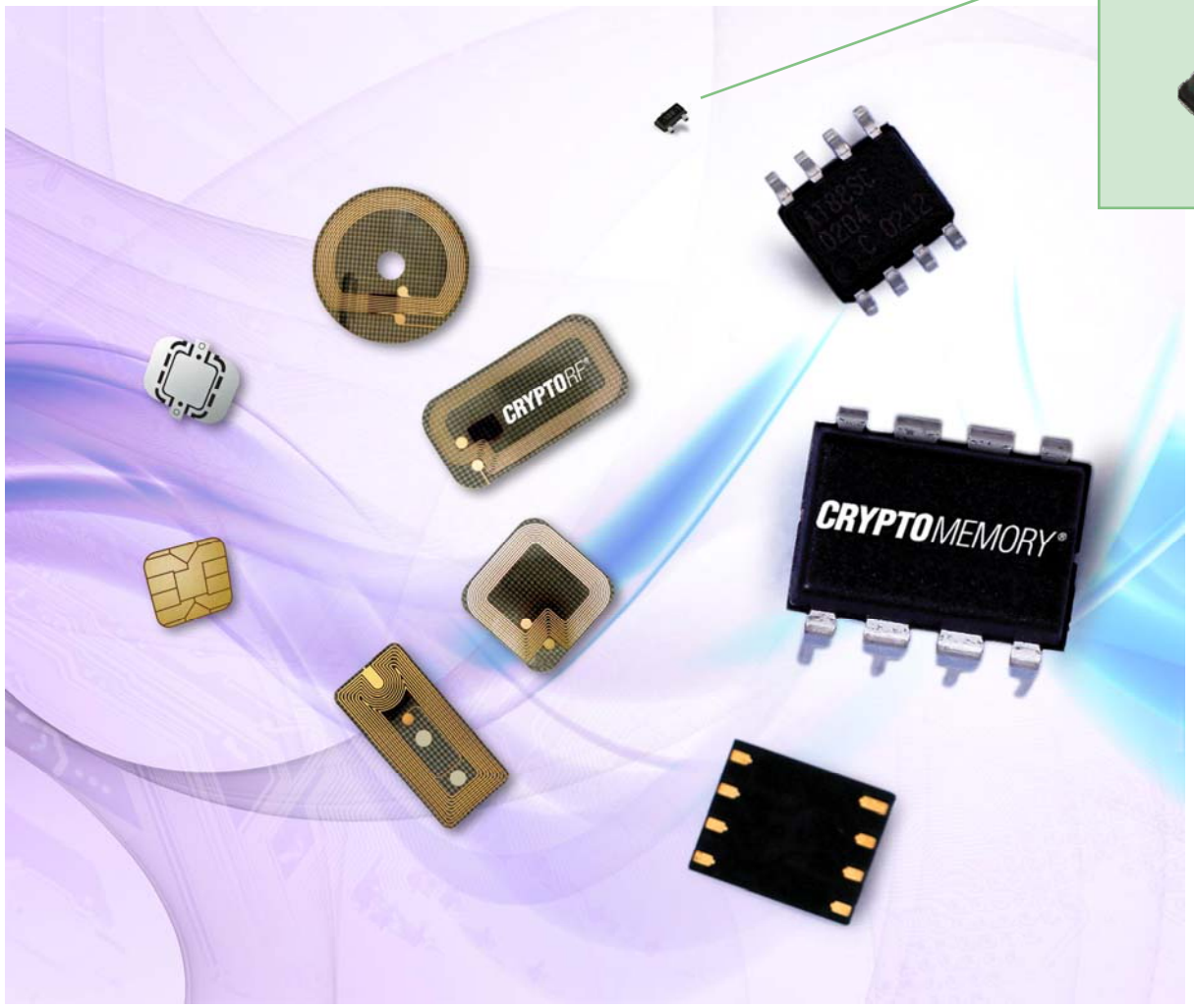
CryptoAuthentication™
Firmware Protection



Atmel...Everywhere You Are...Securely

CRYPTOAUTHENTICATION

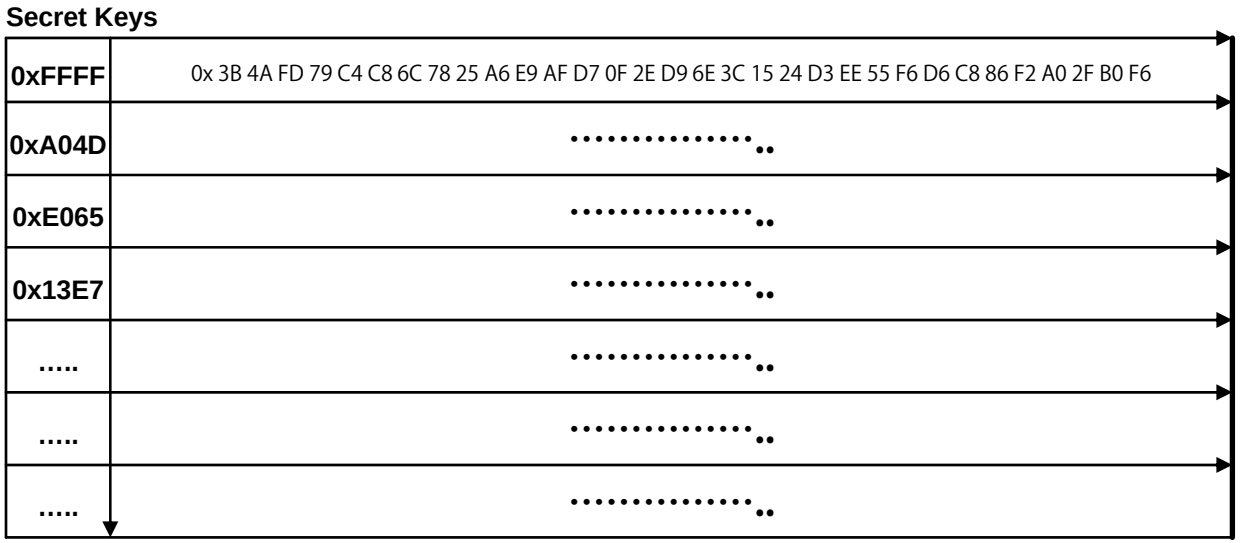
Agenda

- Device basics
  - Keys and OTP fuses
  - Operational block diagram
- Firmware protection
- Categorizing Protection
  - Protecting the question answer process
  - Firmware Updates
  - Network connected
  - Encryption and other runtime protection
  - Physical Protection

CRYPTOAUTHENTICATION

Device Basics

SA102S/10HS Secret Keys



- **Secret Keys hidden in Metal layers**
- **Never readable by any means**
- **Commands references Keys by index value**
- **Key provided to customer**
  - **Securely transmitted to customer by Atmel**
  - **One key provided to each customer**
- **Key 0xFFFF is published for testing,**
  - **The displayed value is correct for the first released SA102S Test parts**

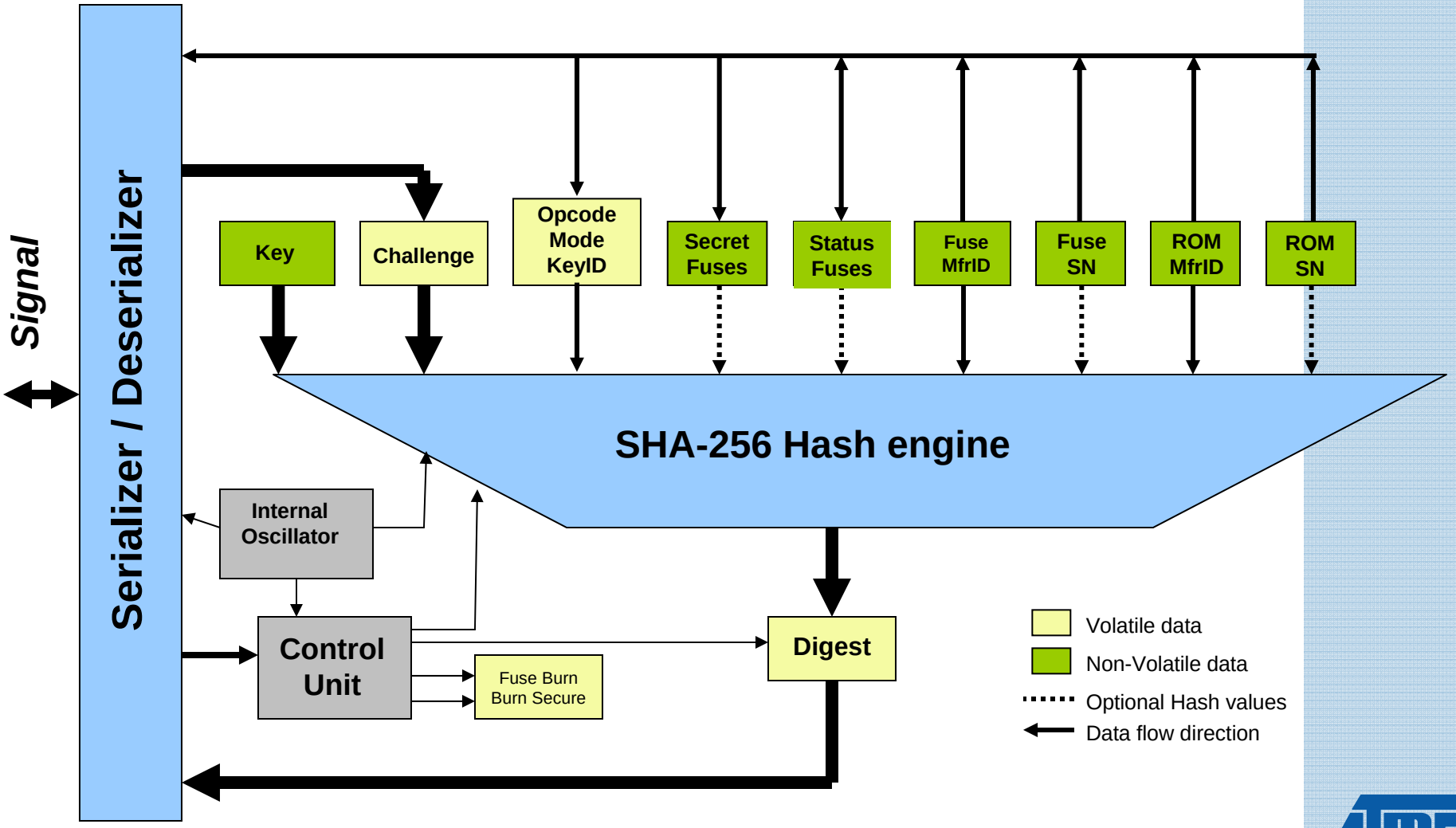
SA102S/10HS Fuse Mapping

SA102 Fuse Map

Read Address 0x00	0 – 15	0x00 0x0F	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	16 – 31	0x10 0x1F	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Read Address 0x01	32 – 47	0x20 0x2F	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	48 – 63	0x30 0x3F	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Read Address 0x02	64 – 79	0x40 0x4F	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
	80 – 95	0x50 0x5F	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Read Address 0x03	96 – 111	0x60 0x6F	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
	112 – 127	0x70 0x7F	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x

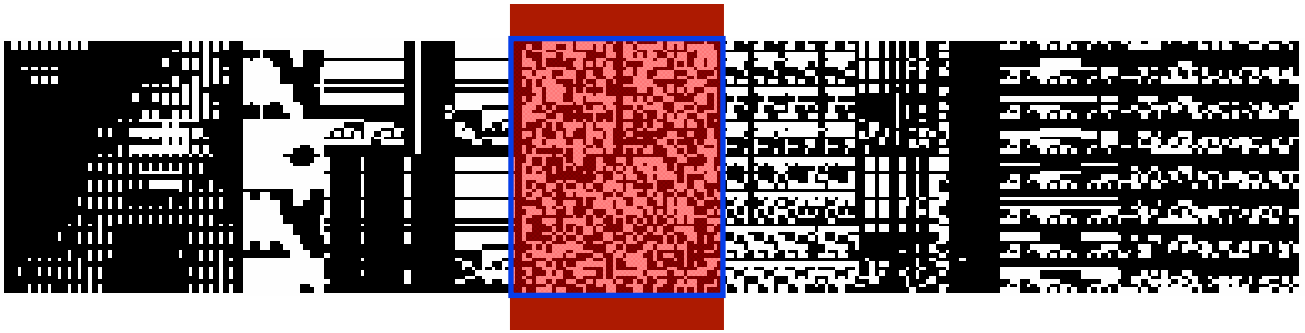
Fuse #	*Name*
1	BurnFuse Disable
0, 2 → 63	Secret Fuses
64 → 86	Status Fuses
87	BurnSecure Disable
88 → 95	Fuse MfgID
96 →127	Fuse SN

SA102S/10HS Block Diagram



Why a hardware device

- **Add CryptoAuthentication based security**
  - Strong security with 256 bit key & SHA-256 standard algorithm
  - Hardware-based authentication utilizes keys that **NEVER** leave the secure hardware crypto-logic and so are always hidden from attacks
- **Software is never a valid solution**
  - If it can be read it can be attacked



Detecting keys in software or on storage devices

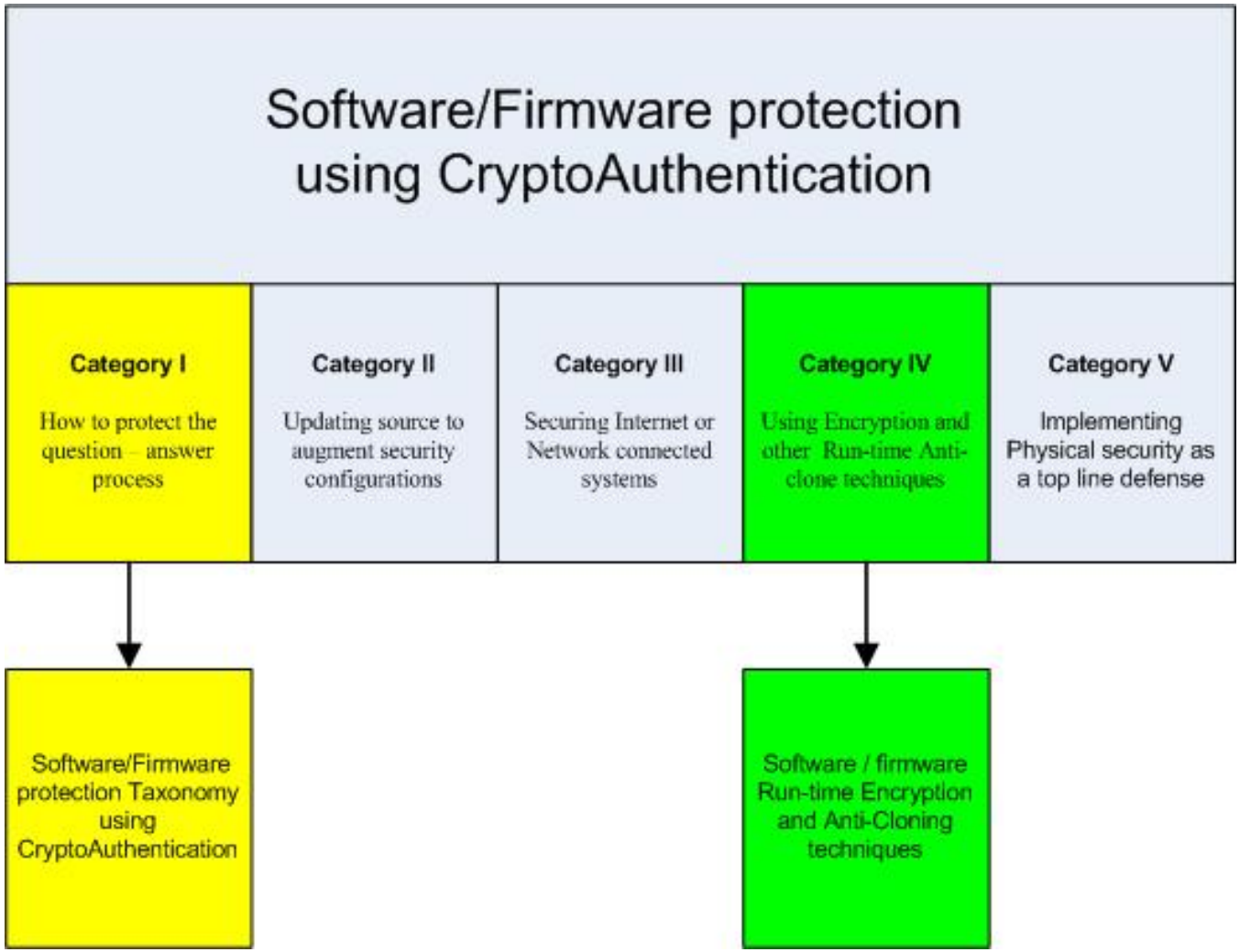
Firmware Protection

- **Secure Microprocessors are the only 100% Solution**
- **Adequate level of security in 1995**
  - Not be a challenge to a entry level hacker
  - Security is a path not a destination
- **There is always a higher level of protection to be achieved**

Firmware Protection Solutions Approach

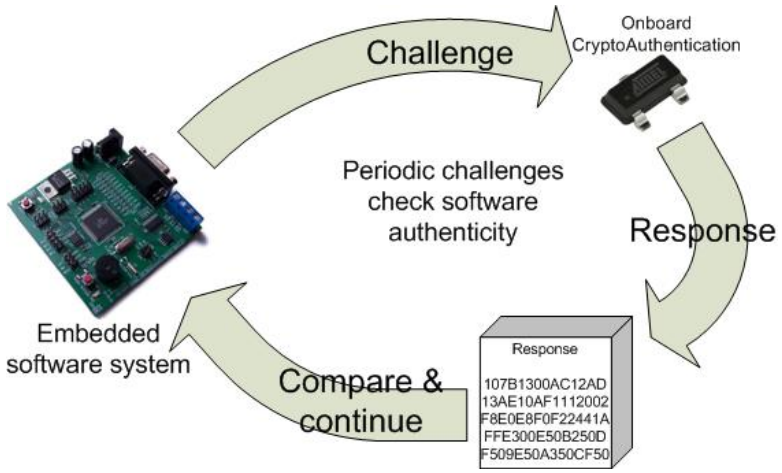
- **Provide an Implementation based on**
  - Utilizing one secure hardware device
  - Provide an continuous structure to increase security
- **Provide security in Categories and Levels**
  - Best solution implements features of all categories
  - Designers should always have the next level of security identified and ready to implement.

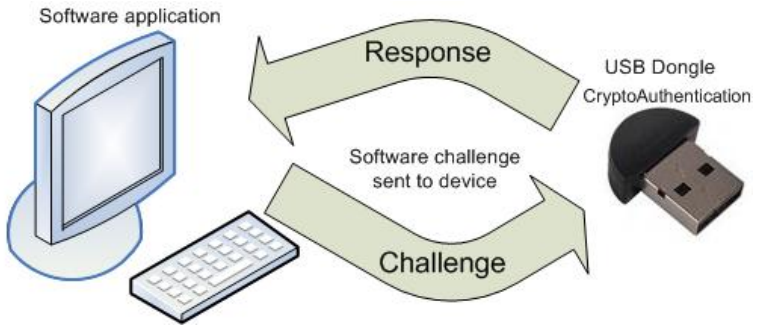
Categorizing Protection



Category I
Protecting the question answer process

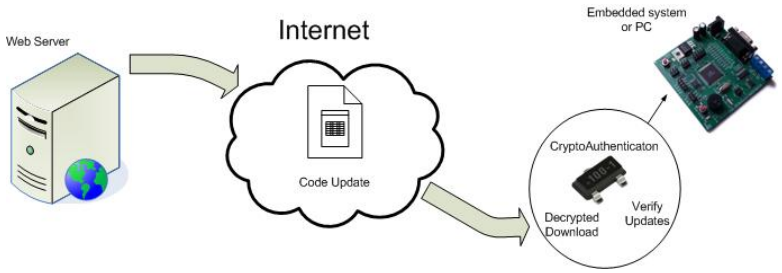
- **Level One – single challenge response to device**
- **Level Two – Make numerous challenge and responses**
- **Level Three – examine methods of obfuscating the calls.**
  - **Example: *firmware makes 10 calls to the security device use the 2nd response, XOR its value with the 5th response and then use that calculated value as the 9th challenge.***

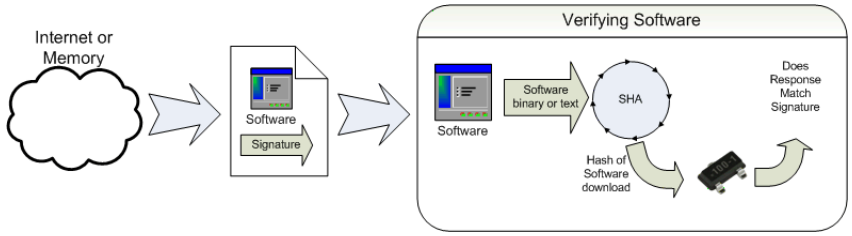




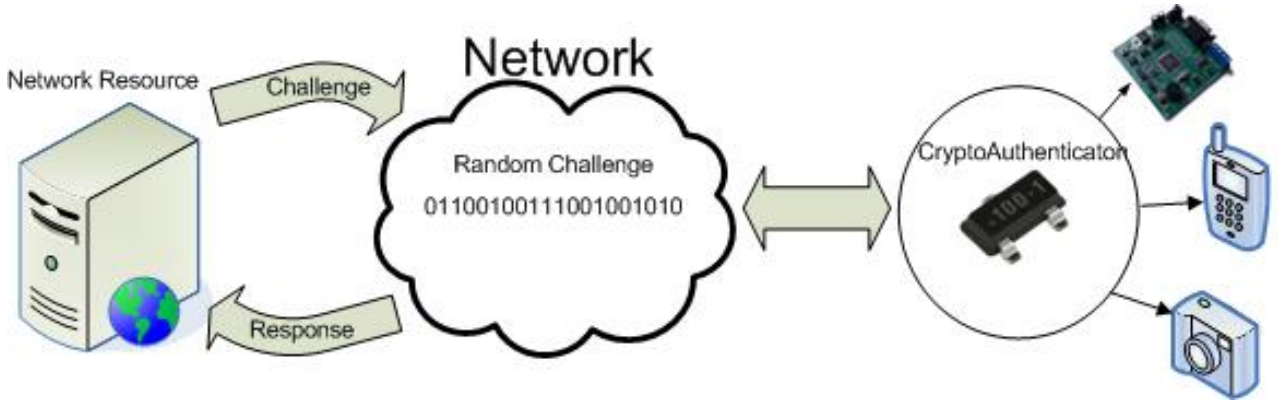
Category II
Firmware Updates

- **Updating source to augment security configurations**
- **Level One** – Change the single challenge and response with each upgrade
- **Level Two** – Change the locations of multiple challenge-response calls within the firmware or change challenge response strategies
- **Advanced levels**
  - use runtime components
  - Add Verification of download
  - Encrypt update
- **Sends all current cloned devices back to ground zero**



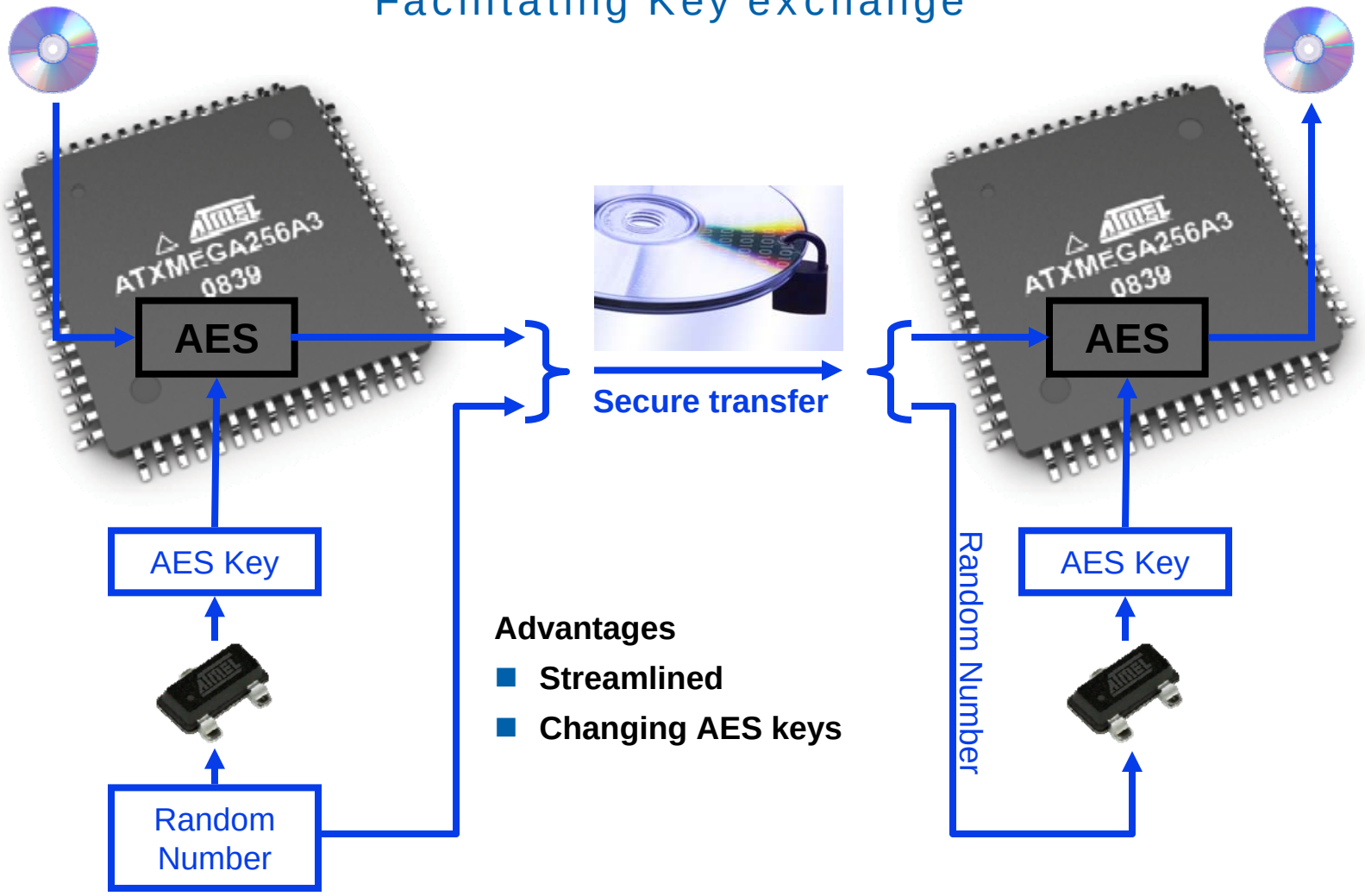


Category III
Network Connected



- **Per use direct connection to remote trusted system**
- **Level One** – Maintain a list of challenge-response pairs that change when connected to network, docking station, charger, PC, etc.
- **Level Two** – send verify message over network directly to remote system.
- **Advanced levels**
  - Remote resource logon
  - Help desk call in application
  - Encrypt content from remote system for individual product
- **Blacklist/Whitelist accessories , or Identify user tamper attempts.**

Category IV
Encryption and other runtime protection
Facilitating Key exchange



Advantages

- **Streamlined**
- **Changing AES keys**

Category IV
Encryption and other runtime protection

- **Encrypted blocks of code that are decrypted at runtime prior to executing**
  - **Level one – encrypt some or all of the firmware and decrypt at runtime**
  - **Level two – Encrypt multiple blocks of code each with different random challenges**
  - **Advanced levels – Obfuscate Encryption schema**
    - **Many blocks throughout the code**
    - **Blocks within blocks**
    - **Some blocks in rarely executed code**
    - **Decoy or non used blocks**

Physical protection

- **Physical security of Host device**
- **CryptoAuthentication has no markings on package or Die**
- **Materials that protect or obfuscate physical board attacks**
- **Remove all device markings**
- **Control user access to systems**
  - **Physical tampers**
  - **High cost devices contain root of security**

Additional uses

- **Once the CryptoAuthentication device is installed it can be used later for adding security features**
  - Enable call center to remotely authenticate user prior to rendering service.
  - Authenticate hardware or daughter cards
  - Authenticating Battery packs
  - Remote network logon or individual user authentication
  - Encrypt confidential files produced by embedded systems
  - Authenticate wireless nodes or encrypt communication between wireless nodes
  - Authenticating nodes for devices communicating over power lines

Questions?