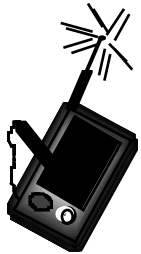


Presentation Outline

- Historical Overview
- Radio Fundamentals
- US Developments in PCS
- **Mobile Data**
- Satellite Systems
- Problems with existing schemes
- Wireless Overlay Networks
- US Government Research Initiatives



Wide Area Mobile Data Services

- ARDIS
- EMBARC
- MobileComm
- Nextel
- RadioMail
- RAM Mobile Data
- SkyTel
- CDPD
- Metricom Richocet



ARDIS

- **IBM, Motorola**
- **Originally designed for service dispatch**
- **400 Metro Areas, 90% business coverage**
- **High transmit power for building penetration**
- **Multiple transmitters per region**
- **4.8 Kbps, upgrading to 19.2 Kbps**
- **Two-way capability**
- **Nationwide roaming recently introduced**



EMBARC

- **Motorola**
- **931 MHz paging frequency**
- **Email broadcasting, one-way**
- **Used for news feeds**
- **Satellite transmission to groundstations for local/regional retransmission**
- **300 bps**
- **Different priority levels: standby (as available), express (1 hour), priority (15 minutes)**



MobileComm

- **BellSouth Enterprises**
- **Text messaging, one-way paging**
- **Up to 500 characters in length**
- **Single large regional transmitter**
- **Nationwide coverage**
- **ASAP, standard, overnight priorities**
- **PCMCIA cards for popular PDAs**



Nextel

- **Special Mode Radio (SMR)**
- **Based on Motorola MIRS technology**
- **Integrated voice, dispatch, data services**
- **Store and forward messaging: hold and deliver when terminal is in range**
- **TDMA, 6 conversations per channel**
- **Many basestations per region/cellular system**
- **800 MHz band**



RadioMail

- **RadioMail Corp., San Mateo, CA**
- **2-way wireless electronic messaging**
- **EMail gateway services: performs integration and format conversion across heterogeneous networks**
- **Operates on top of ARDIS or RAM Mobile Data RF networks**



RAM Mobile Data

- **RAM Broadcasting Corp., New York**
- **2-way data communications services**
- **90% urban business area coverage**
- **Based on Ericsson Mobitex technology**
- **Packet-switched data, 8 kbps**
- **Hierarchical architecture of intelligent base stations and switches**
- **Supports roaming, store-and-forward messaging, TCP/IP interfaces**



SkyTel

- **SkyTel Corp., Washington, DC**
- **First satellite-based paging service**
- **Alphanumeric paging**
- **4.8 Kbps, 240 character messages max**
- **2-way paging systems being deployed**

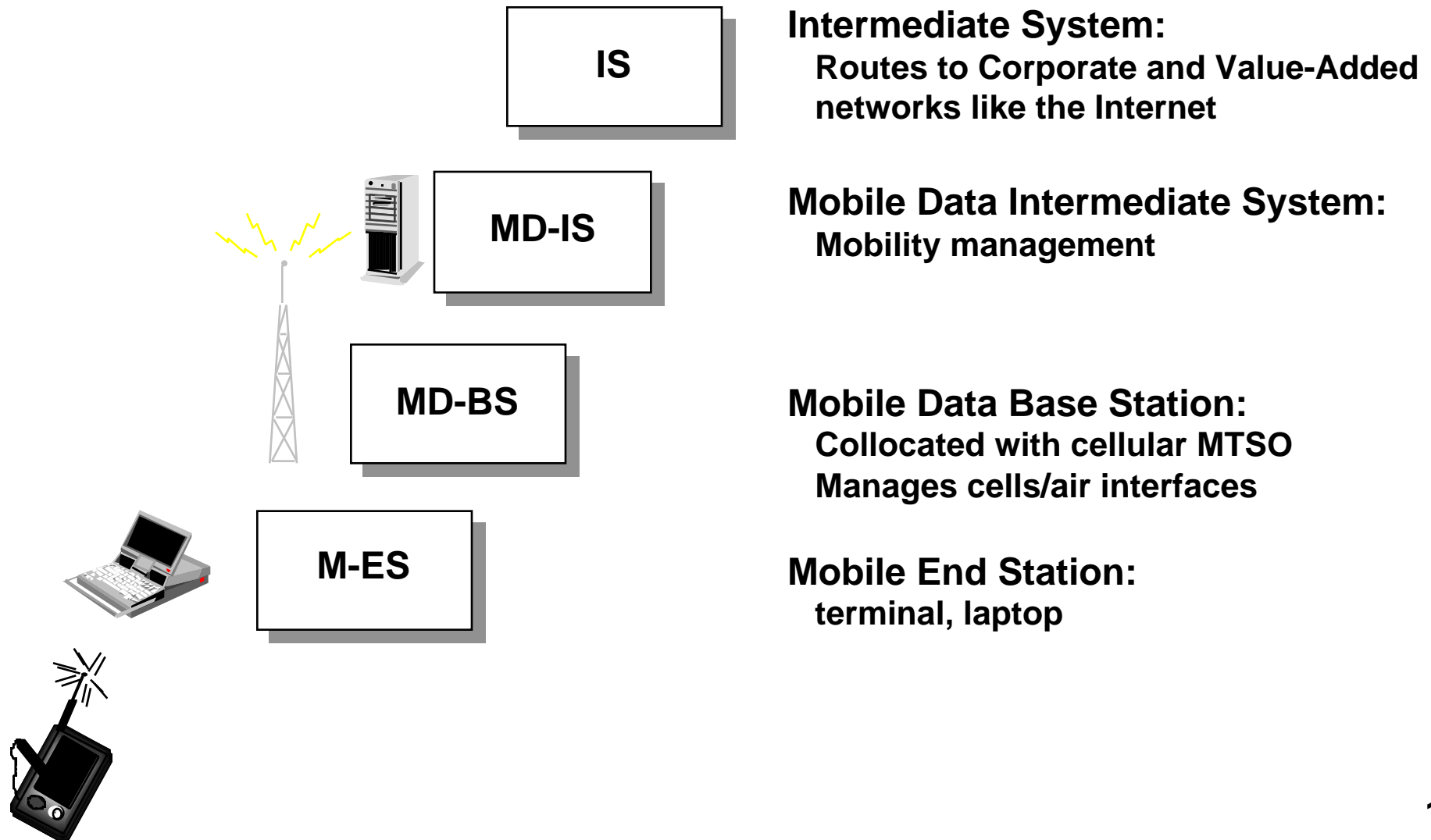


Cellular Digital Packet Data

- **IBM, McCaw Cellular**
- **Data network overlay on analog cellular telephone system**
- **Uses same 30 KHz channels @ 800 MHz; potentially same coverage as cellular system**
- **Schedule data packets to unused voice channels**
- **(Up to) 19.2 kbps**
- **Provides IP packet service**



Cellular Digital Packet Data



Metricom

- **Microcellular “packet relay” network**
- **1-5 mile cell diameter**
- **Poletap radios: 100 kbps, geographic routing**
- **Wired access points: every 2-3 hops to keep latencies low (approx. 100 ms)**
- **User modems: 20-30 kbps effective data rate**
- **Uses 902-928 MHz ISM band and 1W transmitters**
- **Available in SF Bay Area and Redmond, WA**



Wide Area Mobile Data Summary

Metric	ARDIS	Mobitex	CDPD	IS-95	TETRA
Frequency Band					
Base TX (Mhz):	(800 Band,	935-940	869-894	869-894	(400 and 900
Mobile TX (Mhz):	45 kHz sep.)	896-901	824-849	824-849	Bands)
RF Ch. Spacing	25 kHz (U.S.)	12.5 kHz	30 kHz	1.25 Mhz	25 kHz
Channel Access	FDMA/	FDMA/	FDMA/	FDMA/	FDMA/
Multiuser Access	DSMA	Dynamic S-Aloha	DSMA	CDMA-SS	DSMA&SAPR
Modulation Method	FSK, 4-FSK	GMSK	GMSK	4-PSK/DSSS	PI/4-QDPSK
Channel Rate (kbits/s)	19.2	8.0	19.2	9.6	36
Packet Length	up to 256 bytes (HDLC)	up to 512 bytes	24 to 928 bits	(packet service TBD)	192 bits (short) 384 bits (long)
Open Architecture	No	Yes	Yes	Yes	Yes
Private or Public Carrier	Private	Private	Public	Public	Public
Service Coverage	Major Metro. Areas in US	Major Metro. Areas in US	All AMPS areas	All CDMA cellular areas	European Trunked Radio
Type of Coverage	In-building and Mobile	In-building and Mobile	Mobile	Mobile	Mobile



Local Area Mobile Data

	Freq (MHz)	Link Rate	User Rate	Protocol	Access	# of chan/ spread factor	Mod/Coding	Power	Network Topology
Altair-II Moto	18-19 GHz	15 Mbps	5.7 Mbps	Ethernet			4-level FSK	25 mW peak	8 devices per radio
WaveLAN AT&T	902-928 MHz	2 Mbps	1.6 Mbps	Ethernet-like	DS SS		DQPSK	250 mW	peer-to-peer
AirLAN Solectek	902-928 MHz		2 Mbps	Ethernet	DS SS		DQPSK	250 mW	radio to hub
Freeport Windata	902-928 MHz	16 Mbps	5.7 Mbps	Ethernet	DS SS	32 chips/bit	16 PSK trellis coding	650 mW	Hub
Intersect Persoft	902-928 MHz		2 Mbps	Ethernet, Token Ring	DS SS		DQPSK	250 mW	Hub
LAWN O'Neil	902-928 MHz		38.4 kbps	X.25	SS	20 users/ch; 4 chan		20 mW	peer-to-peer
WiLAN WI-LAN	902-928 MHz	20 Mbps	1.5 Mbps/ch	Ethernet, Token ring	CDMA/ TDMA	3 ch 10-15 links	Unconventional	30 mW	peer-to-peer
RadioPort ALPS	902-928 MHz		242 kbps	Ethernet	SS	?/3 channels		100 mW	peer-to-peer



Local Area Mobile Data

	Freq (MHz)	Link Rate	User Rate	Protocol	Access	# of chan/ spread factor	Mod/Coding	Power	Network Topology
ArLAN Telesys	902-928 2.4 GHz		1.35 Mbps	Ethernet	SS			1 W max	Radio to hub
RadioLink Cal Microwave	902-928 MHz	250 kbps	64 kbps		FH SS	250 ms/hop 500 Khz spacing 3 Channels			hub
RangeLAN Proxim	902-928 MHz		242 kbps	Ethernet, Token ring	DS SS			100 mW	
RangeLAN2 Proxim	2.4 Ghz	1.6 Mbps	50 kbps max	Ethernet, Token ring	FH SS	10 chan@5 kbps/ch, 15 subch each		100 mW	peer-to-peer, bridge
Netwave Xirxom	2.4 GHz	1 Mbps		Ethernet, Token Ring	FH SS	82 1 Mhz ch. or "hops"			Hub
Freelink Calbetron Sys	2.4 and 5.8 GHz		5.7 Mbps	Ethernet	DS SS	32 chips/bit	16 PSK Trellis coding	100 mW	Hub

