

The RFID Data Tsunami

Professor Terry Curtis
Systems Consulting Consortium &
Calif. State Univ., Chico

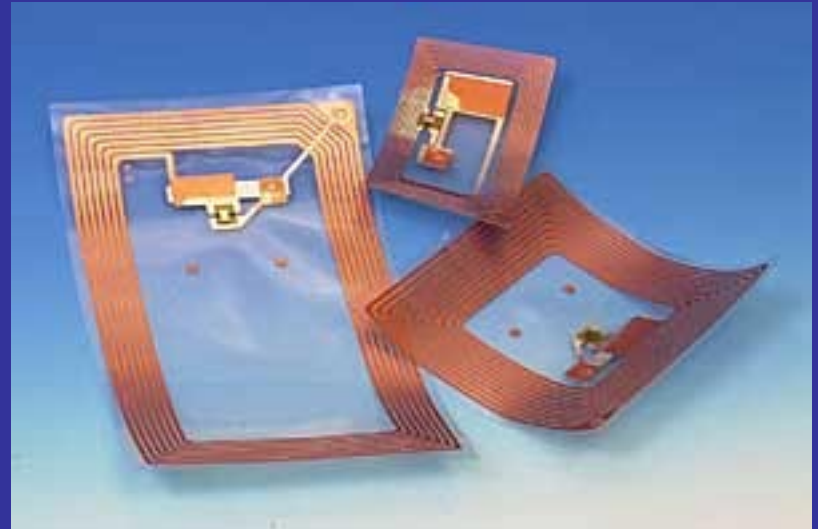
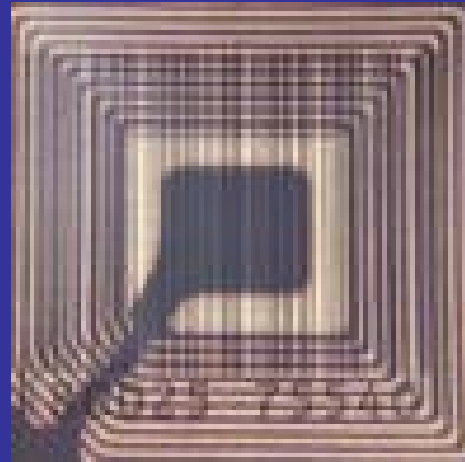
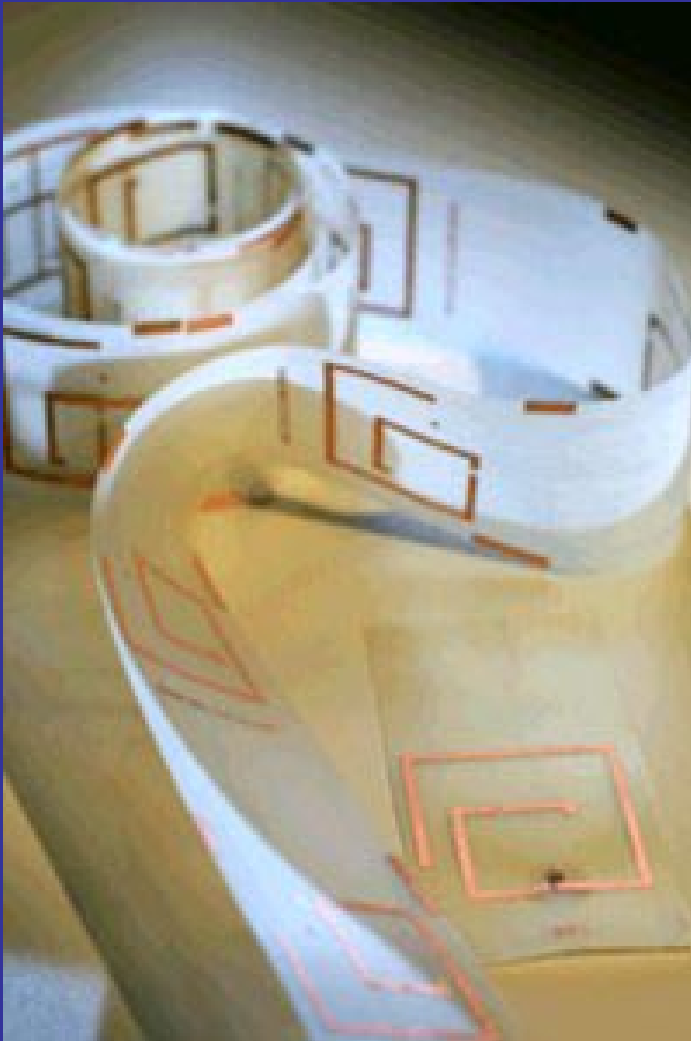
Agenda

- ⇒ Strategies of RFID players
- ⇒ Size and shape of the RFID market
 - ⇒ Early successful applications
- ⇒ Risks and concerns
- ⇒ Integration scenarios

Strategic Directions

- ⇒ The chip
 - ⇒ Smaller, lighter, embedded, more durable, readable further
- ⇒ The spectrum
 - ⇒ Less interference, more penetration
- ⇒ The data
 - ⇒ More integration

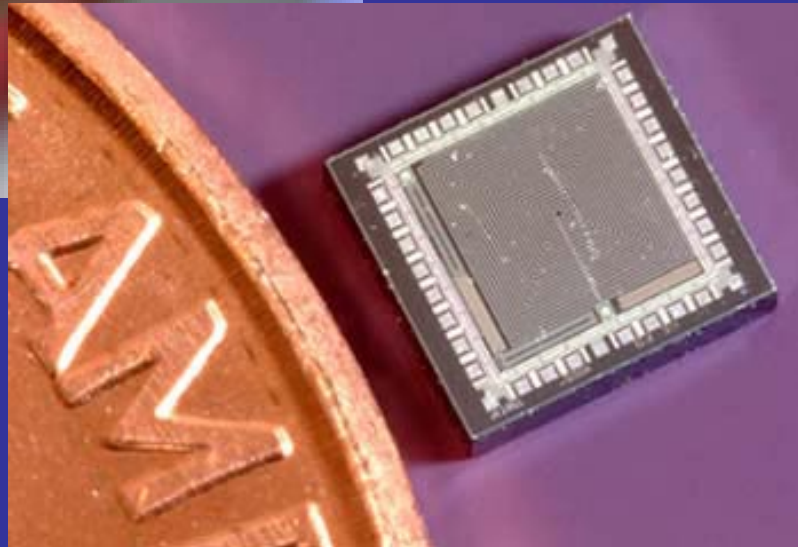
Chips and Tags



23 February 2006

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Market Forecasts

⇒ IDTechEx forecast of global market:

⇒ \$2.71Bn in 2006

⇒ \$12.35Bn in 2010

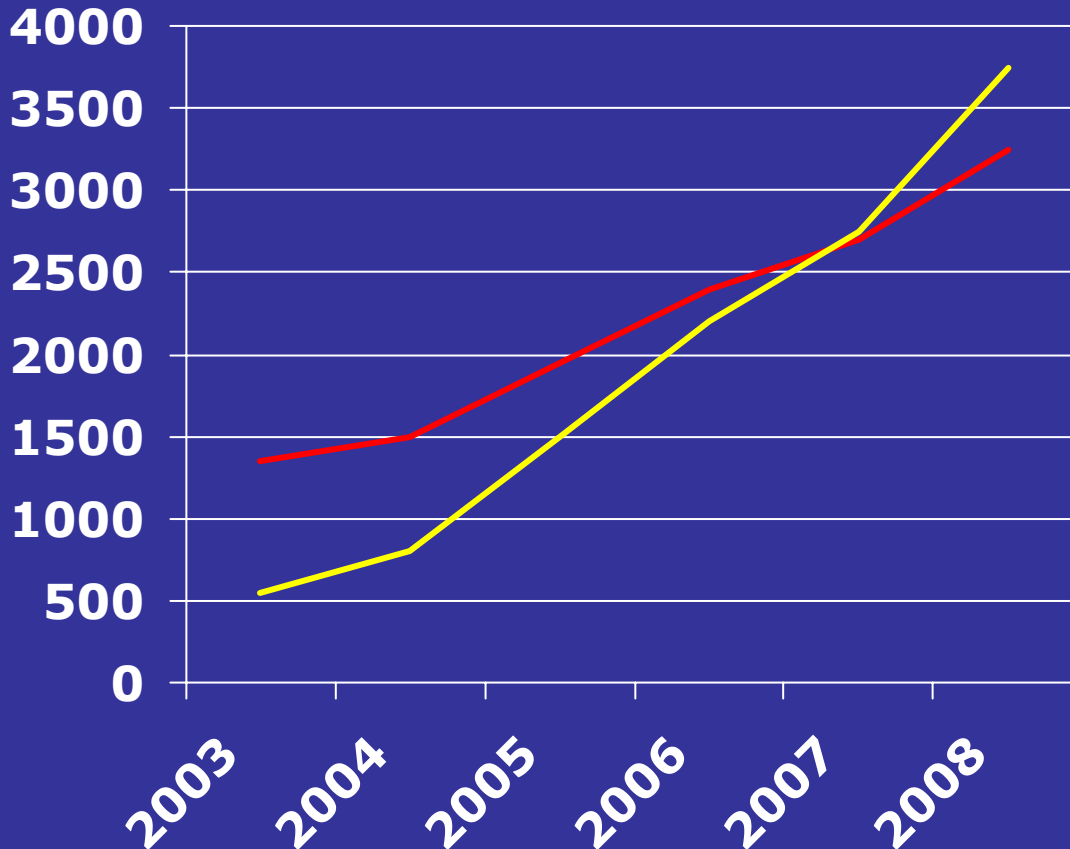
⇒ \$24.5Bn in 2015

Ultimate Global Potential

Global Potential Market		RFID Leadership
Application	Billions/year	
Livestock	1	East Asia/Europe
Blood	2	Europe/USA
Air baggage/freight	4	USA/China
Pallets and cases	40	China/Japan/USA
Drugs	50	USA/Korea
Books	50	Japan
Postal	650	Europe
CPG	10,000	Europe/Japan/USA

RFID Revenue Mix

Revenues
(\$Millions)



— Product Revenue
— Integration Services Revenue

Source:
ABI
Feb 2004

Application Fields

- ⇒ Retail & consumer packaged goods
- ⇒ Postal and courier services
- ⇒ Land and sea logistics
- ⇒ Airlines and airports
- ⇒ Healthcare and pharmaceuticals
- ⇒ Animals and farming
- ⇒ Libraries and archiving
- ⇒ Manufacturing
- ⇒ Leisure
- ⇒ Laundry
- ⇒ Financial and security
- ⇒ Military
- ⇒ Passenger transport

**Source:
IDTechEx 2004**

Early Successes

- ⇒ Smart card (e-purse and access)
- ⇒ Electronic Toll Collection
- ⇒ Pet ID
- ⇒ Bar code replacement
 - ⇒ Satisfy customer mandates
 - ⇒ WalMart, US DoD, Target, etc.
 - ⇒ This is case or pallet only

Profitable Niche Markets

- ⇒ Passports, prompted by terrorism
- ⇒ Livestock and food traceability
- ⇒ Intermodal containers (Smart and Secure Tradelanes, etc.)
- ⇒ Healthcare
- ⇒ Prisoners and parolees
- ⇒ Ubiquitous Sensor Networks (USN) (disaster warning, military, etc.)

Amusement Parks & Events

- ⇒ Disneyland and Six Flags
- ⇒ 13.56MHz active chip tags
- ⇒ E-purse applications
- ⇒ Asset management
 - ⇒ Defibrillators and wheelchairs
- ⇒ Lost child location
- ⇒ Customer behavior analysis

Fuji Rock Festival



- ⇒ Wristband “tickets” with Softbank RFID
- ⇒ 3-days and 30,000 people
- ⇒ Access control and crowd management

VeriChip Human Implants

- ⇒ FDA approval for human implants
- ⇒ Health records access
- ⇒ Physical access control
 - ⇒ Currently in use for secure ID for Mexican drug agents
- ⇒ Already used in pets and livestock



Michelin Tires

⇒ Product ID

- ⇒ Replace the 12 current labels on tires with an active ePC

⇒ Passive monitor

- ⇒ UHF Gen2 tags in sidewall

- ⇒ Pressure and temperature readings reported to/through vehicle telematics system

Risks and Concerns

- ⇒ High fixed (sunk) cost – slow ROI
- ⇒ Slow standards development
 - ⇒ Major vendors do not yet see reason for consensus
- ⇒ Tag production bottlenecks
- ⇒ Security and privacy issues
- ⇒ Interference and reach

Retailer Costs & Rewards

⇒ Retailer costs

⇒ US\$400K/distribution center

⇒ US\$100K/store

⇒ US\$35-40 million for SI

⇒ Retailer rewards

⇒ One-time inventory reduction = 5%

⇒ Annual labor reduction = 7.5%

⇒ Annual new revenue from "out of stock" loss avoidance = .07%

Source: A.T. Kearny Nov. 2003

Manufacturer Costs & Rewards

- ⇒ Manufacturer costs
 - ⇒ US\$400K/factory
 - ⇒ US\$35-40 million for integration
 - ⇒ Recurring costs of tags
- ⇒ Manufacturer benefits
 - ⇒ Increased inventory control
 - ⇒ Improved order fulfillment processes
 - ⇒ Visibility into retailers' inventories
- ⇒ Volume and price/unit determine cost effectiveness of implementation

Source: A.T. Kearny Nov. 2003

Acceptable Costs

⇒ Passive tags

⇒ 40% say less than US\$0.05

⇒ 22% say US\$0.06-\$0.10

⇒ Active tags

⇒ 28% say less than US\$1.00

⇒ 17% say US\$1.00-\$2.50

⇒ Readers

⇒ 33% say less than US\$250.00

⇒ 23% say US\$250-\$1,000.00

Source: Bearingpoint, SIIA, CIO Magazine June 2004

RFID Standards

Bands	Standards	Comments
<135 kHz	ISO 18000-2	
6.765-6.795 MHz		
7.400-8.800 MHz		
13.55-13.57 MHz	ISO 18000-3	In common usage
26.96-27.28 MHz		Special applications
433.0 MHz	ISO 18000-7	Asia – Active tags
868.0-870.0 MHz	ISO 18000-6 A/B	Europe
902.0-928.0 MHz	AutoID Classes 0/1	North America
860.0-960.0 MHz	EPCglobal Gen2	Worldwide
2.400-2.483 GHz	ISO 18000-4	
5.725-5.875 GHz	ISO 18000-5	Rarely used

UHF RFID Standards

	EPCglobal Gen2	AutoID Class 0	AutoID Class 1	ISO 18000-6 A	ISO 18000-6 B
Air Interface	PIE-ASK BPSK FM0	PWM/FSK	PWM/PIM	PIE-ASK Biphase AM	M-ASK Biphase AM
EPC	96, 256b	64, 96b	64, 96b	Not defined	Not defined
Memory	128-1024b R/W	256b read only	256b R/W	64kb R/W	2kb R/W
Data Rate	40/640 kb/s	40/80 kb/s	70/140 kb/s	33/40 kb/s	8/40 kb/s
Arbitration	Probabilistic slotted	Deterministic binary tree	Deterministic slotted	Probabilistic slotted	Probabilistic binary tree
Frequency MHz	860-960	902-928	902-928	860-930	860-930
Security	32b kill, access	24b kill	8b kill	None	None

**Source: Rob Glidden,
Impinj, Inc.**

Acronym Glossary

- ⇒ ASK = amplitude shift keying
- ⇒ Biphase AM = biphase amplitude modulation
- ⇒ BPSK = binary phase shift keying
- ⇒ FSK = frequency shift keying
- ⇒ M-ASK = M-ary amplitude shift keying
- ⇒ PIE = pulse interference elimination
- ⇒ PIM = pulse interval modulation
- ⇒ PWM = pulsed wave modulation

Gen2 Standard Benefits, Page 1

- ⇒ **Open Standard - multiple sources, low prices, cross-vendor compatibility**
- ⇒ **Memory/Password - 96 bit memory (2×10^{19} for every human being alive); 22 bit password**
- ⇒ **Size - chips one-third to one-half current size**
- ⇒ **High Reliability - close to 100% read rates**
- ⇒ **Better Tag Identification - no duplicate reads during multiple tag scans**

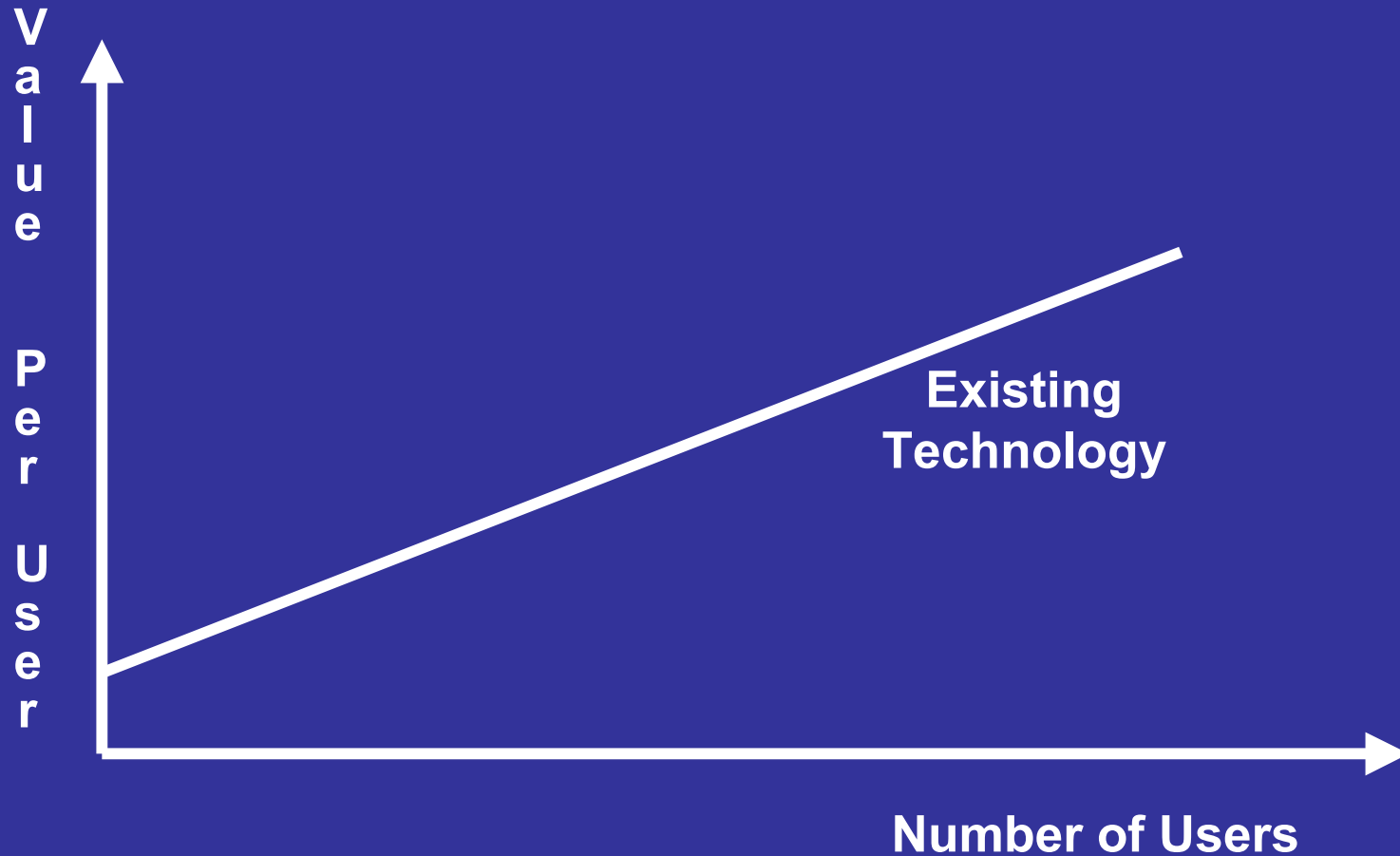
Gen2 Standard Benefits, Page 1

- ⇒ **Kills** - tags can be permanently killed by a reader
- ⇒ **Security** - encrypted tag data; readers do not broadcast
- ⇒ **Timing** - tags entering reader field late will be read
- ⇒ **Global Frequency** - spread spectrum UHF with frequency-modulation capabilities to minimize interference
- ⇒ **Read Rate** - ten times faster than current tags

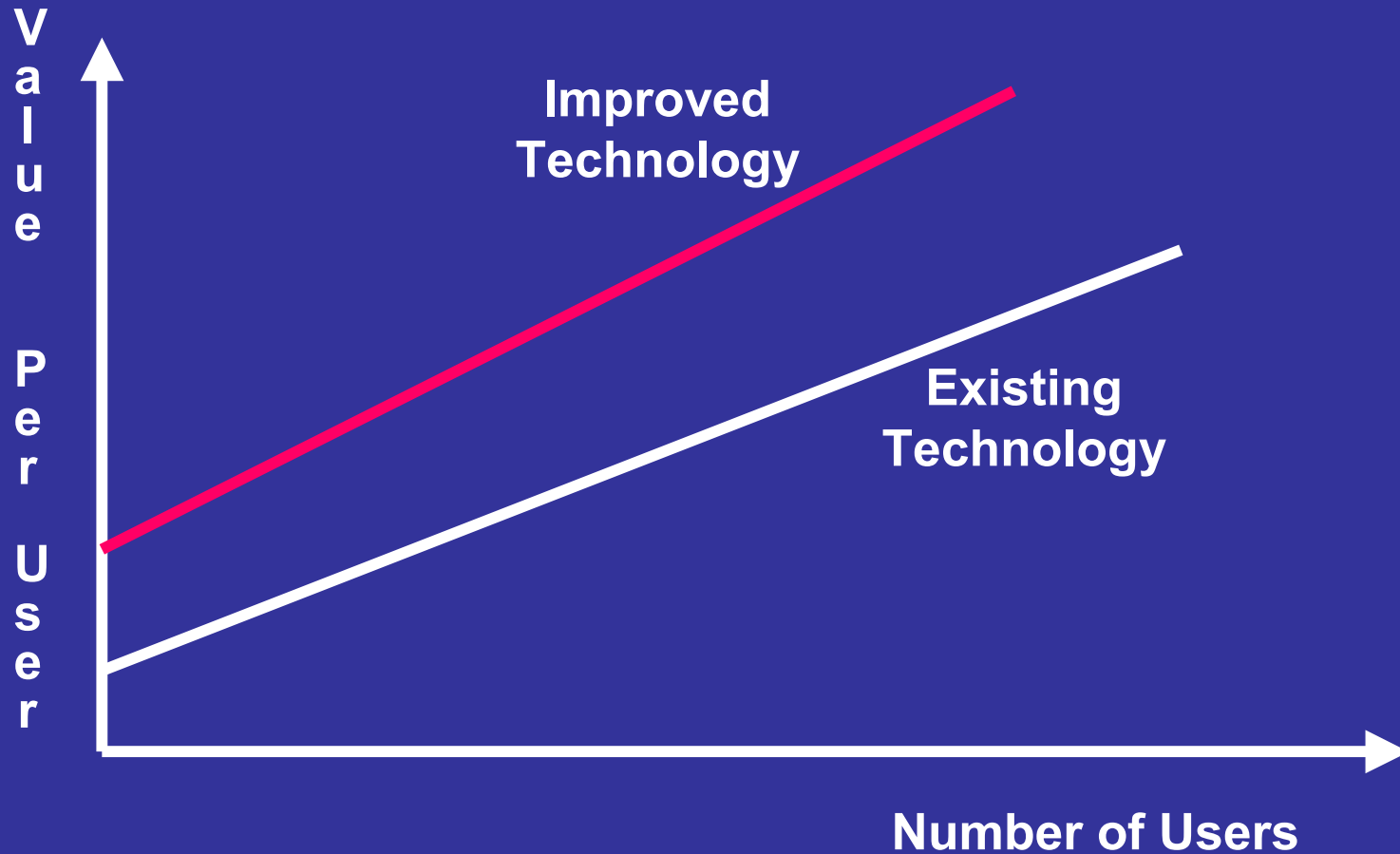
Gen2 Standard Drawbacks

- ⇒ **Intermec contends that some portions of Gen2 make use of its patented technology and licenses will have to be bought**
- ⇒ **Gen2 standards are vague in some areas and different vendors are implementing them differently**
- ⇒ **Gen2 tags currently cost 7.2 cents each in volumes of ten million units or more**

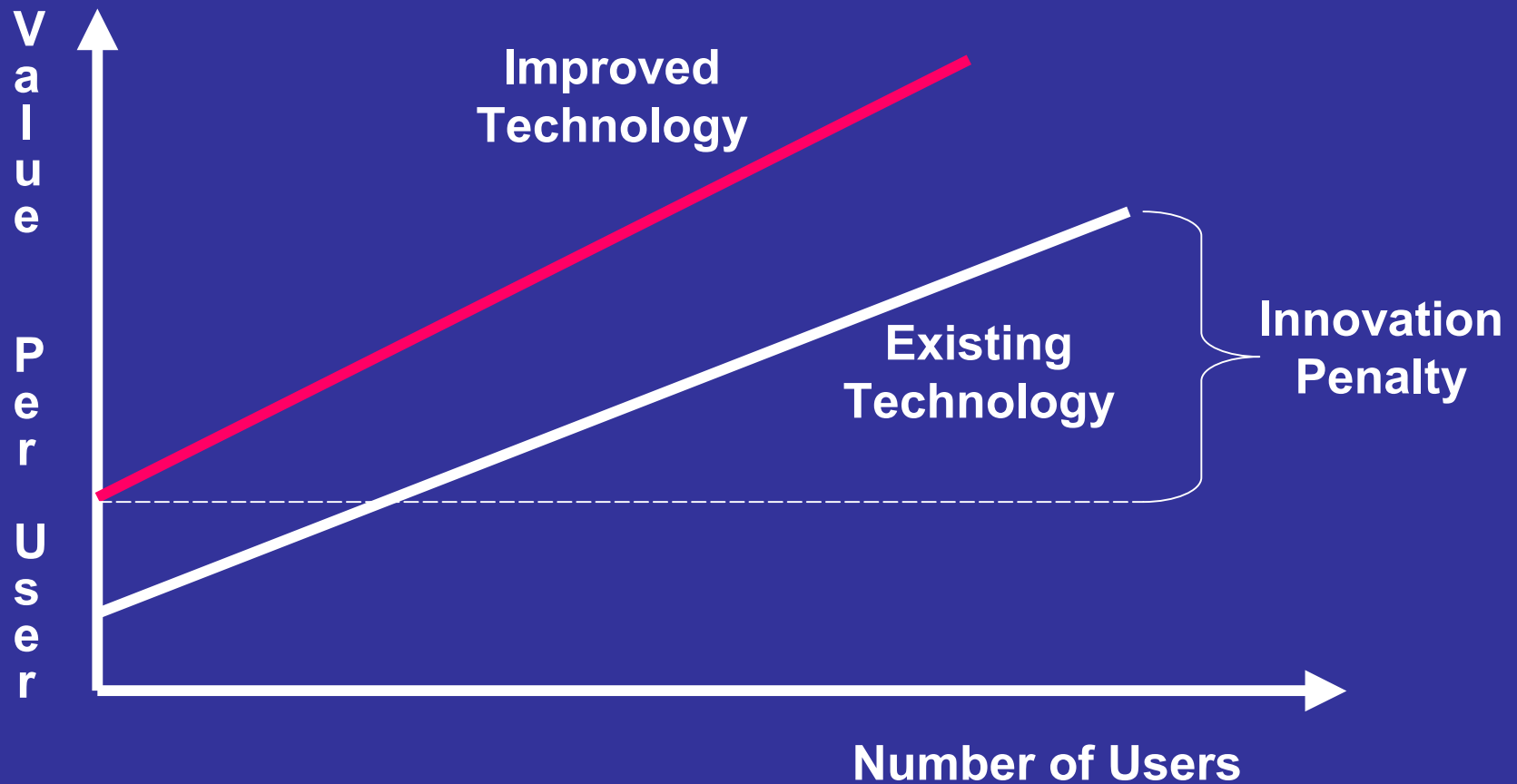
Standards and Interoperability



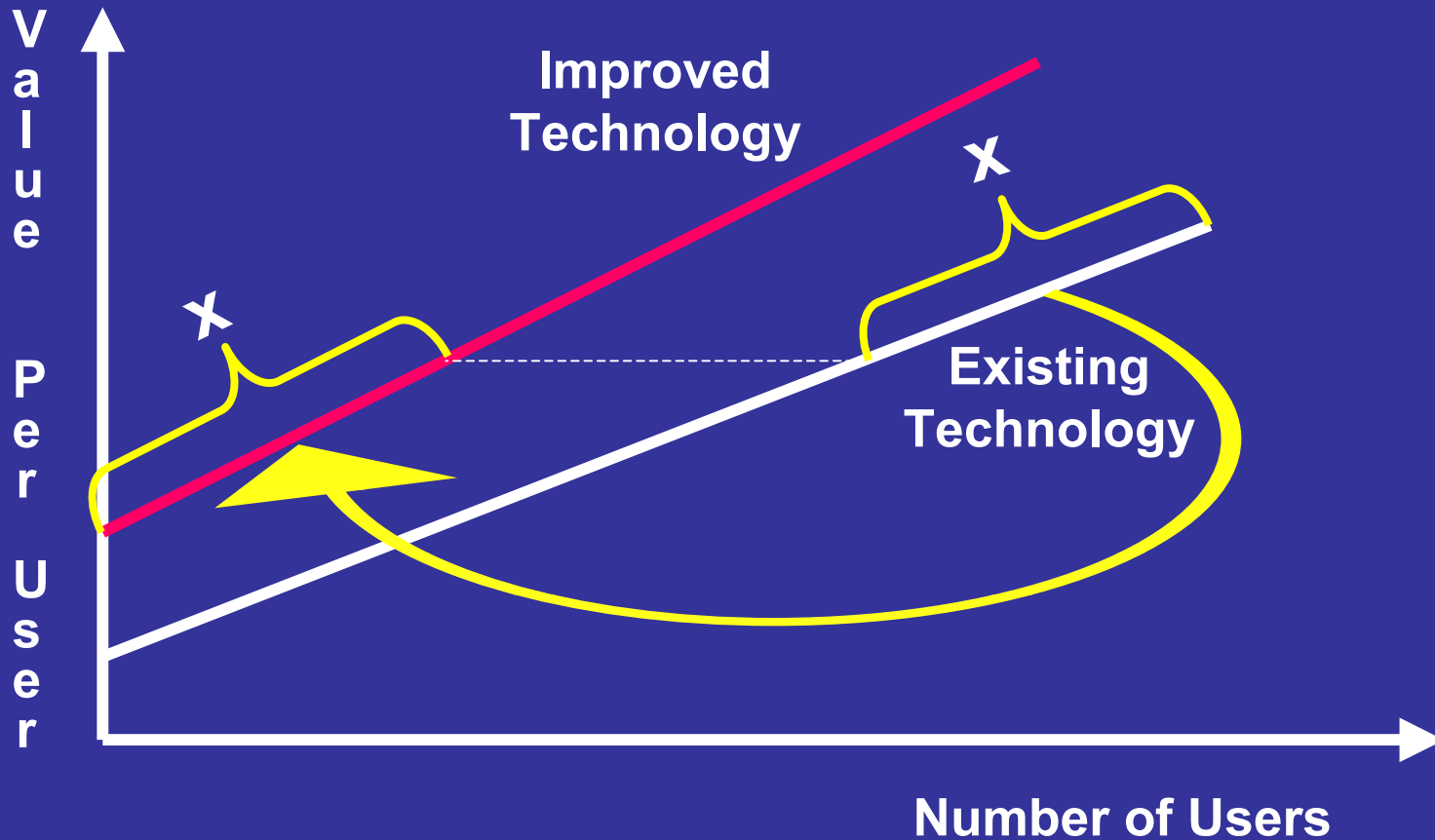
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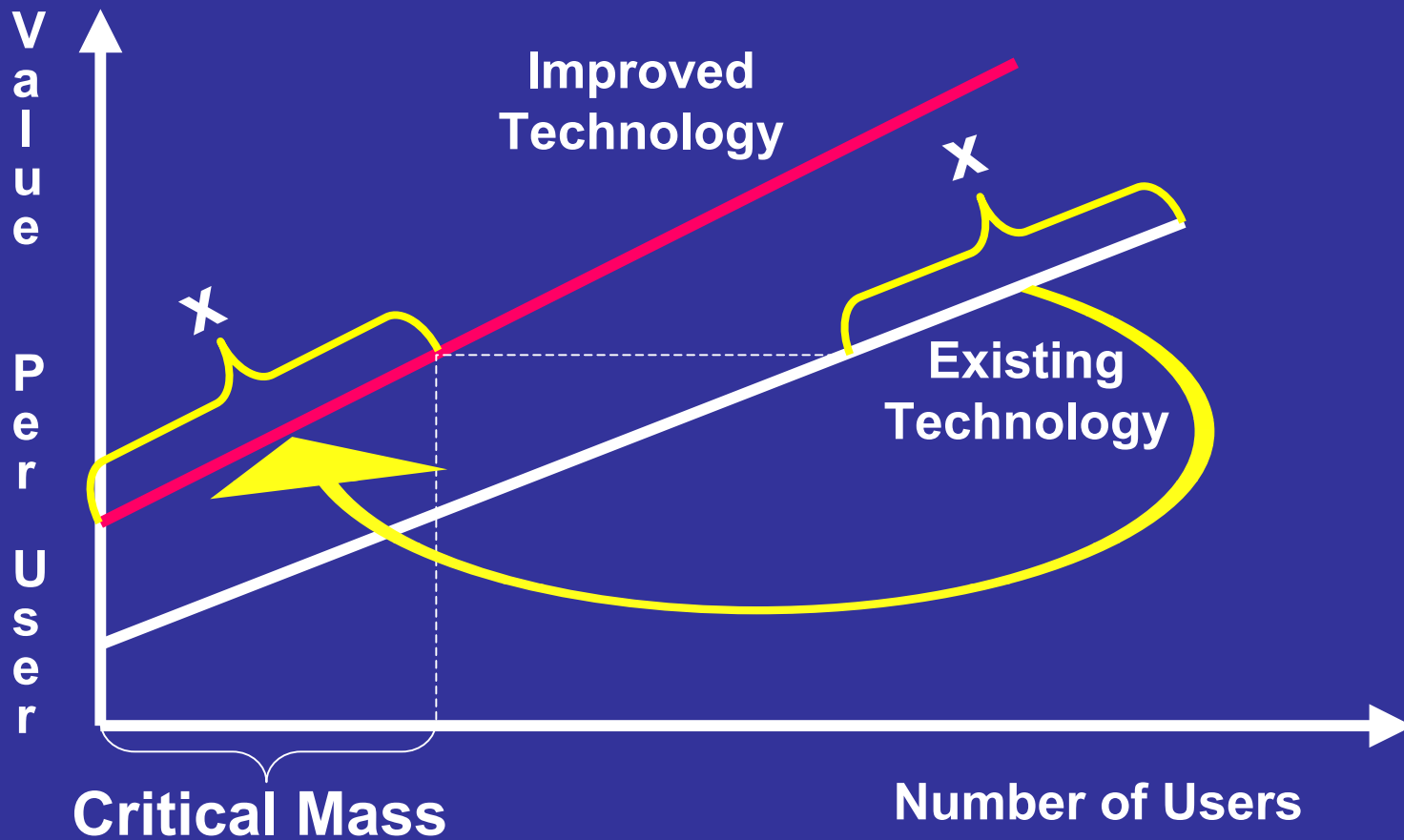
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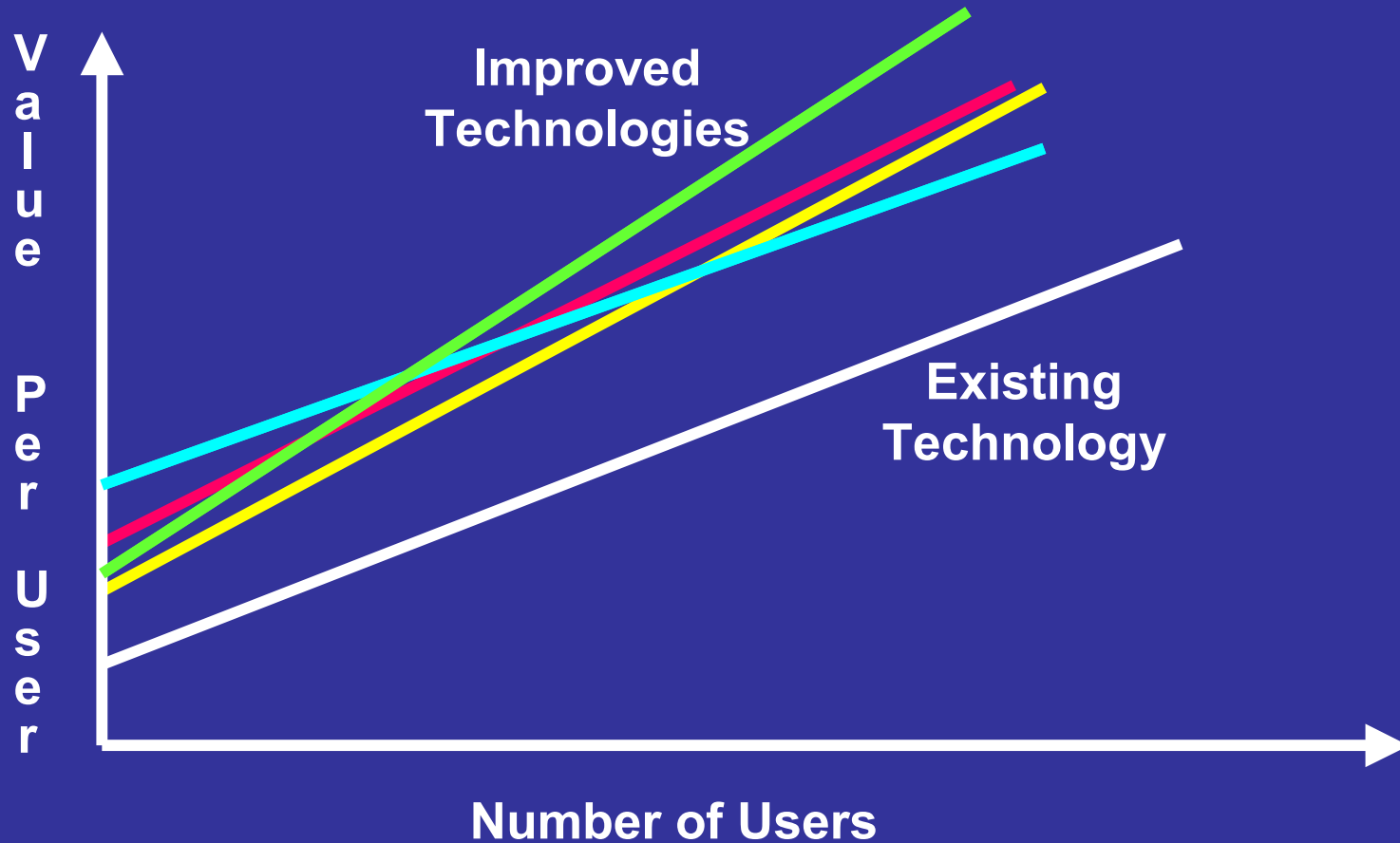
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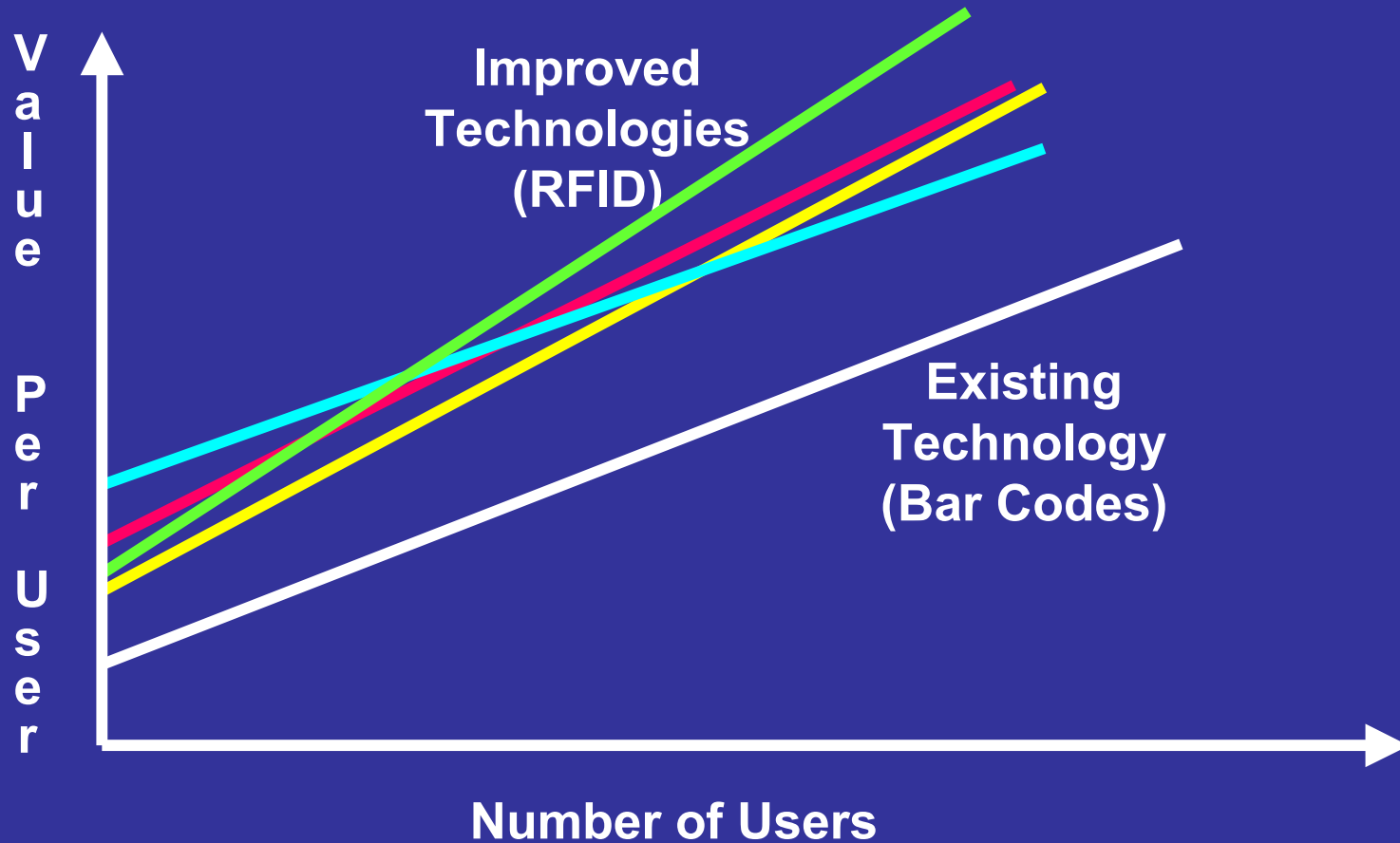
Standards and Interoperability



Standards and Interoperability



Standards and Interoperability



Tag Production Bottlenecks

- ⇒ Two primary vendors for Class 0/1
 - ⇒ Alien Technology
 - ⇒ Matrics, Inc.
- ⇒ Other vendors are waiting for firm Gen2 standards (Philips, TI)
- ⇒ WalMart, DoD, Target, Metro, Albertson's are phasing in mandates
- ⇒ Manufacturers are holding off orders
- ⇒ Cycle time for production is longer than these customers are used to

Security and Privacy

- ⇒ Benetton case made the point
 - ⇒ This is not a trivial issue!
- ⇒ Tags must be easy to disable
- ⇒ Unintentional disabling must be hard to do
- ⇒ Protecting individually identifiable data is legally required and is a critical success factor for RFID

Main Privacy Concerns

- ⇒ Purchasers may not be aware of the tag or be able to remove it
- ⇒ Tags can be read without the knowledge of the individual
- ⇒ Tagged items paid for by credit card or with a loyalty card can be tied to the purchaser's identity
- ⇒ Gen2 standards will create globally unique serial numbers for all products, which is unnecessary for most applications

RF Interference and Reach

- ⇒ RF sources abound
 - ⇒ Forklifts; bug zappers; cell phone towers; microwave ovens
- ⇒ Low frequencies = low speed, low cost, short range, low interference
- ⇒ High frequencies = high speed, high cost, long range, interference

Integration with other Systems

- ⇒ Integration is perceived as both:
 - ⇒ A critical risk for adoption, and
 - ⇒ The enabler of major benefits
- ⇒ By 2007 it may be the source of more revenues than hardware
- ⇒ It may be the critical success factor in business software

Early Integration Strategies

- ⇒ Cope with “a tidal wave” of data
 - ⇒ Limit the data gathered and the applications
 - ⇒ Use business rules to ignore business as usual and concentrate on exceptions
 - ⇒ Use middleware for a few links

RFID Middleware

- ⇒ Early adopters will need packaged features for
 - ⇒ Reader data integration and coordination
 - ⇒ Basic filtering and exceptions
- ⇒ Longer term, greater integration into existing systems required

Integrated Supply Chain

- ⇒ “Component ID”
 - ⇒ Manufacturer’s inbound logistics
 - ⇒ Warehouse management
 - ⇒ Constituent element of ERP
- ⇒ Information sharing
 - ⇒ Up the supply chain to vendors
 - ⇒ Down the supply chain to customers

Principles of Integration

1. Communications Infrastructure Service to communicate among components
2. Process Management Service to control interactions
3. Shared data model for every business concept
4. Directory Service for applications to find each other and request services
5. Business process models can be changed without changing component systems

Integration Scenarios

- ⇒ Separate RFID database, data accessible by other applications using middleware
- ⇒ Separate RFID database with shared data model, business logic accessible by other applications
- ⇒ RFID database part of integrated, *very large* enterprise database

An Historical Metaphor

- ⇒ SAP 1972-1995: relatively small manufacturing management firm
- ⇒ Eve of Y2K: enterprises recognize cost of Y2K compliance
- ⇒ SAP ramps up to offer fully integrated ERP
- ⇒ Only SAP was fully ready to capitalize on the demand

RFID and the Metaphor

- ⇒ The size of the RFID database will grow rapidly
- ⇒ Most firms will throttle it down
- ⇒ Some firms will want to use it
- ⇒ Will any business software firm be ready to fully integrate it?
- ⇒ SAP? Oracle/Peoplesoft? MS?