innovations
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Energy efficient middleware design in support of user privacy

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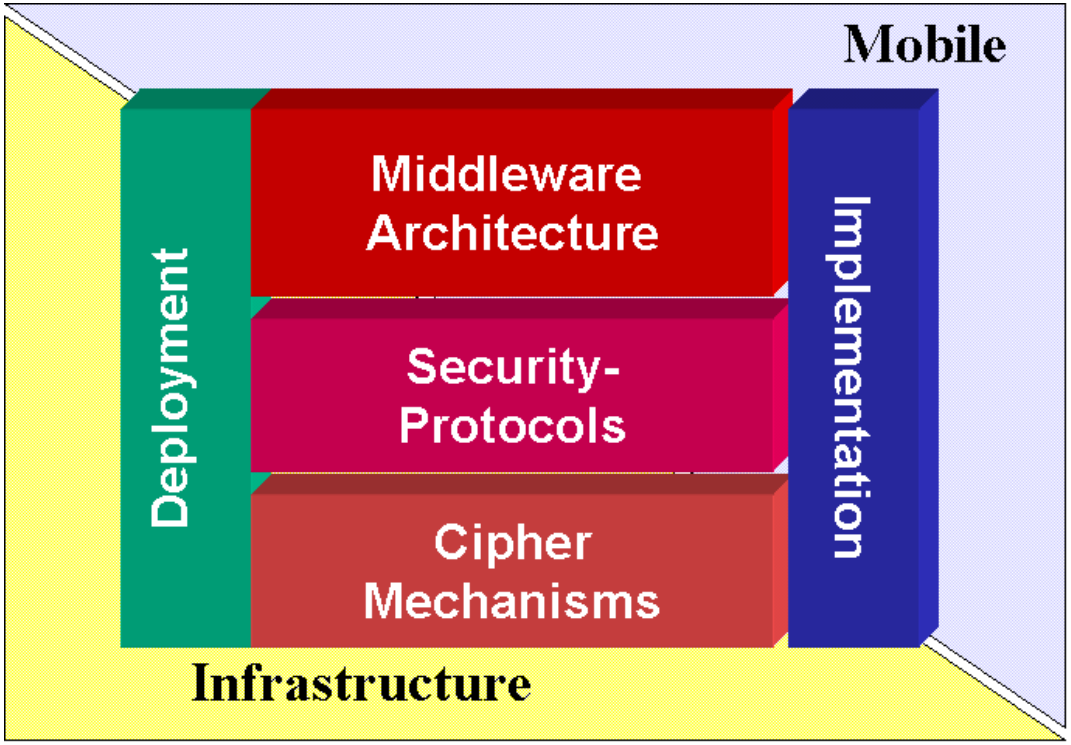
Outline

- **Motivation**
- **Case Study: PLASMA's vertical cross-layer approach**
- **Analysis of the state of the art**
- **Discussion of open issues**
- **References**

Why a vertical cross-layer Approach?

- **Consider only the platform?**
  - Lot of opportunities to improve the system are excluded
- **Consider only hardware accelerators?**
  - Limited flexibility
  - Only some specially equipped devices will benefit
- **Solution: Inter-domain Approach**
  - Take into account all aspects of the whole system
  - Adaptation to the different/changing situations

PLASMA‘ s vertical cross-layer Approach



Potential savings for combined RSA/ECC approach

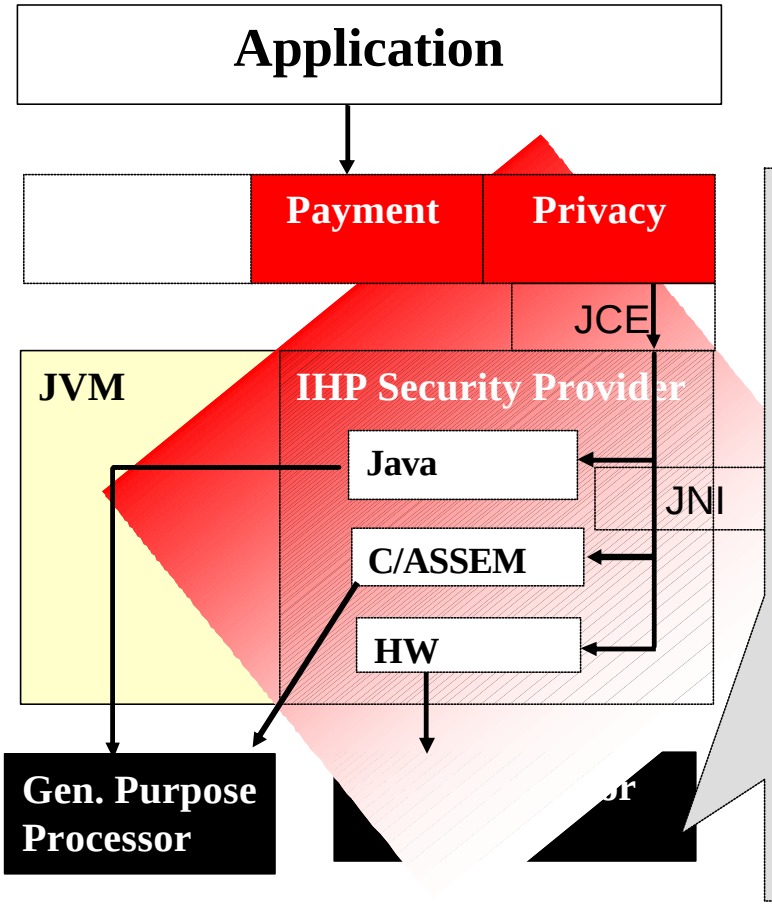
Computational load: signature generation/ verification 23/24;

Approach / Measured results	Combination	pure RSA: exp=3		pure ECC: B-163	
Speed up factor	K-163, RSA exp=3	47.0	14.4	1.6	2
Saved computing time [s]		458.9	859.1	5.6	64.63

Measurements done on HP Journada using the Miracle lib.

Values from literature measured on a Palm (J. Lopez et.)

HW/SW Architecture of the Mobile Device



Accelerator for ECC

- Complexity: ~40 000 gates
- Clock cycles per encryption of 233 bytes: 90 404
- Energy needed per encryption: 0.8mWs

Accelerator for AES

- Complexity: ~36 000 gates
- Clock cycles per encryption of 100 Mbit: 10 937 500
- Energy needed per encryption: 66 mWs

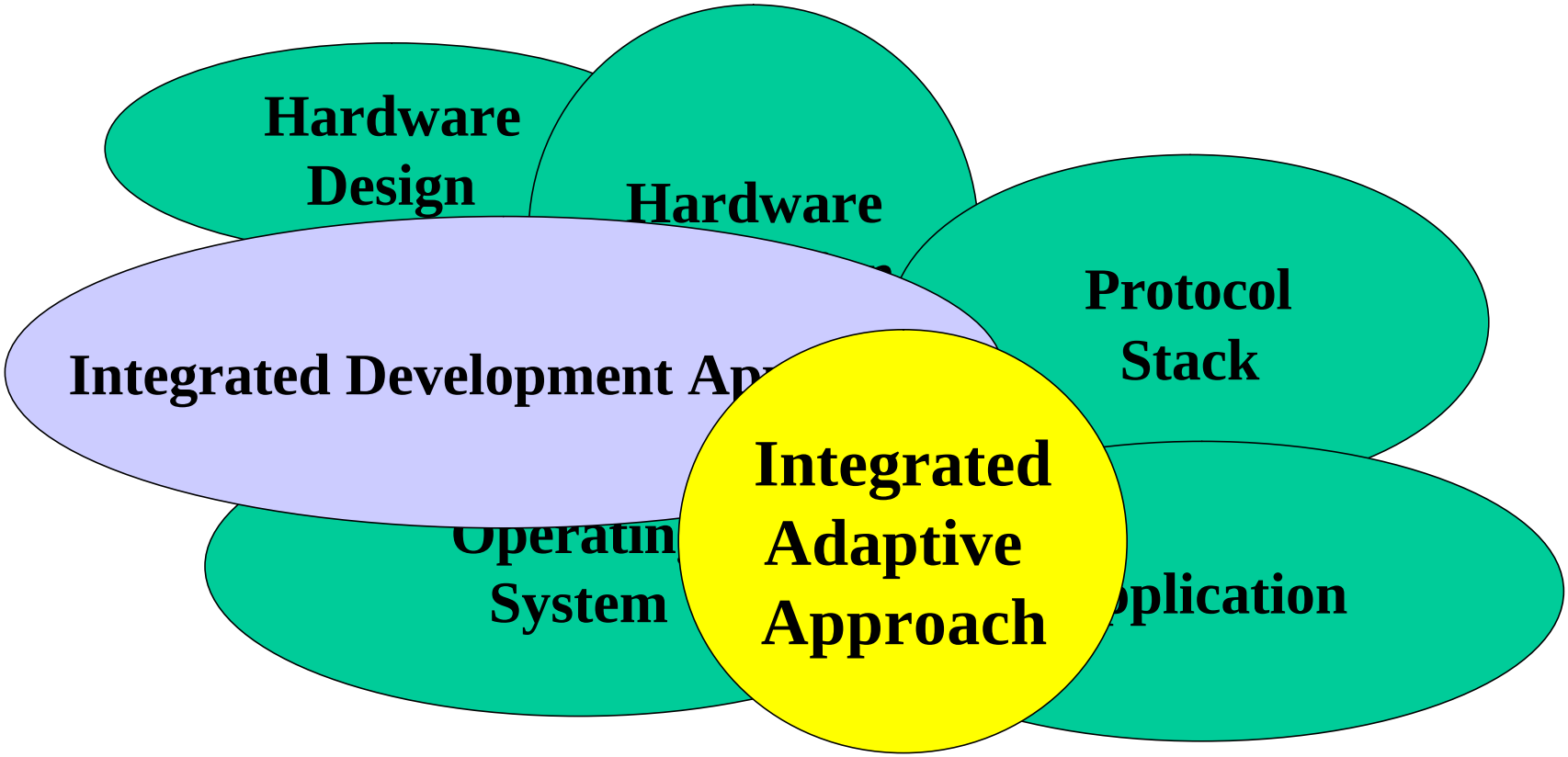
Performance compared to software solutions

- Two orders of magnitude less in energy consumption
- Two orders of magnitude less in time consumption

Analysis: State of the Art

- **Hardware Optimization Opportunities**
  - Specialized hardware e.g. ASICs [12],
  - Tuned HW components e.g. multiplier operand size [7]
  - Clock frequency/ Dynamic Voltage Scaling [7]
- **Protocol Stack Optimization**
  - Integrated Layer Processing [14, 15]
  - Protocol Layer Interaction [4, 8, 9]
- **Middleware Optimization (Adaptive/ a priori)**
  - Load shifting [5, 3]
  - Application specific optimizations [1, 6, 12]
  - Adaptive concepts [2]

What is missing/ What is needed



Open Research Topics

Further progress needs

- **Integrated Development (IDA)**
- **Integrated Adaptive Approach (IAA)**

Such as

- **Methodologies to develop IAA supporting systems**
- **Methodologies to exploit IAA for a certain application/environment**
- **Semantic description of optimization knobs**
- **IAA Management Plane**

PLUS your suggestions . . . . .

Thank you for your attention

Questions, Comments?

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