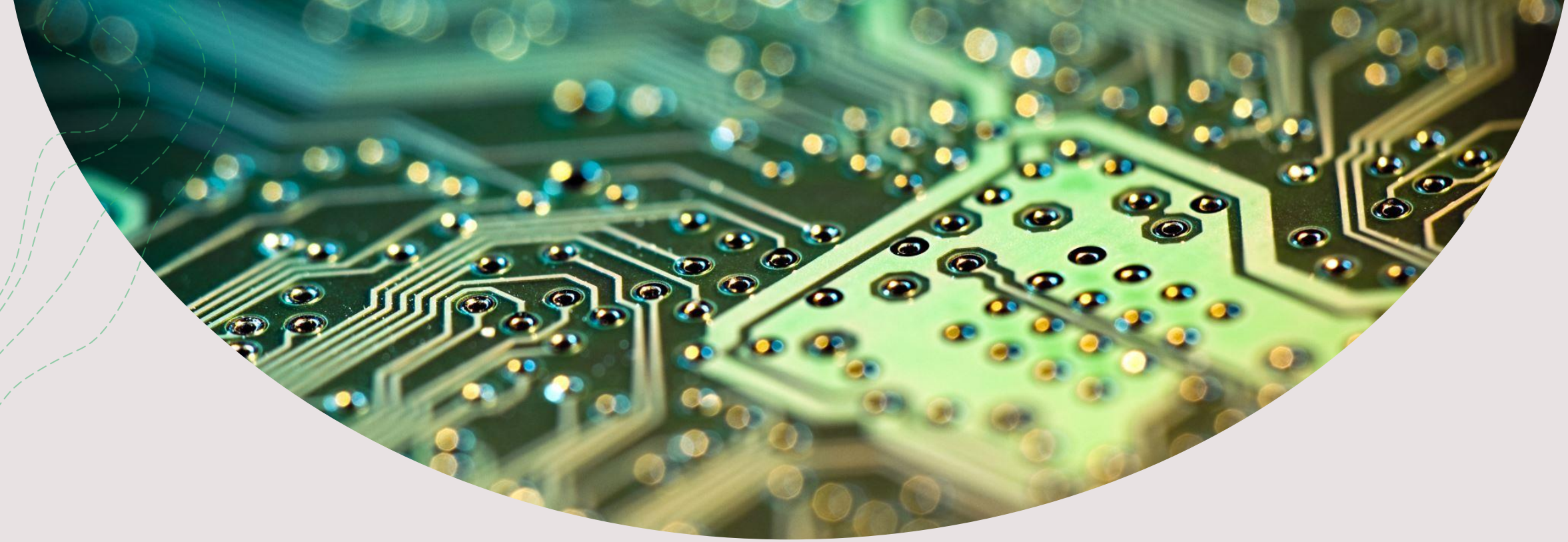

What You Can Do in The Integrated Circuit Industry

Dr. Scottie MAN

Adjunct Assistant Professor at ECE of HKUST

Who am I

- In the IC industry
  - Analog IC designer (from year 2008 to now)
  - Specializing in power regulators, gate drivers, motor drivers, etc.
- At HKUST
  - Adjunct Assistant Professor (from year 2020 to now)
  - Teaching ELEC2350 and ELEC4430
  - Supervising FYP in the area of analog and power IC design

Objective

- Introduce different technical positions in the integrated circuit (IC) industry (emphasizing on hardware-related positions)
- How they collaborate to develop IC products to the market
- What knowledge and skills are required for those positions

Positions

- To develop one IC product, we need following people
  - Marketing/Sales
  - Application Engineer
  - Analog/Digital Design Engineer
  - Verification Engineer
  - Layout Engineer
  - Test Engineer
  - Package Engineer (normally with mechanical engineering background)
  - Product Engineer (more like a project manager)
  - Software/Firmware Engineer (normally for System-on-Chip (SoC) ICs)
  - CAD (Computer-Aided Design) Engineer (Manage CAD software for design teams)
- How they work together to develop an IC product?

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- How they work together to develop an IC product?

Marketing/Sales & Application Engineer: Role

- They both work together to communicate with customers
- Marketing/Sales
  - Manage the profit and loss of IC products
  - Identify profitable markets and corresponding customers
  - Define IC products to fulfill needs of customers
- Application Engineer
  - Provide technical supports about the use of IC products
  - Evaluate performance of IC products
  - Sometimes, they also define system architectures of IC products

Marketing/Sales & Application Engineer: Skills

- They both have good verbal and written communication skills
- Marketing/Sales
  - Understand cost structure of IC products
  - Understand the market needs and customer needs
  - Identify key features of IC products to differentiate from competitors
  - Strong interpersonal and networking skills
- Application Engineer
  - Strong foundations and skills on hardware and electronics (e.g., ELEC1100, ELEC2400)
    - Use of bench equipment, PCB design and layout, debugging skills…
  - Programming skills for firmware and/or GUI development (e.g., C/C++, Python)
  - Strong system knowledge (depends on what exactly you are working on)

Analog/Digital Design Engineer: Role

- Design Engineer
  - Determine whether the defined products and system architectures are implementable or not
  - Select an IC process (e.g., 180nm vs 28nm) suitable for the defined products
  - Perform system-level evaluations
  - Perform circuit-level implementations
  - Supervise floorplan and layout (Layout engineer implements the actual layout)
  - Define test plan (Test engineer develop test PCB and test program)
  - Define packaging plan (Package engineer oversee the whole package process)

Analog/Digital Design Engineer: Skills

- Design Engineer
  - Understand IC process and technology (e.g., ELEC3500, ELEC4520)
  - Strong foundations and skills on circuit-level implementations
    - Analog design (e.g., ELEC3400, ELEC4420)
    - Digital design (e.g., ELEC3310, ELEC4410, ELEC4320)
  - Understand floor planning and layout (e.g., ELEC4410)
  - Understand what is Electrostatic Discharge (ESD)
  - Understand what is Latch-Up (LU)
  - Understand what is DFT (Design for Testing)
  - Understand what is IC packaging

Verification Engineer: Role and Skills

- Verification Engineer
  - This position exists in companies producing sophisticated IC products
  - Verify circuit-level implementations fulfilling the requirements or not
  - Good understanding on circuit-level implementations
  - Strong skills on verifying circuit-level implementations
    - Analog design (e.g., ELEC3400, ELEC4420)
    - Digital design (e.g., ELEC3310, ELEC4410, ELEC4320)
  - Following are names of "programming" language used by verification engineers
    - e.g., System Verilog, Verilog-AMS, Linux scripting language

Layout Engineer: Role and Skills

- Layout Engineer
  - Perform floor planning to optimize the performance of IC products
    - e.g., minimize silicon area, noise coupling, impacts of manufacturing variations, …
  - Implement the layout design
    - For analog design, layout is normally done manually
    - For digital design, layout is generally generated by Place-and-Route (P&R) software
  - Understand IC process and technology (e.g., ELEC3500, ELEC4520)
  - Understand floor planning and layout (e.g., ELEC4410)
  - Understand what are Design-Rule Check (DRC), Layout-versus-Schematic (LVS), Electrical-Rule Check (ERC), and Parasitic Extraction (PEX)

Test Engineer: Role

- Test Engineer
  - Design different testing circuit boards for different tests
    - e.g., Automated Test Equipment (ATE) board, burn-in board
  - Write ATE program to automate the IC production test
  - Perform different tests to qualify the performance and reliability of IC products
    - e.g., ATE test, ESD test, reliability test

Test Engineer: Skills

- Test Engineer
  - Strong foundations and skills on hardware and electronics (e.g., ELEC1100, ELEC2400)
    - Use of bench equipment, PCB design and layout, debugging skills…
  - General high-level programming skills
  - Understand different ESD test standards
    - e.g., Human-Body Model, Machine Model, and Charged-Device Model
  - Understand different reliability test standards
    - e.g., High Temperature Operating Life (HTOL), Latch-Up, …

Q & A

Thanks