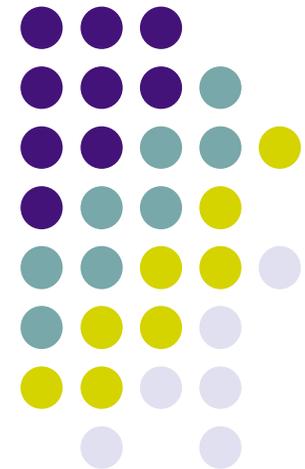


Emerging IPv6 Applications

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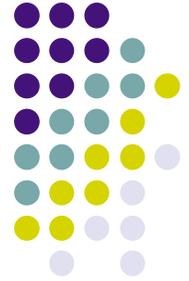


Today's Internet



- Enabled by the underlying Internet Protocol
- Until recently, two “killer applications”
 - Web
 - E-mail
- Internet users are consumers
 - Connect to Internet servers from own networks
 - Fetch web pages, fetch or send email messages
- ISPs and content providers offer services
 - Consumers (users) access those services
- Limited access to user-provided services
 - Due to current Internet Protocol (IPv4) limitations

Vision



- Using Internet technology for better
 - Exploring, understanding, playing, learning, ...
- Ubiquitous access to information (knowledge)
 - Home networking (access **into** the home)
 - New networking scenarios (e.g. vehicle networks)
 - New types of devices (e.g. sensors)
- Interacting with our environment
 - With seamlessly integrated computer devices
 - Underpinned with advanced networking infrastructure
- IPv6 as a key enabler of the vision

Some enablers of the vision



- Architecture buzzwords:
 - Peer-to-peer (p2p)
 - Semantic web services
 - Knowledge technologies
 - Agent-based computing
 - Ambient intelligence
 - GRID computing
- Hardware technology:
 - Wireless LAN
 - Bluetooth
 - RFID tags
 - Wearable computers
 - Embedded systems
 - Sensor networks
- Underlying Network
 - Internet Protocol
 - **IPv6**

Peer-to-peer (p2p) computing



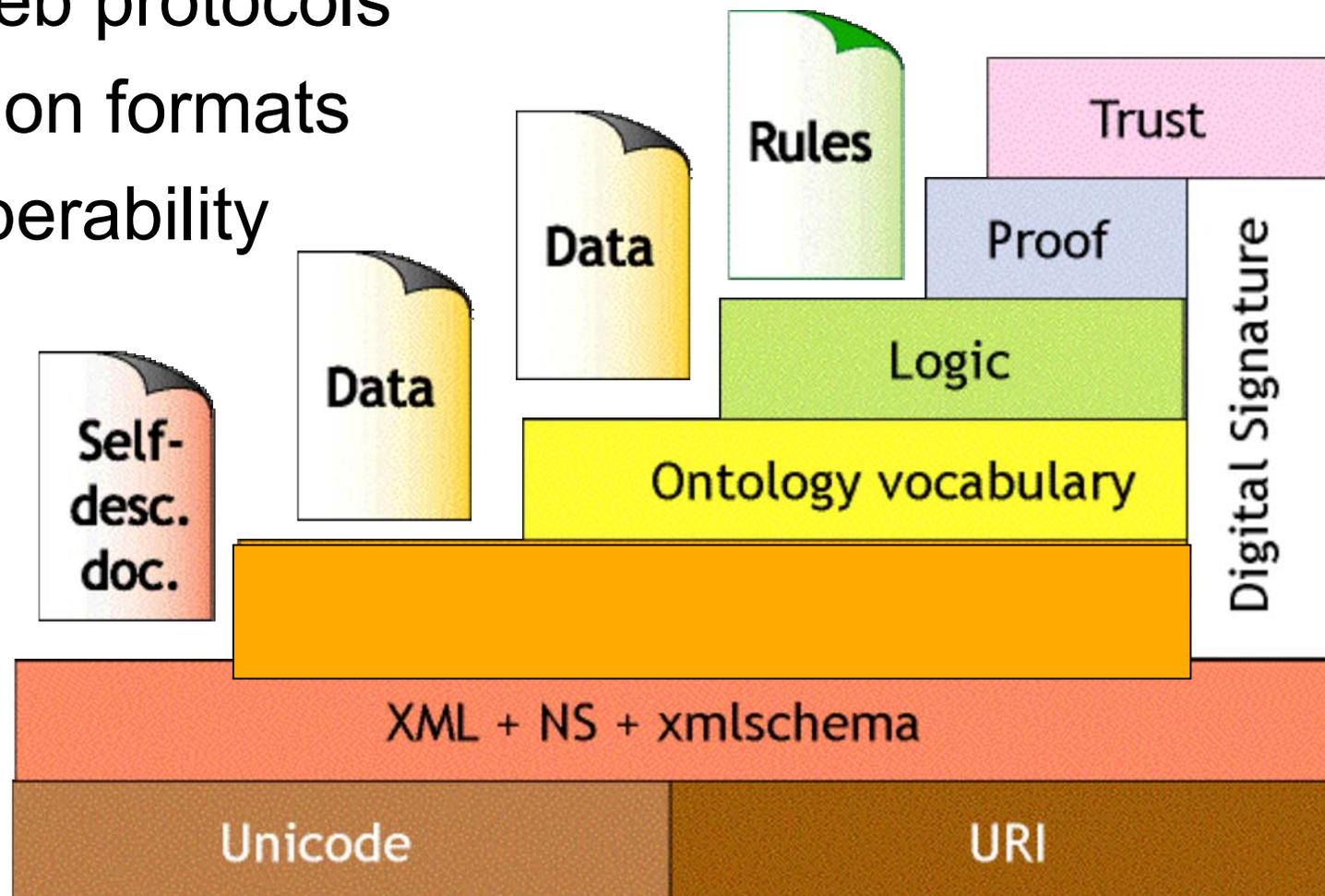
- User-to-user device-to-device communication
 - Emerging “killer app”
- Direct, bypassing intermediary servers
 - Requires all networked devices be addressable
- Examples:
 - File-sharing - popularised by Napster, etc.
 - Instant messaging
 - Voice over IP (VoIP)
- Currently usually provisioned by intermediaries due to limitations of the IPv4 protocol



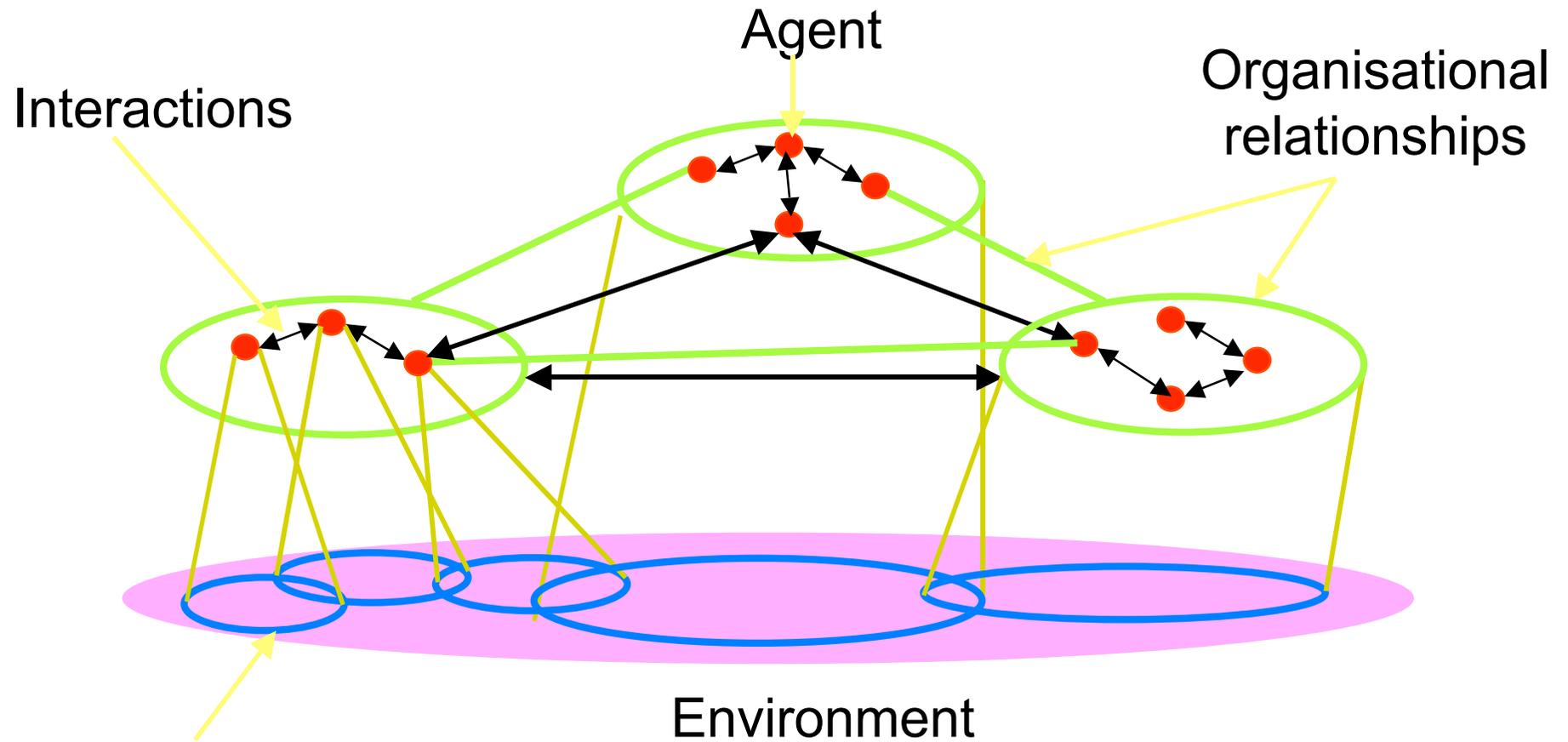
Semantic web services



- Use web protocols
- Common formats
- Interoperability



Agent-based technology



Ambient intelligence



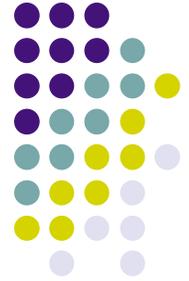
- Info Society today

- PC-based
- “Writing and reading”
- “word”-based searches
- Low bandwidth networks
- Mobile telephony (voice)
- Micro scale
- e-Services emerging
- Less than 10% online

- Future Info Society

- Surroundings is interface
- Use all senses, intuitive
- Context-based handling
- High bandwidth, convergence
- Mobile/wireless multimedia
- Nano scale
- Wide adoption (e-Health, learning, ...)
- World-wide adoption

GRID



- GRID is a new view on distributed computing
 - Using available (potentially idle) computer (CPU) power
 - Using network links between the computers to distribute data for computations
 - Distributing tasks to multiple processors
 - Implies remote processes/computers are addressable
 - May require synchronous processing of multiple streams of incoming data
- Usually requires authentication and security
 - Control access to resources
 - Many development frameworks (e.g. Globus)

Wireless networking



- Growing fast in parallel areas
 - Telco provision - GPRS, 3G, ...
 - Wide coverage, but expensive
 - Public spectrum Wireless LAN (“WLAN” or “Wifi”)
 - Data rates up to 50Mbit/s where available
 - Focused into local “hotspots” (e.g. campus, airport, ...)
 - Personal, short-range local communications
 - Bluetooth (“room local”)
- New faster wireless technology coming
 - All devices must be addressable

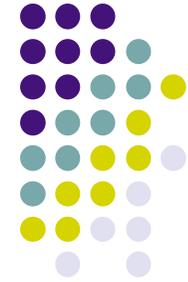
Now: Community WLAN



- Networking for communities
 - Often rural, remote locations
 - Point-to-point links, mesh networking
- Includes academic outreach
- People become self-empowered
 - Share local resources
 - Be accessible remotely



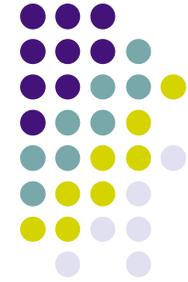
Soon: Wireless on the road



- Opportunistic connectivity
- Ad-hoc networking
 - At home in garage
 - At petrol stations
 - Car-to-car (c2c)



RFID



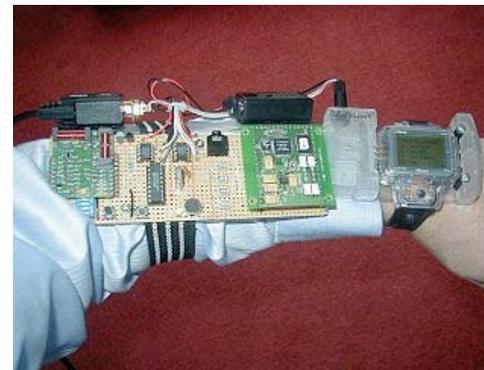
- A tag with a unique identifier
 - Very short range radio signal
- RFID reader may be IP-enabled
- Can trace tagged objects
 - e.g. farm livestock
 - Implies privacy issues
- Cost falling
 - Sub-Euro



Wearable computing



- PDA-like devices
 - Lightweight
 - Low power
 - Eye (HUD) display
 - Wireless networking



Environmental sensors



- Pervasive computing in the environment
- Many application scenarios
 - Earthquake prediction
 - Global warming monitoring
 - Flood plain monitoring
 - Glacial drift measurement
- Technology
 - Radio based sensors
 - IP-based monitoring, real-time or periodic
 - Remote processing of data



Floodnet



- UK DTI-funded project (in East Anglia)
- Monitoring
 - Trend analysis
- Predictions
 - Early warning



GlacsWeb



- Also DTI funded
 - Measure drift
 - Extreme location



GlacsWeb



- Issues:
 - Robustness
 - Temperature
 - Power
 - Wireless data
 - Deploy and forget

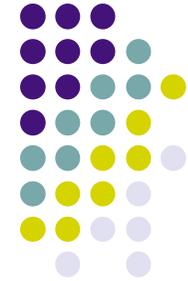


IPv6?



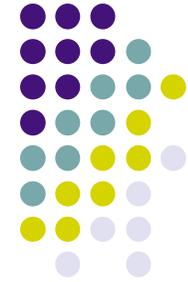
- What does it offer us?
 - Globally unique Internet Protocol address space for huge variety of new IP-enabled applications
 - Implies support for more “always-on” services
 - Autoconfiguration - network “plug and play”
 - Better support for communication with mobile devices on the Internet
 - Ad-hoc and mobile networks
 - Greater potential for end-to-end security
- Enables Internet growth
 - Billions of IP-enabled devices, in all walks of life

Physical meets Digital

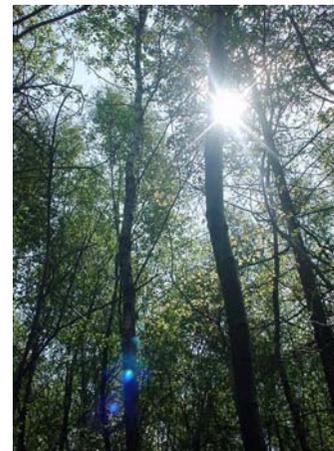


- Blurring the line between virtual and real worlds
 - For recreation or working environments
 - Local or remote interaction
- A combination of technologies in this talk
- Requires:
 - Adaptive infrastructures
 - Understanding interaction models
 - Embedded systems and devices
 - “The disappearing computer” to become reality
 - Underlying, scalable network technology
 - Globally addressable devices

Ambient wood project



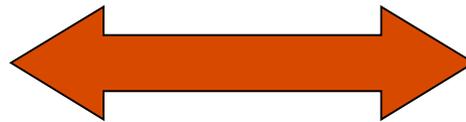
- Playful learning for kids
 - Sensors - radio pingers/probes
 - Tangibles - objects with RFID
 - Interfaces - PDAs
 - Infrastructure - speakers



Sensors meet GRID



- GRID computing used to distribute the sensor output analysis task, possibly real-time
 - For example for Floodnet



Model of floodplain

Can we shift the computation towards the devices?

Medical sensors meet GRID



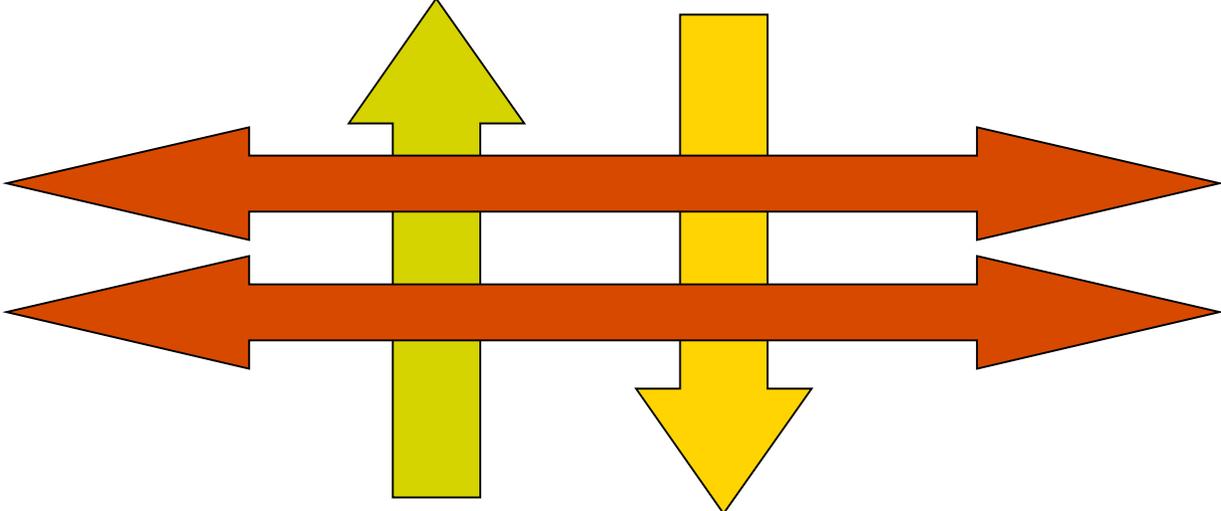
- Use of GRID-based medical devices for everyday health
 - Wearable monitoring systems
 - Wireless communications
 - Intelligent analysis, early warning
 - Remote IP-enabled monitoring



Model:



Adaptive
infrastructures



Agents

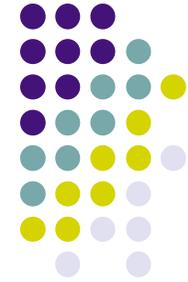
Grid

IPv6



Devices

The path ahead



- Many issues ahead, e.g.:
 - Deploying interoperable systems & components
 - Semantics, web services, ontologies
 - Further efficiencies
 - Reducing size and cost of components
 - Low power for low-cost networked devices
 - Security, trust and privacy issues
 - Scalability, innovation, device-to-device
- Using IPv6 as an enabling protocol
 - Global addressing, mobility, ad-hoc, plug-and-play

References



- EU IPv6 Research
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- EU IPv6 Task Force
 - www.ec.ipv6tf.org
- IPv6 Forum
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