# Physical Inspection for PCB Assurance

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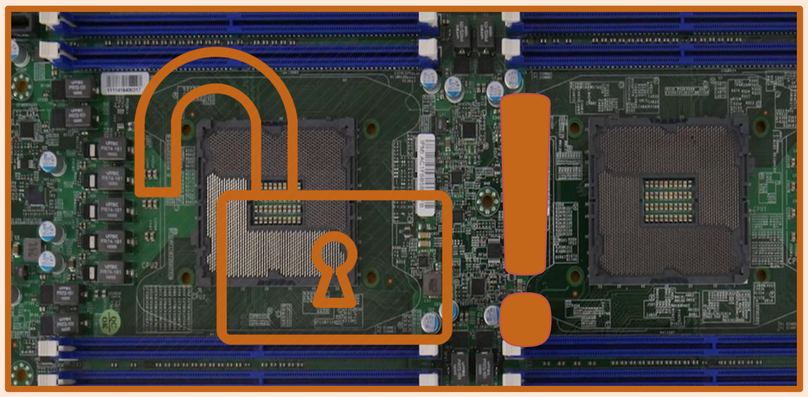
## Motivation

- PCBs are prevalent in every aspect of modern technology
- Production quantities have increased far beyond current verification capabilities
- Security concerns have never been more serious (defects, trojan insertion, component integrity, …)
- We need newer, faster verification techniques!

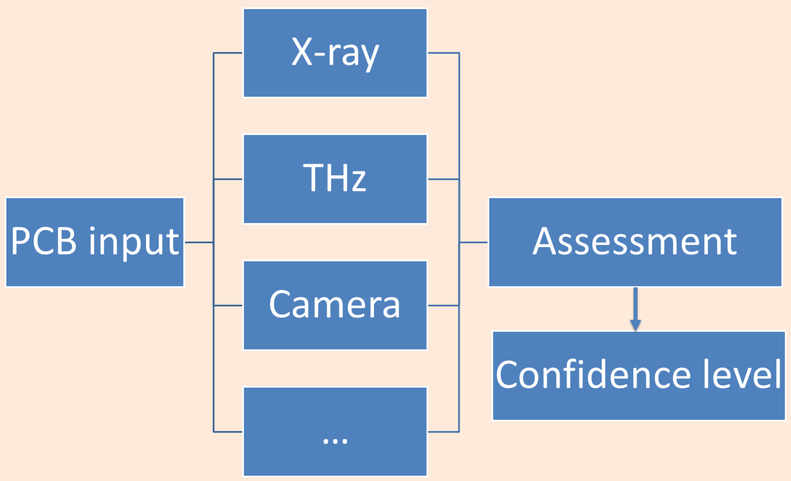


## PCB Assurance Methods

- **Existing techniques:**
  - Electrical testing
  - post manufacturing verification
  - conventional design

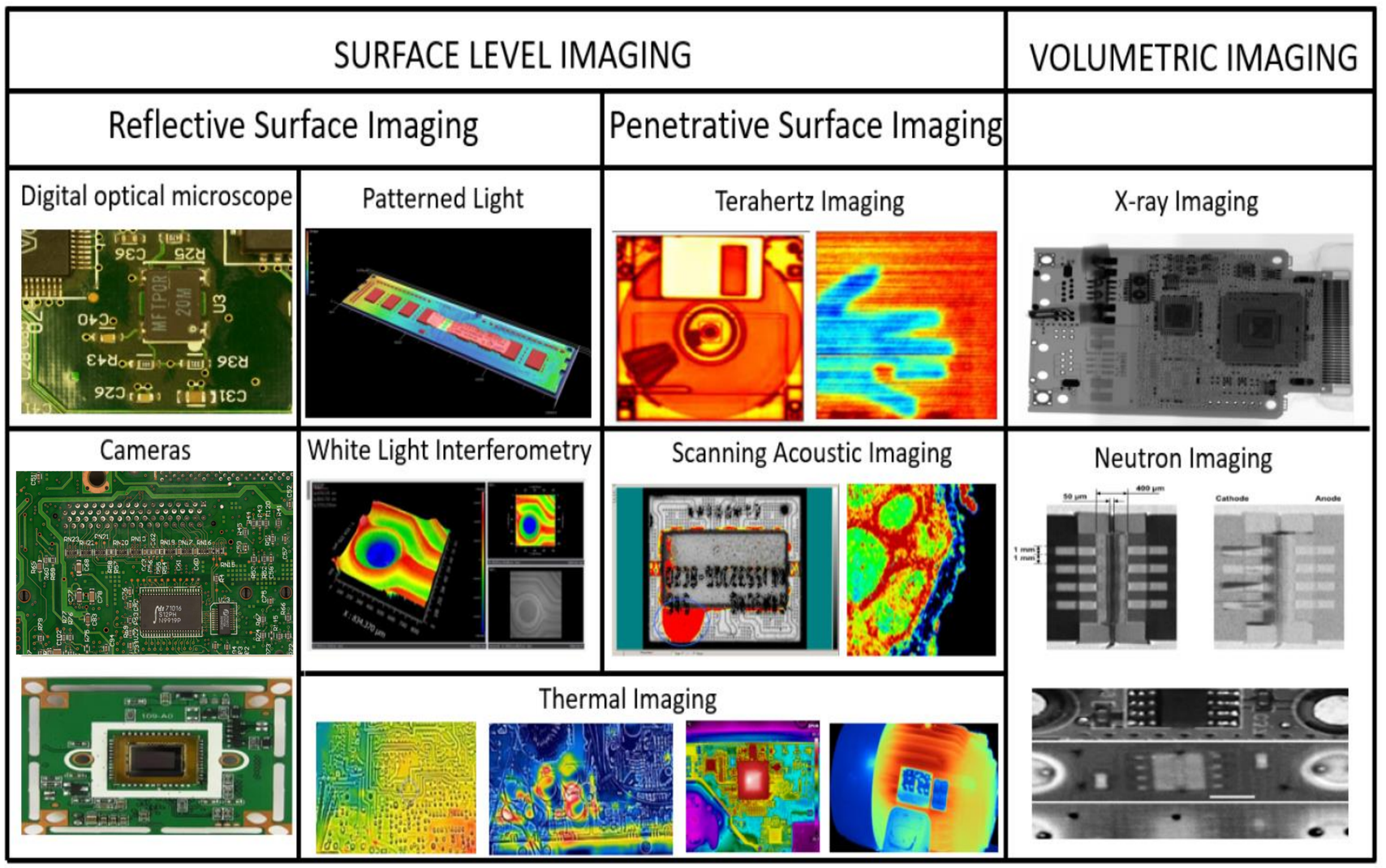
**Time consuming, Error prone**

- **Newer advancements:**
  1. Automatic Visual Inspection (AVI): Automated process flow determines PCB authenticity
     - AutoBoM (automated bill of materials) is a working proof of concept
  2. **Multiple imaging modalities:** Techniques described to the right
     - Allow non-destructive analysis of PCB security




## Imaging Modalities

- Various modalities are used in conjunction to achieve full PCB analysis.
- For instance, terahertz imaging and optical microscopy in combination can both characterize and segment all components on a printed circuit board.




### Terahertz Imaging

| Pros | Cons |
|---|---|
| **Characterizes material properties** | Can't image metals |
| Subsurface imaging | Expensive |
| Can perform remote electrical measurements | New technology = lack of mature resources |

### Optical Microscopy

| Pros | Cons |
|---|---|
| **Extremely cheap** | Limited maximum resolution |
| Fast acquisition time | No subsurface imaging |
| Detects an extremely wide variety of defects | Single lens microscopy lacks depth information |

### X-ray Imaging

| Pros | Cons |
|---|---|
| **Creates high resolution, full 3D PCB images** | CT acquisition is very slow |
| Non-destructively identifies multiple subsurface defects | Cannot directly identify circuit components |
| Mature technology | Expensive |

## Future Work

Further research in contactless measurement of conductivity, resistance, and capacitance of materials in a PCB using THz beam and imaging techniques.

## Conclusion

PCB assurance can be provided through automated visual inspection (AVI) and various imaging modalities to detect a host of security vulnerabilities.