

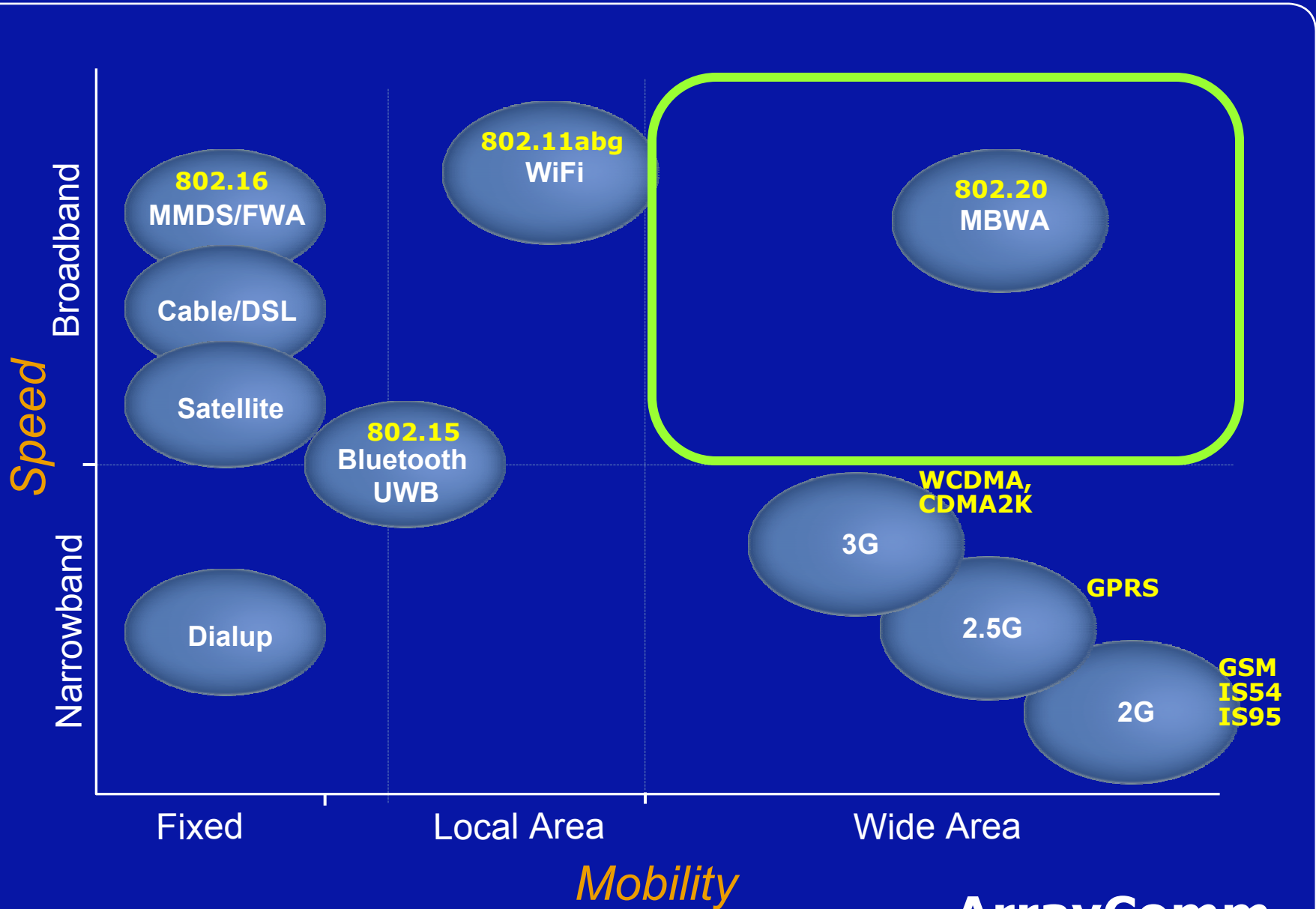
i-BURST
Mobile Broadband IP Access

Wireless Networking & Computing

Wescon 2003

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Access Landscape



- **High speed, 1+ Mbps/user**
- **40 Mbps/sector in 10 MHz**
- **Mobile or fixed use**
- **Always on**
- **Standard IP devices, apps**
- **Affordable, attractive**

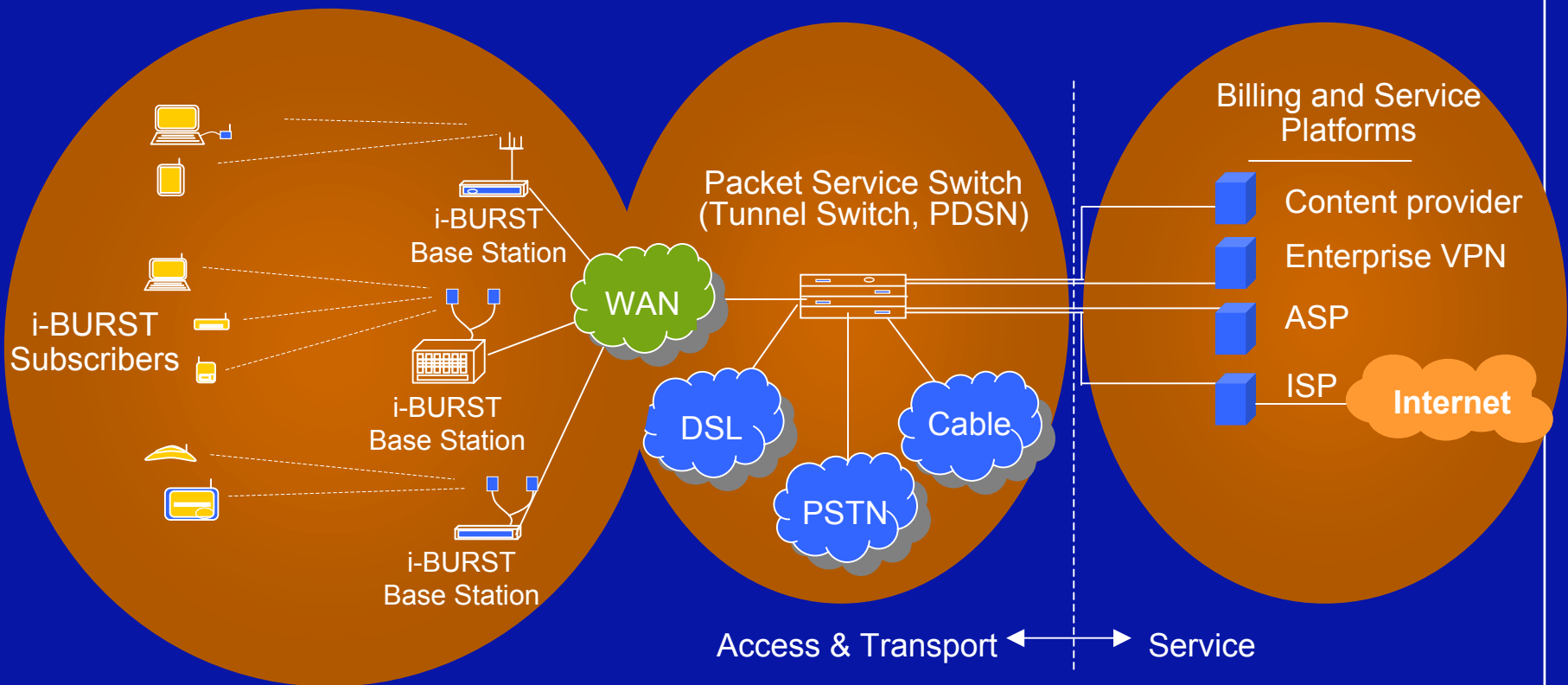
Outline

- **Network Overview**
- **Air Interface Overview**
- **Trial Results**
- **ASICs**
- **Standardization**

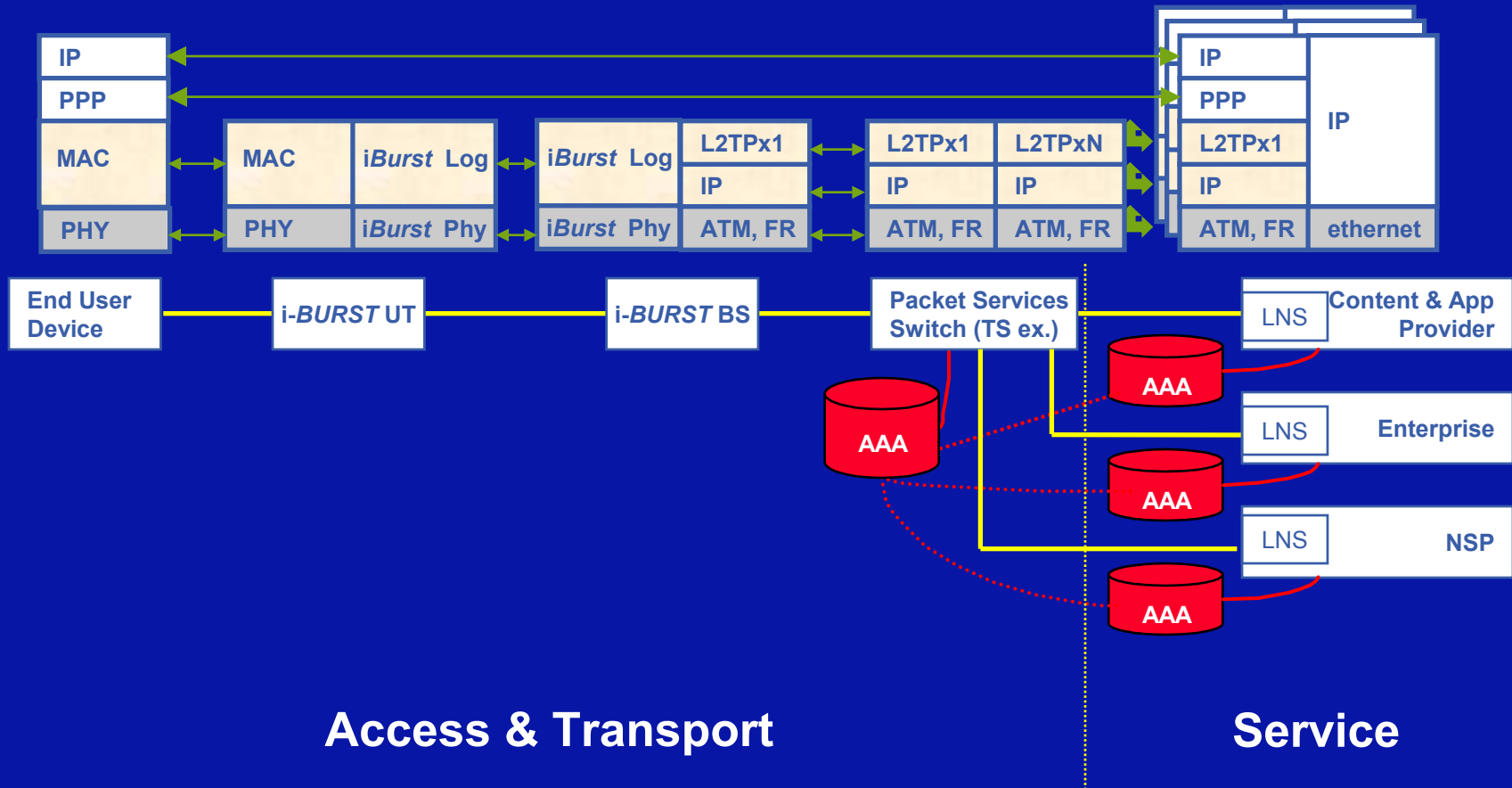
i-BURST Network

- **Unified broadband access architecture**
 - DSL/cable or 3GPP2 PSS
- **Untethers IP/PPP devices, applications**
- **Scales to multiple markets, multiple providers**
- **Standard accounting, provisioning**
- **Wired-side tunneling for security and partitioning**
- **QoS**

i-BURST Network/Service Model System Overview



i-BURST User Data Transport



*PDSN PSS uses GRE on BS/PSS link

i-BURST QoS

- **Implementation**

- policy definition: ISP Radius or LDAP server
- policy propagation: DiffServ markings on tunnel
- policy enforcement: at BS, PSS, LNS

- **Supported QoS classes (partial list)**

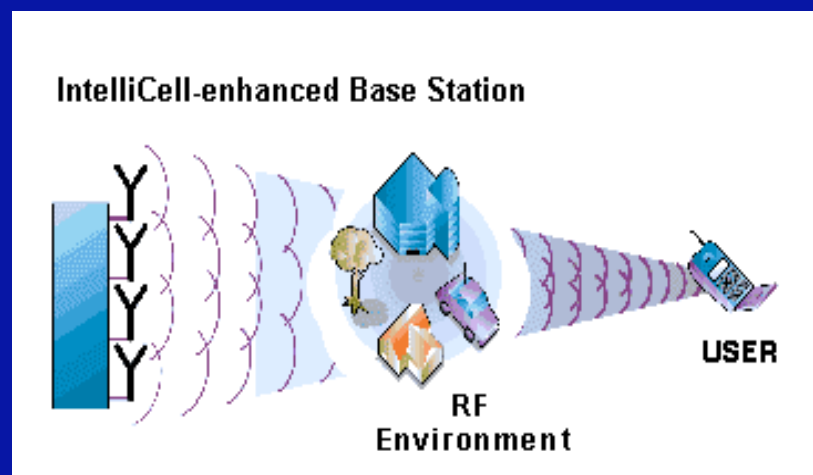
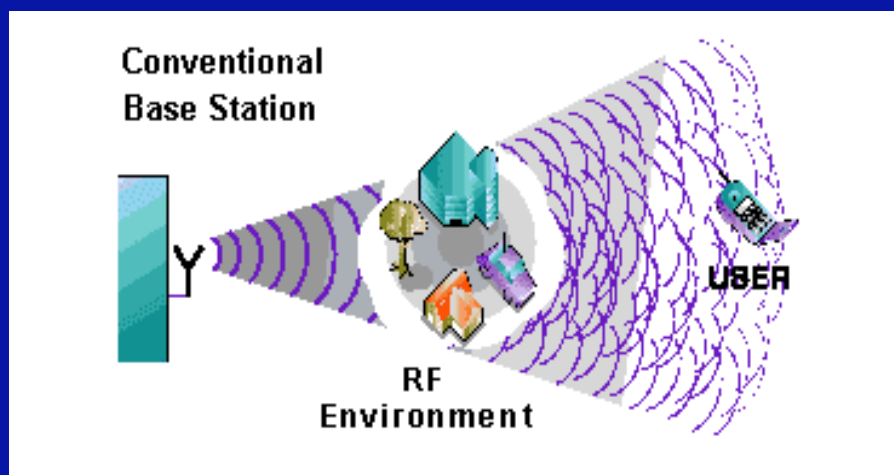
- rate limits
- relative priority
- partitioning

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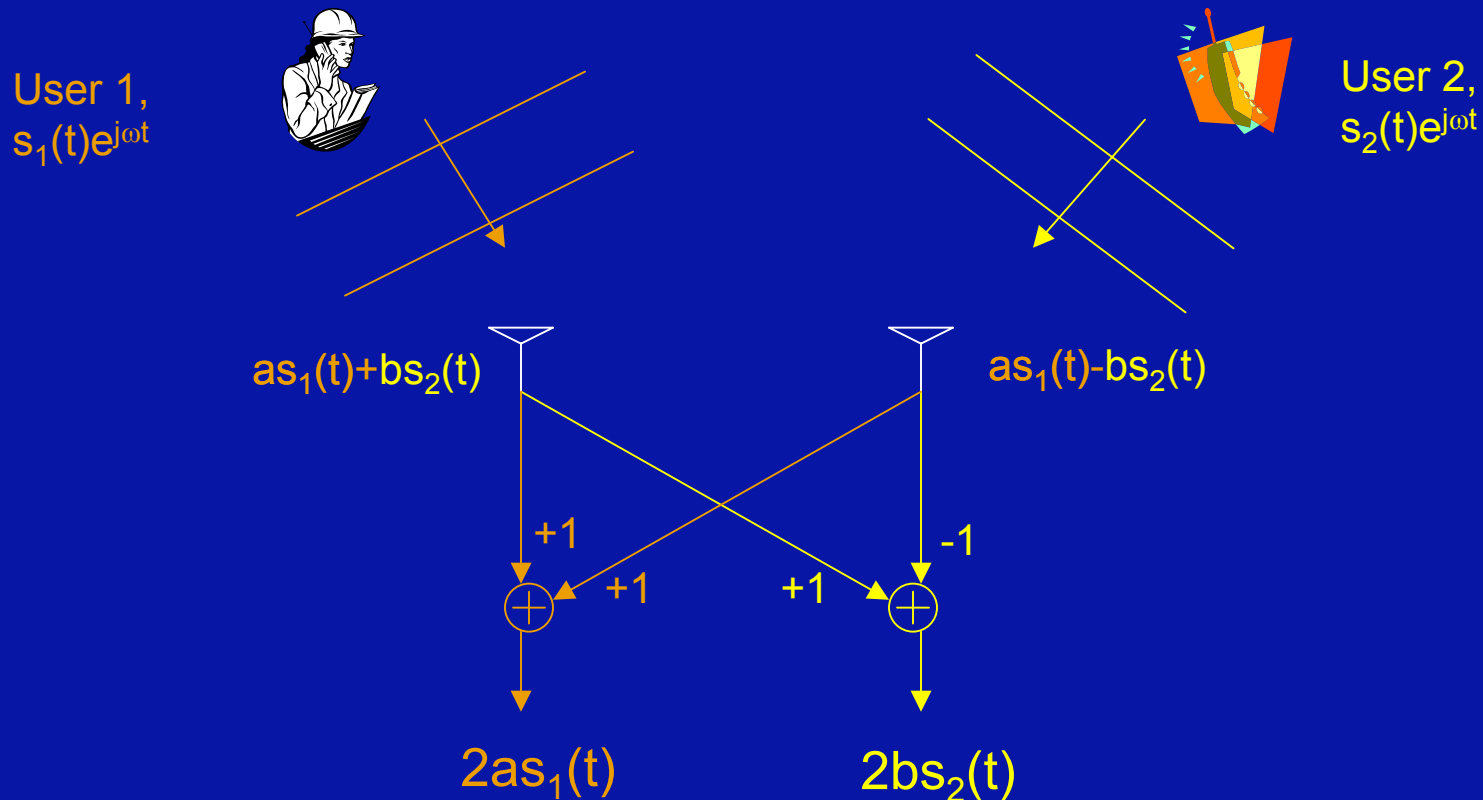
Adaptive Antenna Fundamentals

- Combines signal processing hardware and software at base stations
- Optimizes transmission and reception (“Personal Cell”)



- **Resulting in**
 - Improved coverage and building penetration
 - Simplified installation
 - Increased user data rates
 - Greater capacity, reduced spectrum requirements

Adaptive Antenna Concept



- Users' signals arrive with different relative phases and amplitudes
- Processing provides gain and interference mitigation

Air Interface Highlights

- **Time division duplex (TDD)**
 - maximize flexibility in band selection
 - maximize flexibility in accommodating asymmetry
 - maximize benefits of adaptive antenna processing
- **TDMA/SDMA multiple access scheme**
- **Space-time physical layer processing**
- **Centralized resource allocation for efficiency**
- **Bandwidth on demand**
- **Initial per-user peak rates > 1 Mbps**
- **“Reliable pipe”**

Air Interface MAC/PHY

- **Radio basics**
 - TDMA with 5 ms frame period
 - 3 uplink/downlink slots per frame
 - 500 kSym/s symbol rate
 - 25% excess bandwidth, 625 kHz channel raster
- **Reliability and efficiency basics**
 - tiered modulation/coding for link adaptation
 - fast ARQ for error free link
 - adaptive antennas for interference/collision mitigation
 - reuse < 1 , no frequency planning

Bandwidth on Demand

- **Idle users consume no resources**
- **Efficient messaging for bandwidth assignment, expansion**
- **Protocol supports both carrier and timeslot aggregations**
 - first products support timeslot aggregation only
- **Peak per-user rates scale through aggregation**
 - timeslot aggregation: 1 Mbps down/345 kbps up
 - carrier+timeslot aggregation: 4 Mbps/1.4 Mbps (e.g, 4 carrier)

Spatial Processing MAC

- **Multiple logical channels/physical resource**
 - paging and/or traffic and/or access



- **Spatial collision resolution**
 - enables low latency/low jitter designs

Mobility/Handover Support

- **Radio layer handover**
 - mobile-directed using base station load and power hints
 - make-before-break for transparency
- **Network layer handover**
 - Simple IP for efficient micromobility (cf. 3GPP2)
 - Mobile IP for inter-system mobility, e.g., i-BURST \leftrightarrow WLAN

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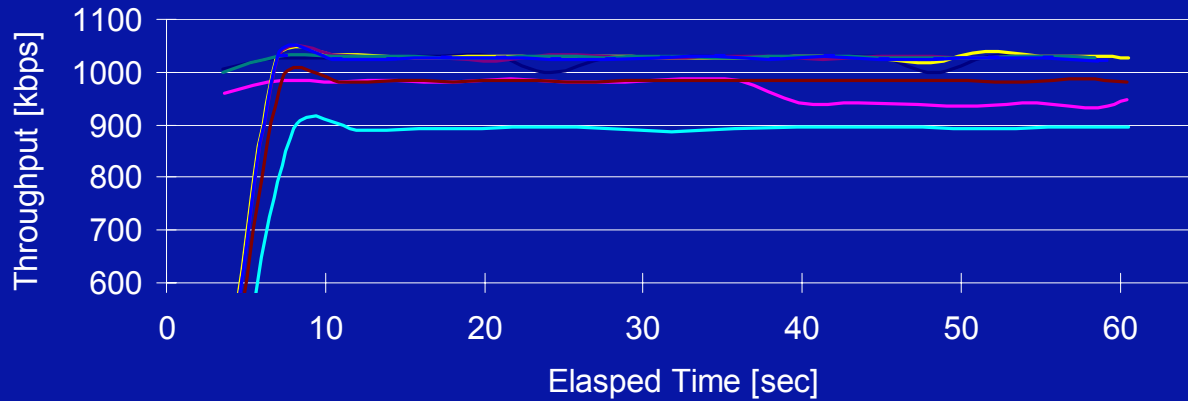
Carrier Trials of Reuse < 1

- Major city trial to assess reuse < 1 performance
- Most challenging case: colocated terminals, LOS
- Reuse of $\frac{1}{2}$ at peak data rate

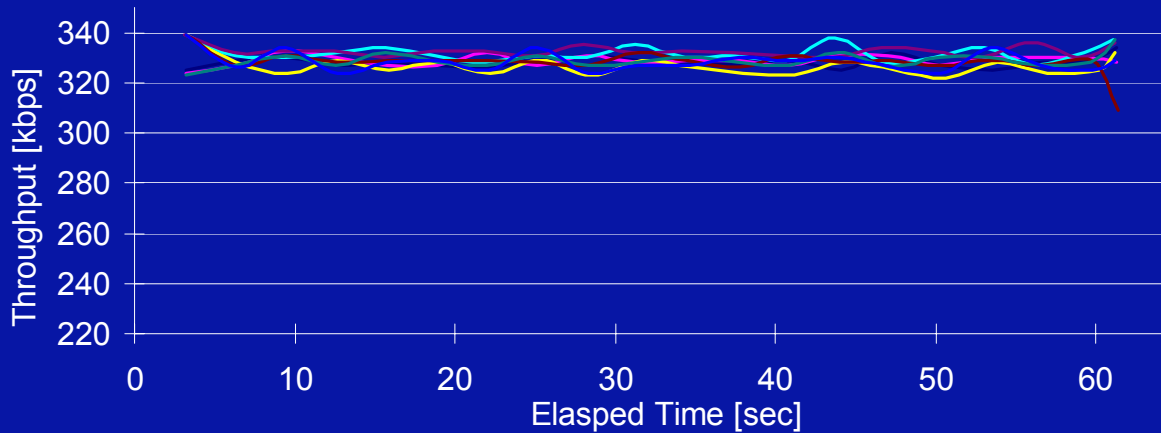


Base Case: 8 Terminals, 8 Carriers

Downlink



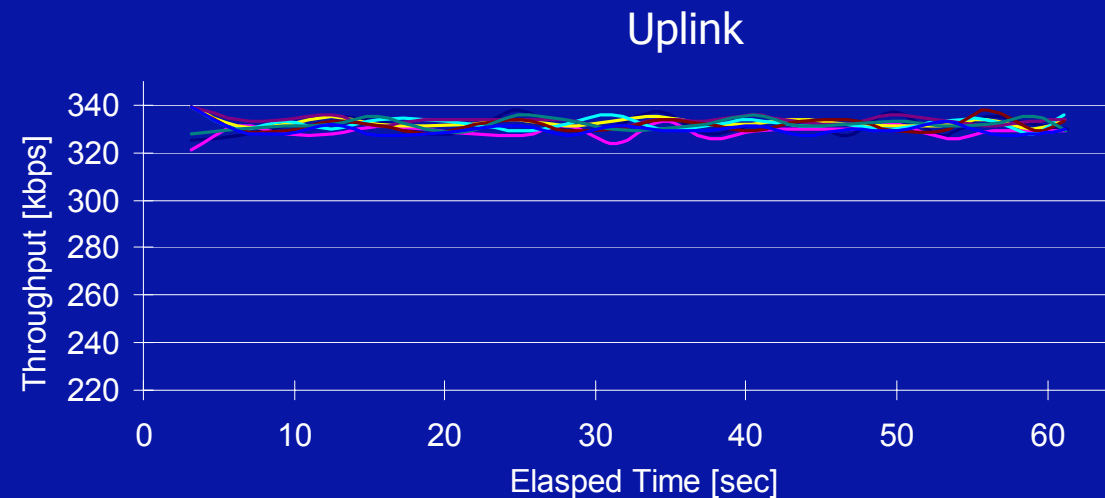
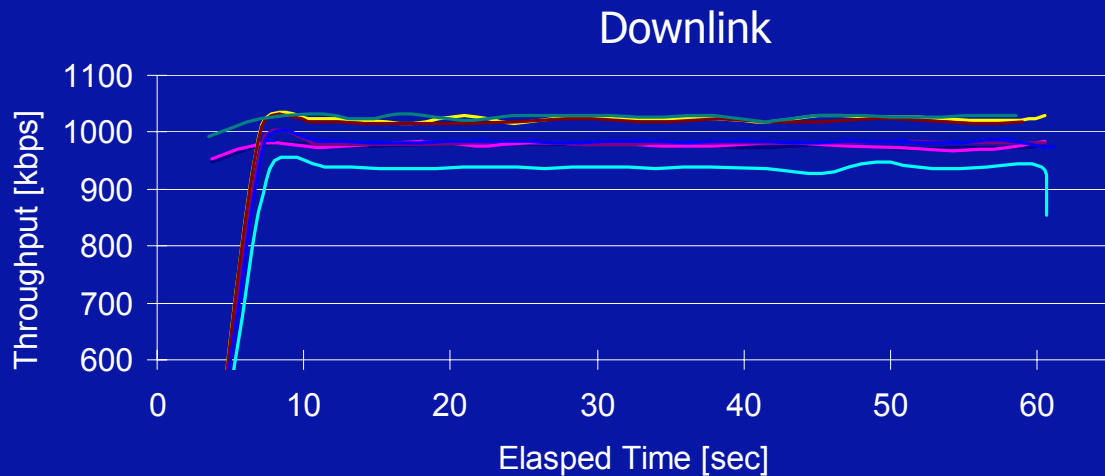
Uplink



| Average Data Rate [kbps] | | |
|--------------------------|----------|--------|
| | Downlink | Uplink |
| UT#1 | 1,023 | 328 |
| UT#2 | 964 | 329 |
| UT#3 | 1,027 | 325 |
| UT#4 | 892 | 331 |
| UT#5 | 1,026 | 332 |
| UT#7 | 982 | 328 |
| UT#8 | 1,027 | 328 |
| UT#6 | 1,025 | 328 |
| Total | 7,966 | 2,629 |

Reuse 1/2: 8 Terminals, 4 Carriers

- Data rates unchanged



| Average Data Rate [kbps] | | |
|--------------------------|----------|--------|
| | Downlink | Uplink |
| UT#1 | 975 | 331 |
| UT#2 | 976 | 329 |
| UT#3 | 1,020 | 332 |
| UT#4 | 936 | 332 |
| UT#5 | 979 | 333 |
| UT#6 | 1,017 | 331 |
| UT#7 | 1,025 | 332 |
| UT#8 | 981 | 329 |
| Total | 7,909 | 2,649 |

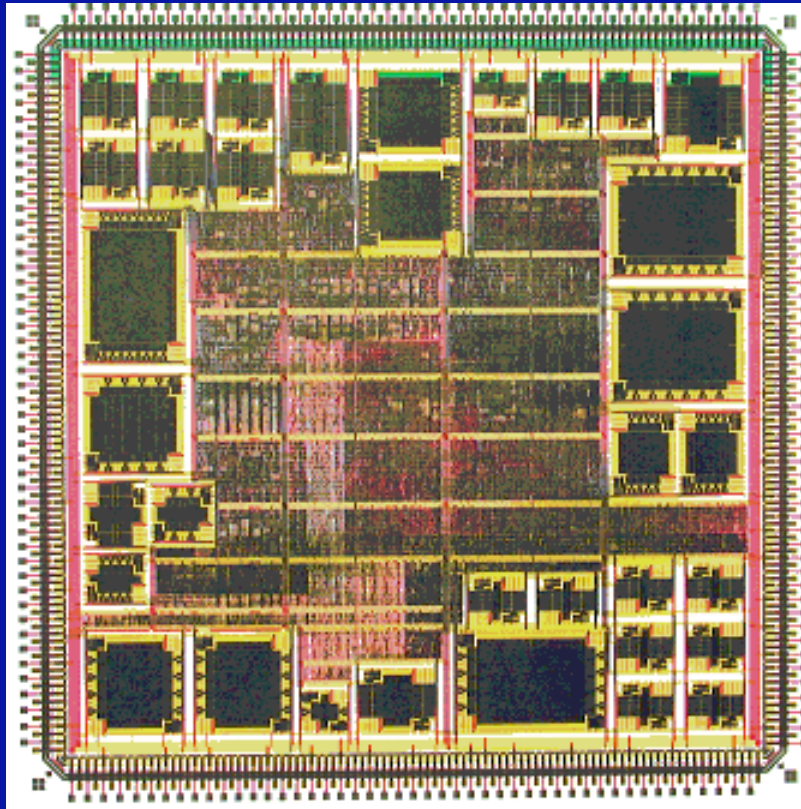
10,558 kbps/2.5 MHz
or **4.2 b/s/Hz/sector**

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i-BURST Chipsets

- Three chip baseband solution today
- Single chip solution sampling this fall



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- **IEEE 802.20, “Mobile Broadband Wireless Access”**
 - targets
 - wide area coverage
 - per-user rates > 1 Mbps
 - spectrally efficiency > 1 b/s/Hz/cell
 - first meeting held in March 2003
- **i-BURST Development Forum**
 - coordinating body for operators, manufacturers, ISP's
 - for technical issues, e.g., roaming
 - standards and regulatory issues
 - marketing
 - formed in 2002

i-BURST Summary

- **Wireless broadband with affordable economics**
- **Distinct/complementary to WLAN, 2/3G**
- **Not 4G: different timeline and capabilities**
- **Extends wired IP services, applications, devices**
- **Commercially deployed in Australia, trials elsewhere**