Router Scalability & Moore's Law

- BCP for a forwarding table data structure is a radix trie
- Storage is on-chip SRAM, off-chip SRAM, or DRAM
- DRAM necessary for RP, low-end routers

- Assumption: continual and indefinite technology refresh & associated expense

Moore's Law

Moore's Law is the empirical observation that the transistor density of integrated circuits, with respect to minimum component cost, doubles every 24 months. (Wikipedia)

- Applicable to high volume processors only
- Low volume applications can ride technology curve, not cost curve

- Table growth has been hidden by per-λ performance growth & costs (4x/3yrs)
- SONET topped out, table growth more visible

DRAM

- DRAM capacity grows 4x/3.3yrs (2.4x/2yrs)
- Speeds improve about 10%/yr (1.2x/2yrs)
- BGP convergence degrades at table growth rate/speed improvement

Off-chip SRAM

- Requires high-speed, high-capacity parts
- Driver was PC cache, now on-chip
- Most of market is cell-phones, for low-power small-capacity parts
- Big fast SRAMs are not volume parts; off the cost curve

Forwarding engines

- Forwarding engines most sophisticated ASICs being built, second only to CPUs
- Currently one generation behind CPUs
- Already past knee on price/performance
- High performance requires bandwidth; favors on-chip SRAM
- Gains so far have leveraged technology; little gain to be had
- Technological leadership will be expensive

Chip costs

- Tapeout costs rising about 1.5x/2yrs (Wikipedia)
- Chip development costs rising similarly
- Net per-chip costs rising about 1.5x/2yrs
- Progress faster than 1.3x/2yrs will require non-linear cost

- Does not include CapEx, OpEx from continual upgrades

Smoothed 2yr growth factors
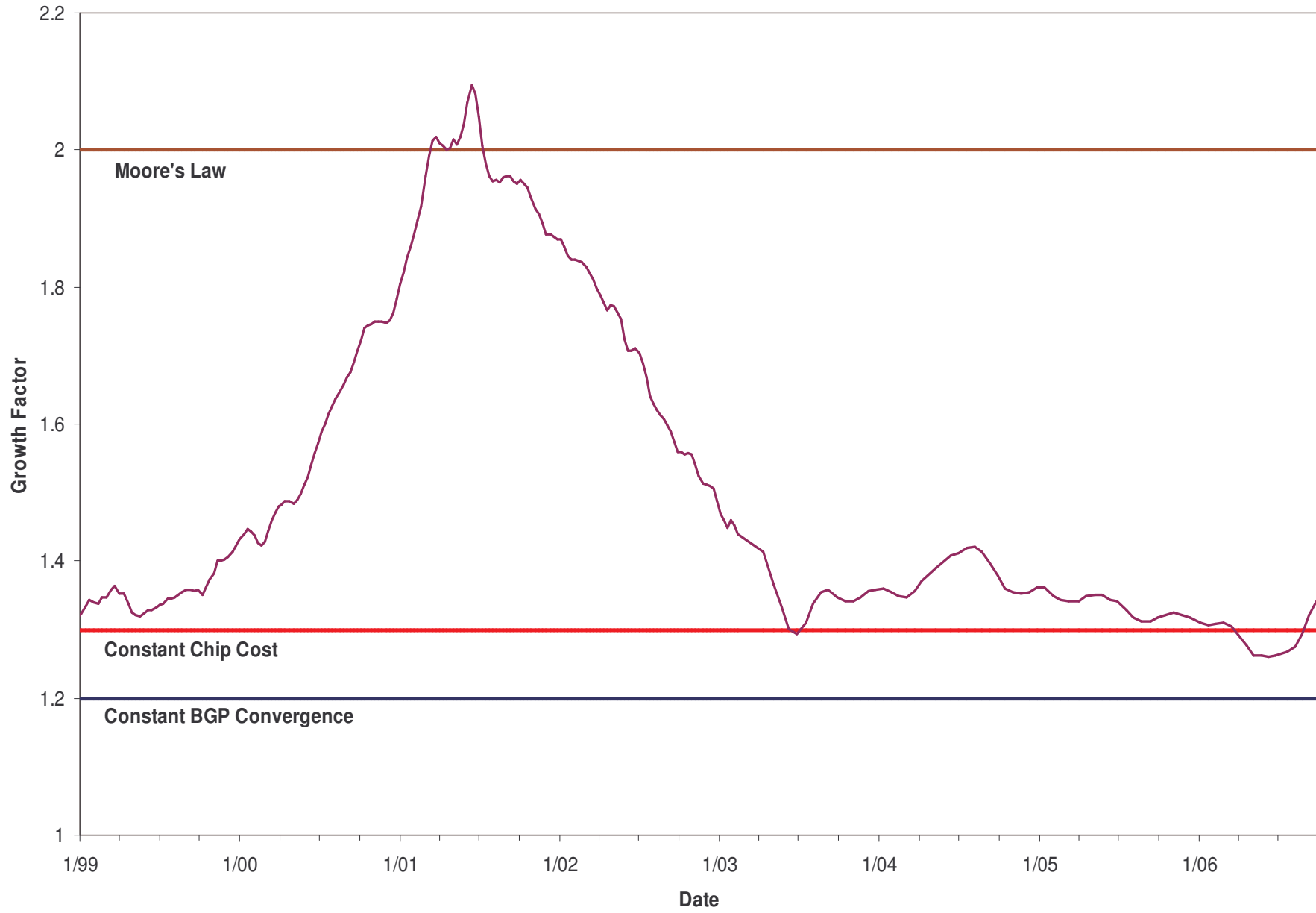
Summary

- Constant convergence growth rate is about 1.2x/2yrs
- Constant cost growth rate is about 1.3x/2yrs
- Current growth is from 1.3x/2yrs – >2x/2yrs

- Without architectural or policy constraints, costs are potentially unbounded
- Even with constraints, SPs are doomed to continual upgrades, passed along to consumers

References

- Moore's law
- DRAM
- SRAM