

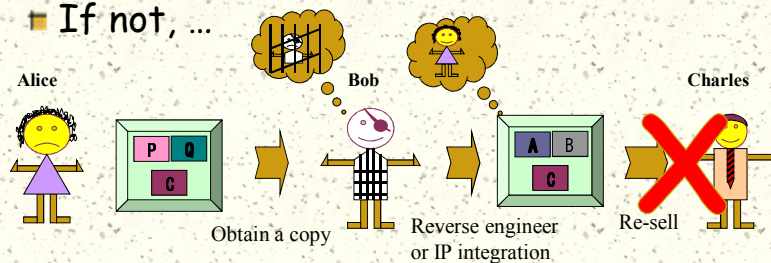
Intellectual Property Protection

-- Watermarking Basics

Cybersecurity Specialization
-- Hardware Security

Watermark as A Deterrent

- # Piracy on unprotected IPs
- # When IPs are watermarked
 - Has Alice's watermark been removed?
 - If not, ...



Ideas Behind IP Watermarking

Challenge:

- must maintain IP's value (functionality, performance, quality, etc.)

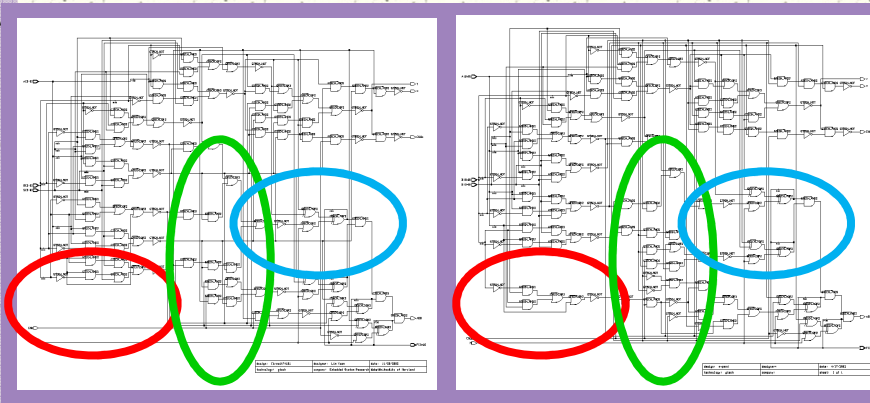
Observation:

- existence of multiple, large amount of, different implementations of the same IP

Approach:

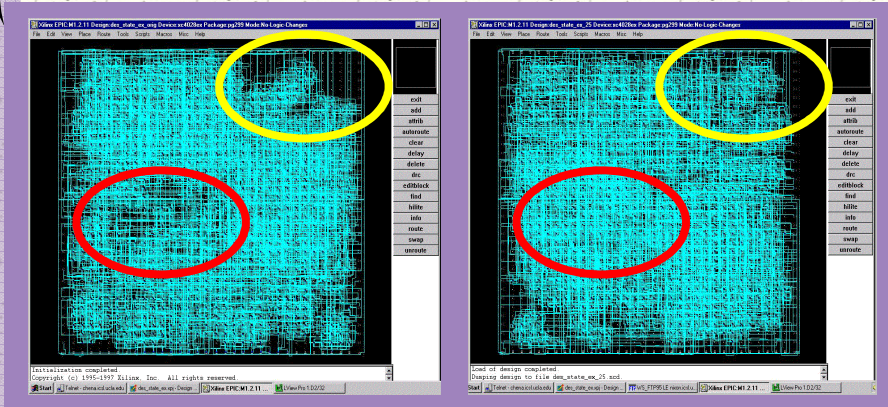
- use IP's implementation or appearance as watermark

Watermarking a 4 Bit ALU



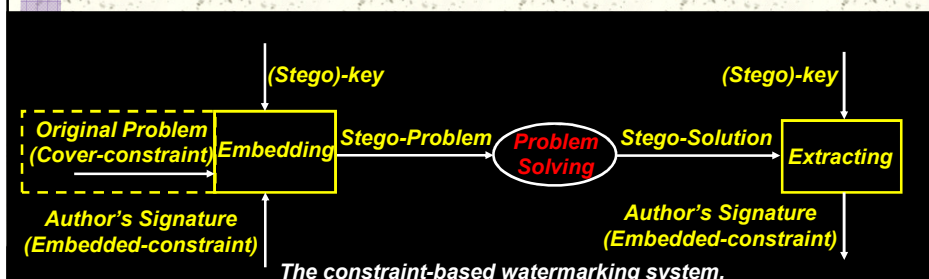
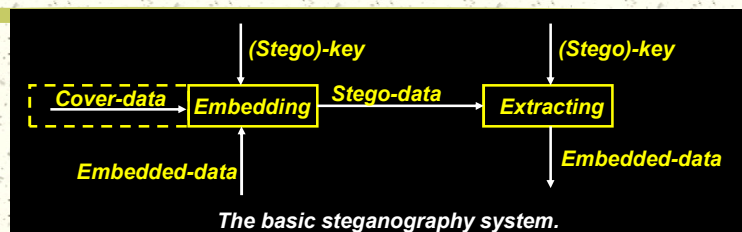
Original gate-level circuit and the same design with message "UMCP TERPS" (in ASCII) embedded.

Watermarking DES Benchmark



Same functionality, area, and performance with a 4768-bit watermark embedded in the FPGA design

Constraint-Based Watermarking



Constraint-based Watermarking

