An Experimental Study on Energy Consumption of Video Encryption for Mobile Handheld Devices

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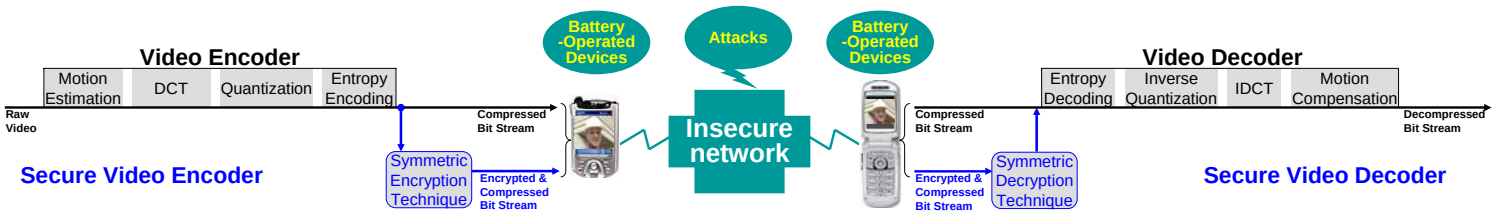
Overview of Secure Video Applications

Problem and Motivation

- Mobile multimedia applications are vulnerable to security attacks in wireless networks
- Significant computation for video encryption is expected on battery-operated mobile devices

▶ **Evaluate symmetric video encryption schemes from the perspective of energy consumption both analytically and experimentally**



Analytical Study of Video Encryption Schemes with respect to Energy Consumption

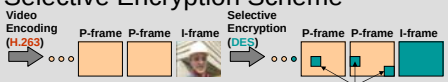
Studied Video Encryption Schemes

(1) Naive Encryption Scheme

❑ $Energy_{Naive} = e_{DES} * S_{Total}$

- e_{DES} - energy to encrypt one byte by DES
- S_{Total} - size of the whole video data

(2) Selective Encryption Scheme



❑ $Energy_{Selective} = e_{DES} * S_{IB}$

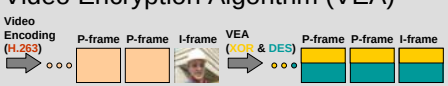
- S_{IB} - size of Intra-blocks in video data

(3) Zig-Zag Permutation Scheme

❑ $Energy_{Zig\text{-}Zag} = e_{overhead}$

- $e_{overhead}$ - energy to shuffle coefficients

(4) Video Encryption Algorithm (VEA)



❑ $Energy_{VEA} = \frac{1}{2} * (e_{DES} + e_{XOR}) * S_{Total}$

- e_{XOR} - energy for XOR

Analytical Comparison of Video Encryption Schemes

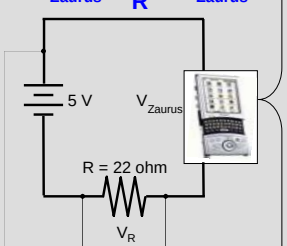
Algorithm		Security	Speed	Size	Drawback	Relative Energy
Naive	Encryption of all frames	High	Slow	No Change	Significant Computation	100 %
Selective	Partial encryption (e.g. Intra-blocks)	Moderate	Fast	No Change	Moderate Security	59 %
Zig-Zag	Shuffling coefficients from Quantization	Very Low	Very Fast	Big Increase	Breaks efficiency of Video Encoding	< 1 %
VEA	XORing and Half Encryption using even byte distribution	High	Fast	No Change	Not applicable for H.263 without even distribution	50 %

▶ **Naïve encryption scheme consumes twice the energy of Selective encryption scheme**

Experimental Study on Tradeoffs between Security and Energy Consumption

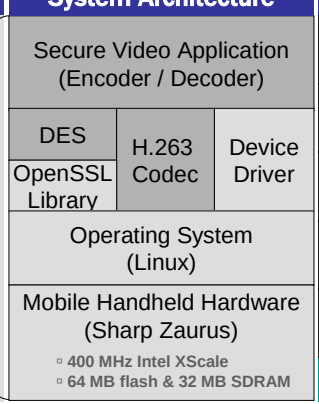
Experimental Setup

$$P_{Zaurus} = \frac{V_R}{R} * V_{Zaurus}$$



Power Measurement System

System Architecture

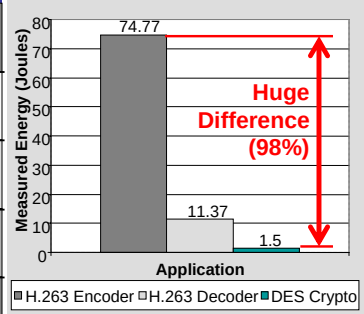


Energy Consumption for Varying Quality & Security

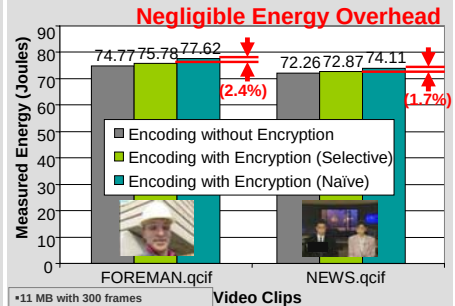
Quality (Quant Scale)	Security (Full vs. Partial)	Measured Energy (J)	Energy Overhead
High (Quant = 1)	High (Full)	128.2	13 %
	Low (Partial)	111.0	
Mid-High (Quant = 4)	High (Full)	92.05	9 %
	Low (Partial)	83.56	
Appropriate for mobile video: Mid-Low (Quant = 10)	High (Full)	77.62	2 %
	Low (Partial)	75.78	
Appropriate for mobile video: Low (Quant = 31)	High (Full)	70.44	1 %
	Low (Partial)	69.89	

▶ **Energy overhead for full video encryption is NEGLIGIBLE**

Experimental Results



▶ **Encryption consumes negligible energy as compared to encoding**



▶ **Energy consumption of encryption is negligible irrespective of video clips**

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