

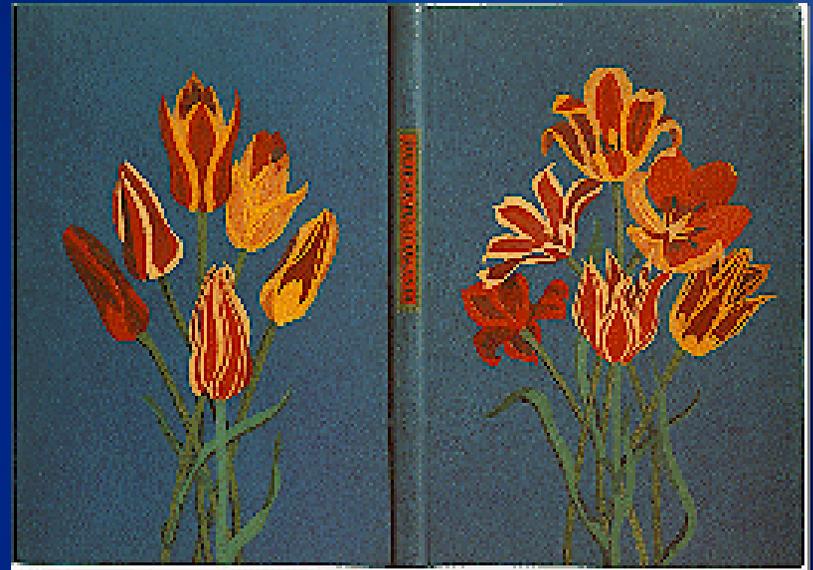
Won't get .fooled again

One outlook for 2003 and beyond

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Boom and Bust

- Is nothing new...
 - 1637 – tulip mania takes hold and the price of tulip bulbs escalates to fantastic levels
 - 1719 Banque Royale – John Law introduces the French crown to the magical mysteries of bank credit and paper money. At this point the word “millionaire” entered our vocabulary. But by 1720 the Parisian crowd were less than impressed with Law’s sharp dealings as the French economy collapsed utterly



It's a post-dot-boom-and-bust world ...

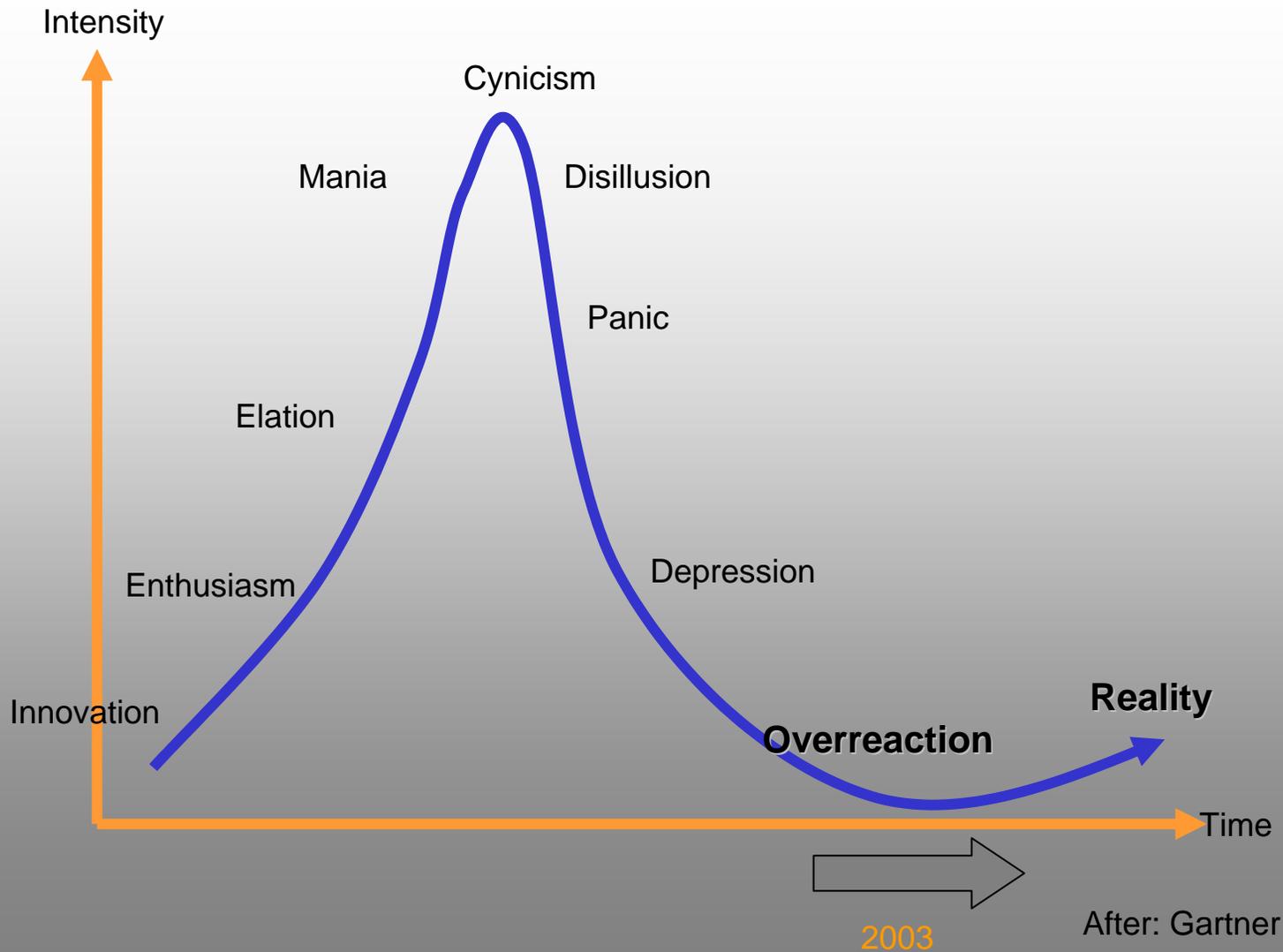
- The Internet boom has been pretty mild by comparison with booms in gold, oil, rail, shipping, ice and, of course, tulips.
 - The peak of the Internet boom saw stock indices peak at 5 times their longer-term value



It's a post-dot-boom-and-bust world

- But the lessons from the boom cycle are no different...

Today



Today

- ISPs can no longer operate a rapid expansion-based business model
 - Business models are tending to use a common theme of service consolidation
- Attention is now concentrating on aspects of the Internet service model:
 - Dependability and integrity
 - Utility and flexibility
 - Value-add service models
 - Quality and performance
 - Innovative applications and services

From Optimism to Conservatism

- We've learned that optimism alone is no substitute for knowledge and capability
- A conservative period of careful expansion rather than explosive growth
 - Investment programs need to show assured and competitively attractive financial returns across the life cycle of the program
 - Reduced investment risk implies reduced levels of innovation and experimentation in service models
 - Combine communications with additional services to create value-added service bundles
 - Accompanied by greater emphasis on service robustness and reliability

Security Focus

- We've learned that we cannot operate global networks based on informal trust models
- A highly visible security focus for the next few years
 - Increased end-user awareness of vulnerabilities and weaknesses and a desire for more secure and trustable services
 - Increased public sector agency awareness of the vulnerabilities of the Internet communications environment and its consequences
 - A response based on increased technology effort in dismantling aspects of the Internet's distributed trust model and attempting to replace it with negotiated conditional trust
 - Expect encryption and authentication at many levels of the IP protocol suite

Security Issues

- We've learned that we need to understand more about what stakeholders want from the Internet in terms of security
- The list of outstanding issues include:
 - How can users identify each other?
 - How can users identify network-based services and validate the integrity of such services before entrusting them with data?
 - How can the network protect itself from abuse and attack?
 - How can users protect themselves from abuse and attack?
 - What are a user's obligations and responsibilities?
 - How can abusers be identified? And whose role is it?
 - What is the role of the ISP?
 - Neutral common carrier?
 - Trusted intermediary?
 - Enforcement point?

Multiple Networks

- We've learned that IP is not the panacea of communications protocols
- Recognise IP's strengths and weaknesses
 - ☺ IP allows adaptable traffic sessions to operate extremely efficiently over wired networks
 - ☹ IP is not the optimal approach to support:
 - mobile wireless traffic
 - resource management requirements
 - ☹ IP is not strong in supporting:
 - real time traffic under localized congestion events
 - various forms of traffic engineering applications
- Continued use of multiple networks to provide specialized service environments for various application sectors for some time yet

Bandwidth Abundance

- We've learned that when you eliminate one choke point in a system you expose others
- Dense Wave Division Multiplexing is lifting per-strand optical capacity
 - from 2.5Gbps to 6.4Tbps (640 wavelengths, each of 10Gbps per lambda) per optical strand
- The major long haul communications routes worldwide are more than amply provisioned with IP bandwidth
 - The shift from demand-pull to supply-overhang is impacting the business stability of the long haul communications supply market.
- The network 'choke' points are shifting to the access domain, not the long haul elements

Broadband Last Mile

- An steady continuation of the shift to a pervasive broadband access model for IP
 - Gradual phase out of modems as the dominant IP access device
 - Here are many externalities that determine the speed of this trend
 - Industry concentration on deployment of fibre, coax and DSL based last mile networks
- Associated with this is the need to deploy higher speed last mile access switching systems
 - allow concentration and switching of user traffic across a shared last-mile high capacity access system

Broadband Last Mile

- What form of Broadband Access?
 - Wireless is probably not a logical contender for ubiquitous last mile, but it has its areas of application
 - Hybrid Fibre Coax systems are capital intensive and often rely on a strong pay-TV market to provide some capital leverage
 - Fibre is great – but its also capital intensive – good for CBD and MTA deployments but less capital efficient for low density deployments
 - DSL is a reasonable compromise for lower density deployment environments

Technology – IPv4

- We're learning that we might be stuck with making IPv4 work for longer than we thought we could or should
- V4 remains the overwhelmingly dominant protocol choice
 - 32 bit (4G) address space
 - 65% allocated
 - 32% deployed
 - 5%- 10% utilization density achieved
 - Consumption at a rate of 32M addresses p.a.
 - Anticipated lifespan of a further 10 years (at most) in native mode
 - Indefinite lifespan in NAT mode
 - But NAT has its own problems!

Technology – IPv6

- “IP with larger addresses”
- Address space requirements are no longer being easily met by IPv4
- This is an issue for high volume deployments including:
 - GPRS mobile
 - Pocket IP devices
 - Consumer devices
- IPV6 appears to offer reasonable technology solutions that preserve IP integrity, reduce middleware dependencies and allow full end-to-end IP functionality for a device-rich world

Sony DCRTRV950



- Playback Zoom
- i.LINK (IEEE1394) IN / OUT
- Video IN / OUT
- S-Video IN / OUT
- Audio IN / OUT (Stereo)
- USB Terminal
- Intelligent Accessory Shoe
- Headphone Jack (Stereo)

- NPQM91: 370 min

Network Function

- Bluetooth Standard: Ver 1.1
- Email: SMTP, POP3
- Web Browser
- HTML: HTML3.2, Frame, JavaScript, SSL (V2/3)
- Image: GIF, JPEG, XBM, PNG

Wireless

- *In theory*
 - IP makes minimal assumptions about the nature of the transmission medium. IP over wireless works well.
- *In practice*
 - high speed TCP over wireless solutions only works in environments of low radius of coverage and high power
 - TCP performance is highly sensitive to packet loss and extended packet transmission latency
- 3G IP-based wireless deployments will not efficiently interoperate with the wired IP Internet without adaptive media gateways
 - Likely 3G deployment scenario of wireless gateway systems acting as transport-level bridges, allowing the wireless domain to use a modified TCP stack that should operate efficiently in a wireless environment
- 802.11 is different
 - And 802.11 is now well established
- Bluetooth is yet to happen (or not)

Voice over IP

- We're learning that voice has more dimensions than just emulating simple carriage of a voice signal
- The technology is getting better...
 - Load-sensitive codecs that adjust their signal rate to the current delay / loss characteristics
 - Abundant trunk bandwidth circumvents the need for detailed QoS in the network core
 - Solutions available to map between the telephone address domain and the Internet address domain (ENUM)
 - Intertwining hand-held devices into phone + PDA
- But many practical technology, regulatory and business issues remain on the VOIP path....

Services and Middleware

- We're learning that you can't completely separate various service platforms from the network
- WWW caching technologies will mature with the addition of a more generic approach to include aspects of:
 - Interception technologies
 - Open pluggable edge service technologies
- Service provision and IP Anycast to create improved resiliency for critical infrastructure elements
- Directory technologies and mapping of disparate protocol and services domains into the IP world
- Public Key Certificate structures
 - Are as needed now more than ever!

What have we learned?

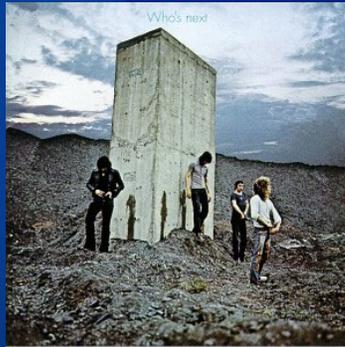
- That where there is demand, suppliers will appear
- That the Internet is not infinitely elastic and some things just cannot fly no matter how much thrust is put behind it
- That social change often takes far longer than technology change
- That the Internet may not be the best entertainment medium today – but it's a remarkable exchange medium
- That an efficient, ubiquitous and communications infrastructure is a valuable national asset
- That building communications infrastructure is one thing, using it to best effect is another. Both aspects require care and attention.
- That this is a technology-intensive activity with much that we still have to learn

So what can we expect?

- My personal list of expectations for the next few years:
 - No repeat of boom and bust
 - Conservative business objectives with conservative returns
 - Continued levels of regulatory interest to ensure that public objectives are being achieved
 - Continued expansion of the underlying infrastructure
 - Sector members with longer term objectives phrased more modestly than may have been the case in the past five years

Meet the new economy.

Same as the old economy.



The classic The Who song, written by Pete Townshend, *Won't Get Fooled Again* was first recorded in early 1971. It was released as a single and on the *Who's Next* album in August 1971. This song formed the climax of their stage set.

This song is about the same age as the Internet.

Thank You

- Questions?