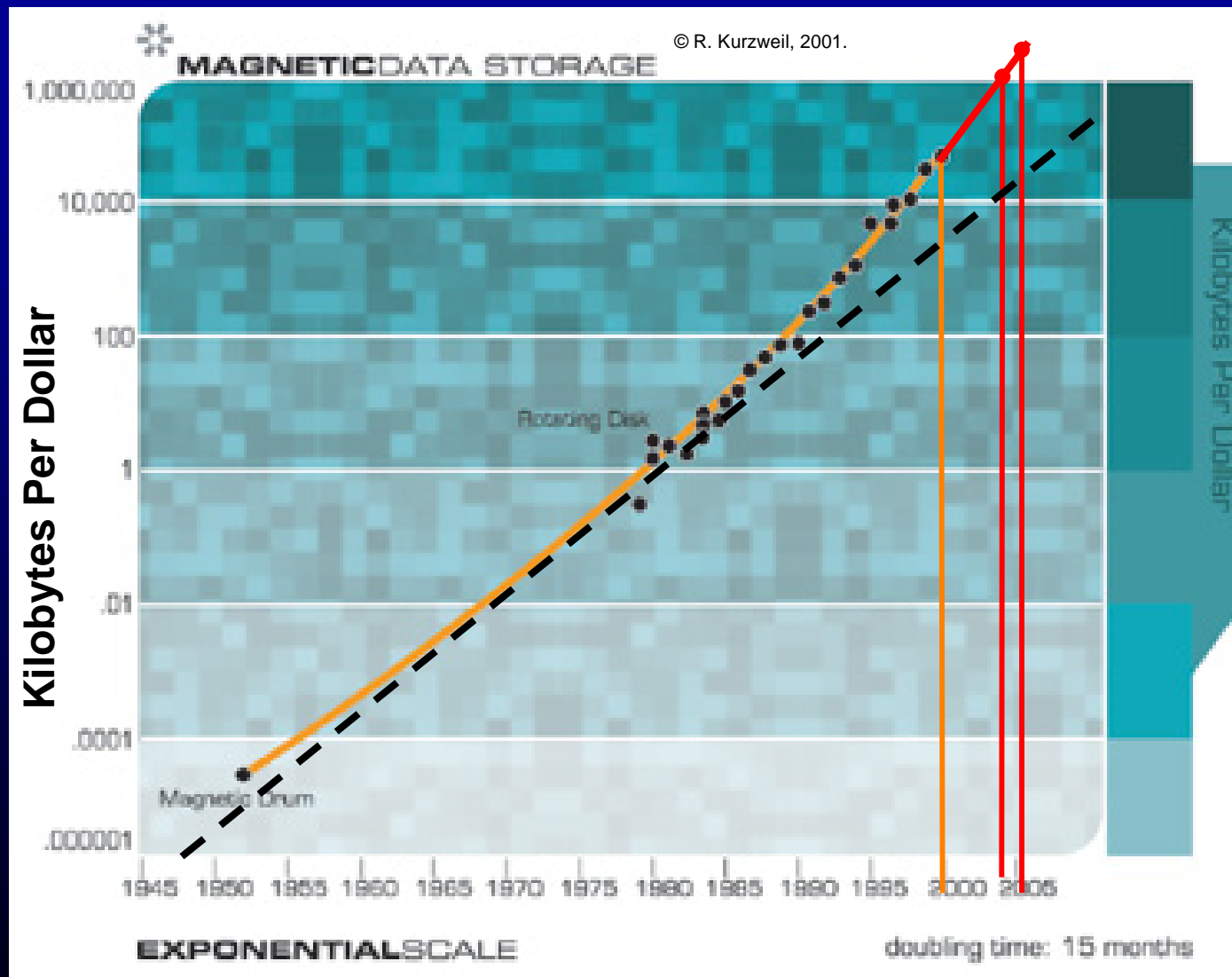
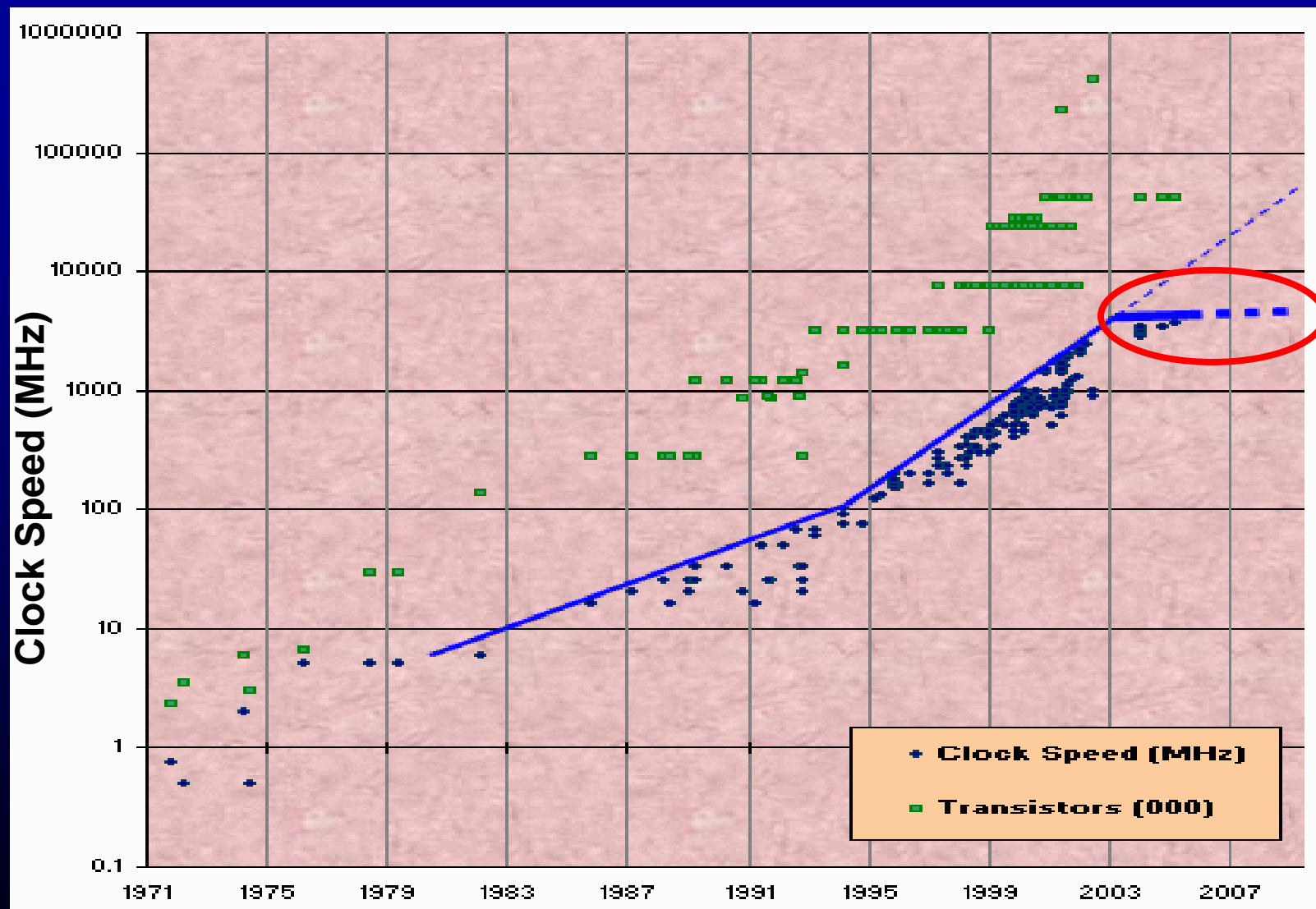

A Scalable Open-Source Digital Video System for Launch Range Operations

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Hyperexponential Change



A Powerful Disturbance in the Force



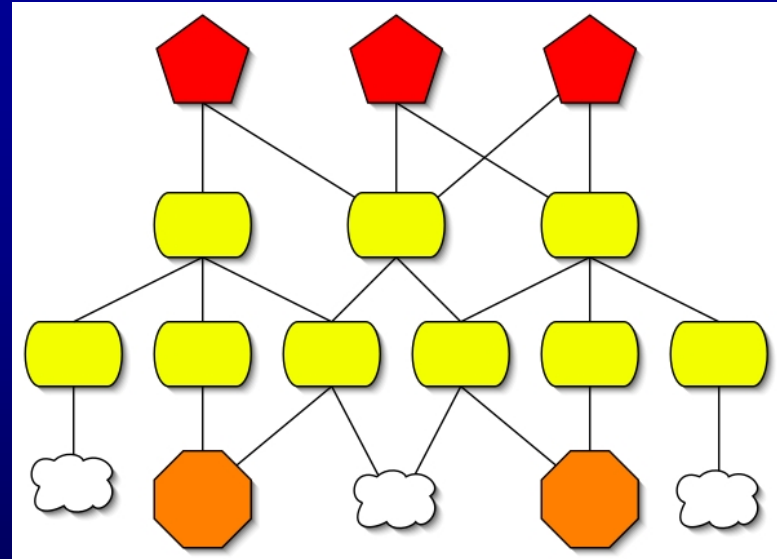
“Think Different” — Think Parallel

- Clock speeds are stalled
 - Intel announces dual-core Pentium
 - IBM announces multi-core Cell processor
- Yet price/performance improves on schedule
 - Processors may not be faster but they are cheaper!
- “When the going gets tough the tough get going”
 - The free ride is over
- Parallel processing is the next frontier
- This looks like a job for *raging incrementalism*
 - Adapt on a



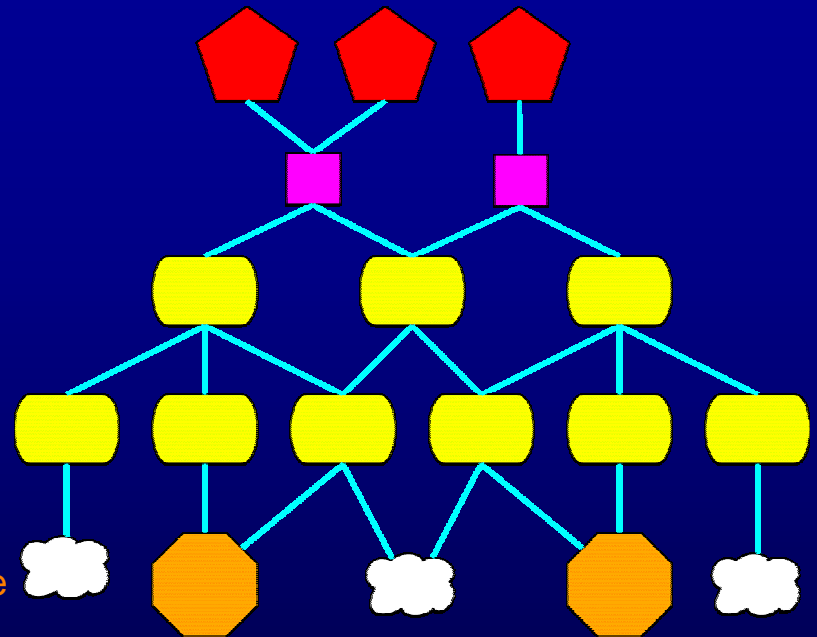
Go With the Flow

- Coarse-grain data flow
 - Satellite telemetry
 - Multimedia
 - Event distribution
 - Process control
 - Global weather prediction
- Information equivalent of the assembly line
- Parallelism for free
- Adaptive



Launch Range Video System

- Video camera brick
 - Shuttle PC & Firewire camera
 - Network camera control
 - Software-based MPEG-4 encoding
 - Digital video streaming
- Proxy brick
 - Protocol translation between camera and streaming bricks
- Video streaming brick
 - Based on Darwin Streaming Server
- Video archive brick
 - 4U commodity rack server with 4 terabytes of storage
 - FreeBSD



- Built in 6 weeks (1 full-time + 1 part-time)
- All bricks constructed and tested in parallel
- Flow everywhere

Faster, Better, Cheaper (Choose any Three)

- Faster
 - Build in weeks to months not years
 - Deploy as you build
- Better—meets or exceeds range requirements
 - 320 x 240 full color video at 15 frames per second
 - Modern standards-compliant video compression
 - Scales to hundreds of cameras
 - Remote network control of all cameras
 - Arbitrary video switching
 - » All cameras anywhere to anyone at anytime
 - Arbitrary video clients
 - » Large-scale video archive for pennies
- Cheaper
 - Low initial investment (< \$10K)
 - Incremental upgrade for components and software
 - Reduced operating and maintenance costs

Use the (Open) Source, Luke

- *Linux* and *FreeBSD*
- *libdc1394* for Firewire camera driver
- *spook* for camera control and unicasting
- *xvid* MPEG-4 codec
- *live.com* RTP/RTSP library for proxy protocols
- *Darwin Streaming Server*
- *mencoder* for generating video archive files
- *MySQL* for video archive metadata
- *mplayer* for video playback on desktops

Summary

- Architecture rules
 - Peering constructions decouple components
 - Flow is parallel and scales naturally
- Open-source rules
 - Transparency
 - The power of the creative commons
- Integration rules
 - Proxy brick required 120 lines of custom software
 - Video archive brick required 370 lines of custom software
- Change rules
 - *Raging incrementalism* is a force multiplier