reuse techniques and economics**
- ■ **Technical and measurement aspects**

◆ **Massive taskforces/management actions**
- ■ **Cannot avoid proliferation of designs**

◆ **Stock options and variable pay**
- ■ **Too diluted in quantity**

◆ **Innovation management techniques**
- ■ **Information and process management, costing**

◆ *Must address incentives to produce reusable designs*

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Overview of Approach

◆ **Methodology and system for encouraging reuse**
- ■ **Multiple reward or compensation structure**

◆ **Encourages team to use existing components**
- ■ **Rewards team that reuses a component**

◆ **Encourages team to incorporate reusability in own component**
- ■ **Rewards individual members of team**
- ■ **Rewards corporate entity that "sponsors" team**

◆ **Administrator may adjust the relative rewards**
- ■ **Modulate preference for innovation in selected areas**

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Process Flow Description

Determine requirements

Evaluate component reusability

Reuse existing component?

Y → **Reward component consumer** → **Reward component producers**

N

Incorporate reusability features

Reward for each future reuse
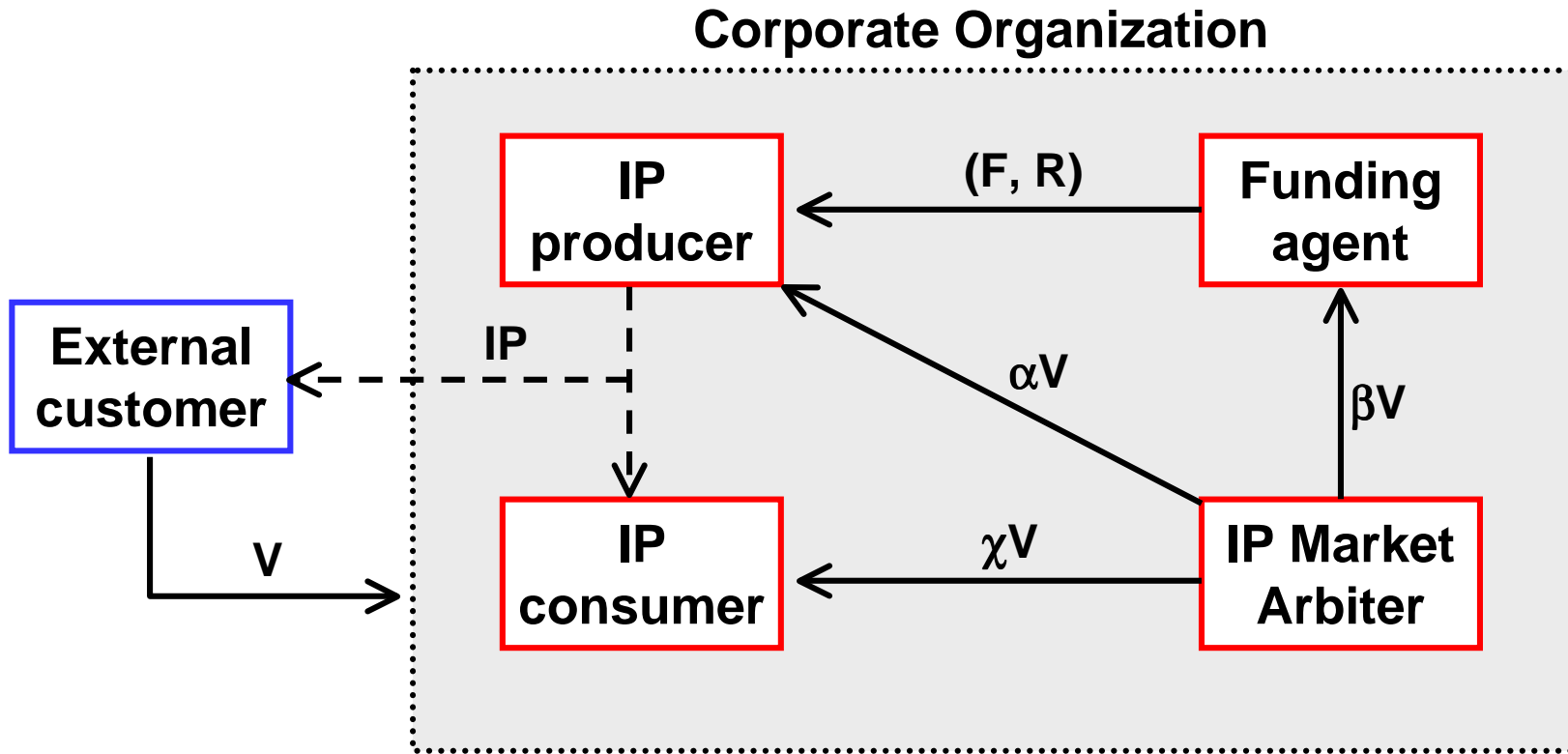
Reward each future re-user → END

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Benefits

◆ **Increase in reuse**
- ■ **Due to expectation of payments**

◆ **Increase in quality**
- ■ **In terms of reusability (e.g., documentation)**
- ■ **Improves return on investment (ROI)**

◆ **Improved cross-functional cooperation**
- ■ **To produce reusable intellectual property (IP)**
- ■ **Common interest to maximize rewards**

◆ **Improved engineer retention**
- ■ **Expectation of payments**
- ■ **Satisfaction of multiple uses for innovations**

Funding Model (Linear Version)

Corporate Organization

| IP producer | ← (F, R) | Funding agent |

External customer → IP → IP consumer

αV → IP producer
βV → Funding agent
χV → IP consumer
V → External customer to IP consumer

IP Market Arbiter

LEGEND

V = market value	α = producer reward coeff.	χ = consumer reward coeff.
IP = component	β = sponsor reward coeff.	**(F,R)** =funding & resources

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System Architecture
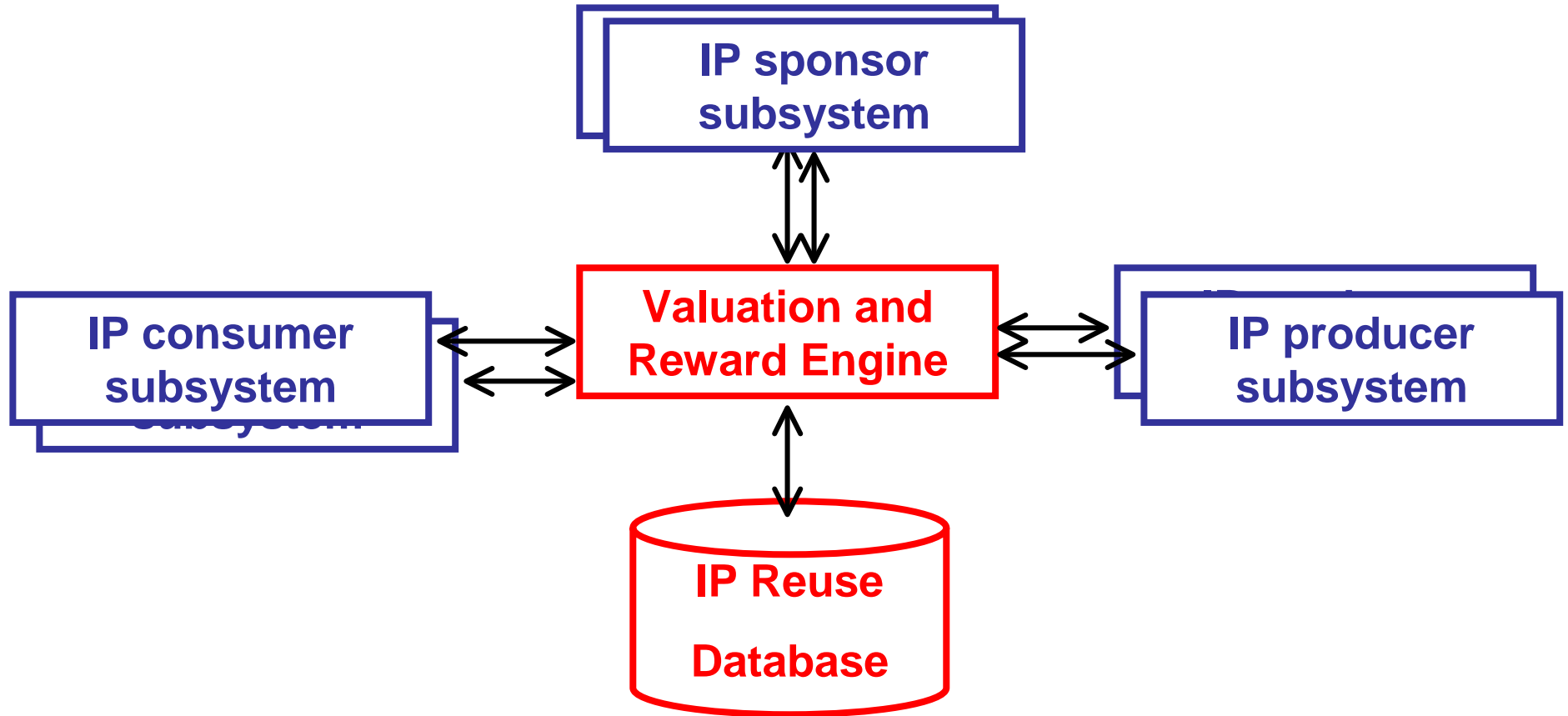
Example Description
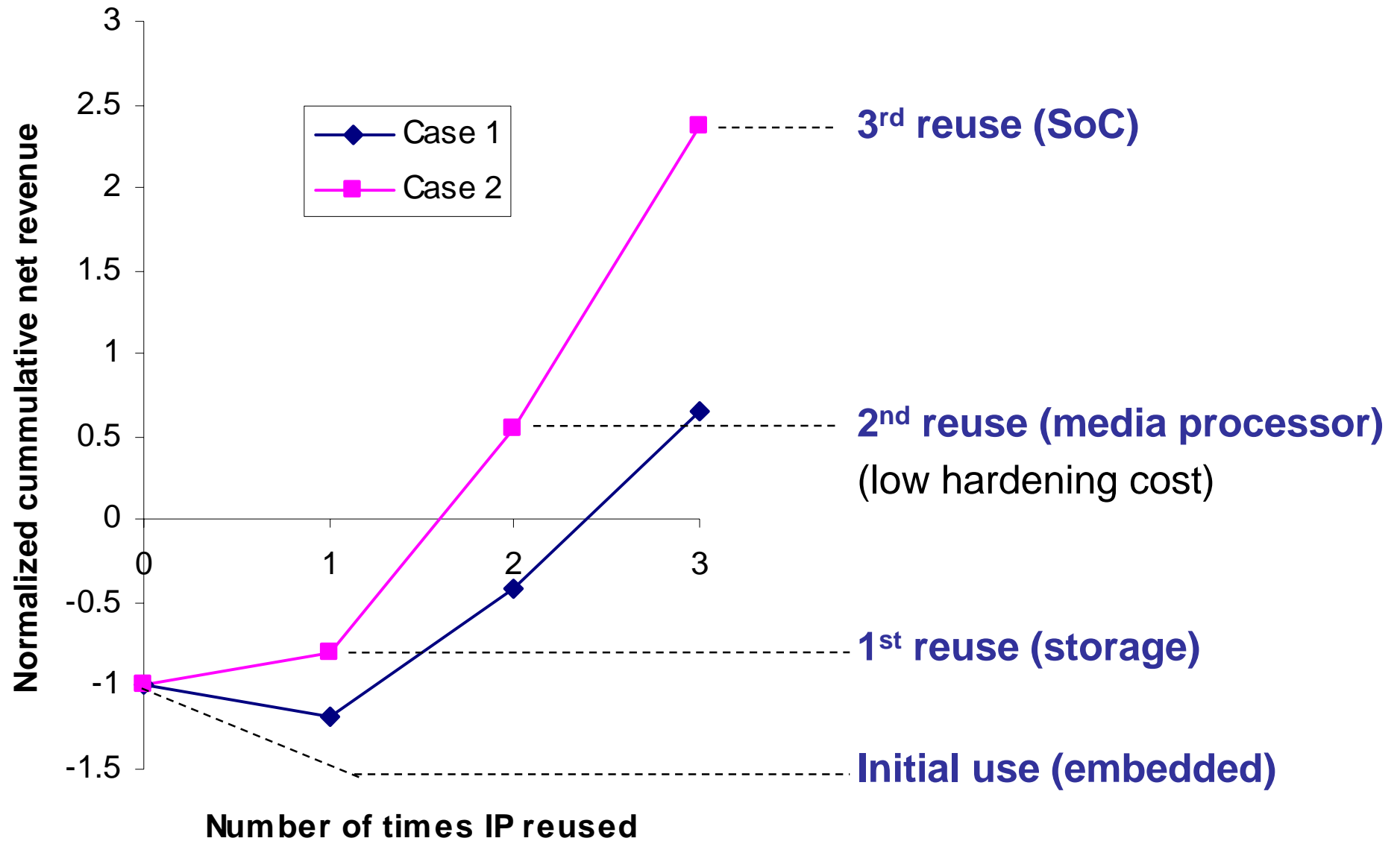
◆ **Serial I/O circuit**

  ▪ **Initially intended for embedded application**

◆ **Assumptions**

  ▪ **Linear reward model**

  ▪ **Two cases considered, using different reward parameters for the IP producer.**

Parameter	Case 1	Case 2
α (producer reward)	10%	15%
β (sponsor reward)	10%	10%
χ (consumer reward)	5%	5%

Results for Component Producer

Observations

◆ **"Break-even" point achieved due to**
  - ■ **Income derived from direct reward**
  - ■ **Higher component value due to faster design**

◆ **Enables *independence effect***
  - ■ **Reduced need for sponsor resources and funding**
  - ■ **Can mitigate by controlling reward**

◆ **Can effect innovation**
  - ■ **Creativity discouraged by higher reward rate**
  - ■ **Decreasing reward function may be needed**

Conclusions

◆ **Method and system encourages reuse by**

- **Evaluating and responding to opportunity to use previous designs**
- **Developing components with regard to future reuse**
- **Rewarding the component innovator, and**
- **Rewarding the component consumer**

◆ **Further work**

- **Development of support infrastructure**
- **Valuation and reward management engine**
- **Techniques to optimally determine reward rates.**

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Outstanding Questions

- ◆ **Rewards**
  - ■ **How to compute optimal reward functions?**
  - ■ **What is the global objective function to maximize?**
  - ■ **Can strategic aspects be accounted for?**

- ◆ **Valuation**
  - ■ **What valuation methodology provides best result?**
  - ■ **How to value a component only for internal use?**
  - ■ **How to value a component bundled in a product?**