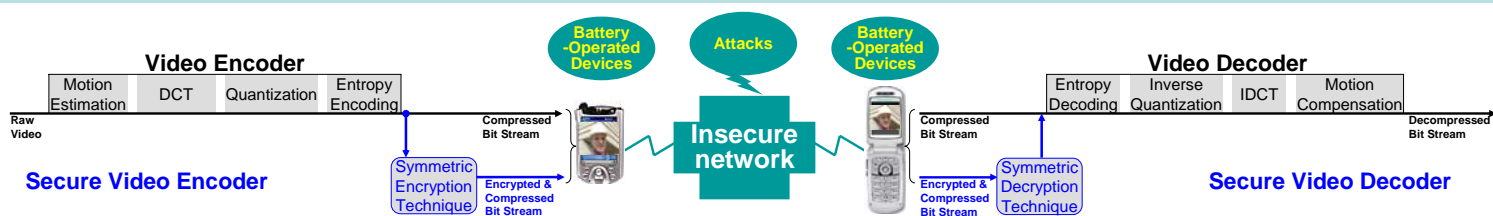


An Experimental Study on Energy Consumption of Video Encryption for Mobile Handheld Devices

Overview of Secure Video Applications

Problem and Motivation

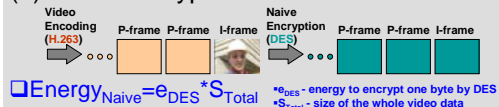
- Mobile multimedia applications are vulnerable to security attacks in wireless networks
- Significant computation for video encryption is expected on battery-operated mobile devices
- Evaluate symmetric video encryption schemes from the perspective of energy consumption both analytically and experimentally



Analytical Study of Video Encryption Schemes with respect to Energy Consumption

Studied Video Encryption Schemes

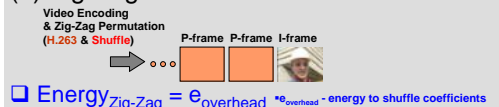
(1) Naive Encryption Scheme



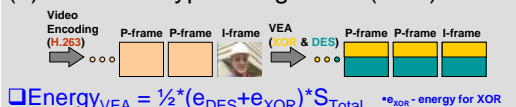
(2) Selective Encryption Scheme



(3) Zig-Zag Permutation Scheme



(4) Video Encryption Algorithm (VEA)



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 %

► Naive encryption scheme consumes twice the energy of Selective encryption scheme

Experimental Study on Tradeoffs between Security and Energy Consumption

Experimental Setup

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

Power Measurement System

- DAQ board with BNC Connector
- Windows XP
- 1,000 samples/sec

System Architecture

Secure Video Application (Encoder / Decoder)

DES	H.263	Device Driver
OpenSSL Library	Codec	

Operating System (Linux)

Mobile Handheld Hardware (Sharp Zaurus)

- 400 MHz Intel XScale
- 64 MB flash & 32 MB SDRAM

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	
Mid-Low (Quant = 10)	High (Full)	77.62	2 %
	Low (Partial)	75.78	
Low (Quant = 31)	High (Full)	70.44	1 %
	Low (Partial)	69.89	

► Energy overhead for full video encryption is NEGLIGIBLE

Experimental Results

Huge Difference (98%)

Negligible Energy Overhead

► Encryption consumes negligible energy as compared to encoding

► Energy consumption of encryption is negligible irrespective of video clips