

Next Generation of Amateur Radio Systems

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The following PowerPoint presentation was originally prepared for a small group of representatives of ARRL, DARC and UBA at Friedrichshafen, Germany. During the discussion, it was acknowledged that HF digital voice was difficult (using LPC-10 or MELP, for example) and that early emphasis should be placed on VHF/UHF multi-media systems. This slide set is offered for your information.

**Next-Generation
Amateur Radio Systems**



*Renewal of Amateur Radio
using new technologies*

Doomsaying 

- . Amateur Radio has peaked
- . Memberships are declining
- . Equipment sales are falling
- . Attendance at events is reducing
- . PCs and the Internet are more interesting
- Commercial services want our spectrum
- . The noise level is rising

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What if we do nothing? 

- . We will lose licensees, members
- . Manufacturers will abandon market
- . Regulators will reallocate our spectrum
- . Bands above 146 MHz could be lost
- . Amateur Radio becomes more CB-like

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We are in this together 

- . The problem and solution are *global*
- . Most developments involve *teamwork*
- . Individual contributions not just technical
- . Amateurs and industry must co-operate
- . IPR **advice** is needed

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ARRL initiatives



- 1997: Created 3 technical awards:
 - Service, innovation, microwave development
- 1998: White paper at Porlamar
- 1999: President's initiative
 - Technology Task Force
 - **Technology Working Group**

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Challenges



- Retain our spectrum
- Fulfill spectrum requirements
- Revitalise HF before sunspots drop
- Develop SHF and EHF systems
- Integrate satellite and terrestrial systems

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Entering a new environment

- Knowledge-based society/information age
- Regulatory environment should permit innovation, digital modes
- Greater competition for spectrum
- Increasing noise pollution/power lines
- Automotive environment evolving

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Automobiles migrating to 42 volts



- Power-hungry options excessive for 12 V
- MIT consortium developing 42-V standard
- Transition may include dual voltages
- Amateur radio equipment could benefit
- Possible need for adaptive power supplies

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SAE ITS data bus



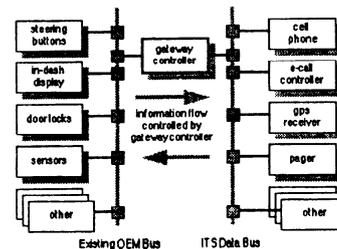
- Electronic devices installed in cars are several generations old as automotive design takes 4 times as long.
- IDB to facilitate **plug-and-play**.
- Cell phones, GPS, roadside ITS services
- Should amateurs take account of IDB?

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SAE IDB architecture



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Impact of Internet



- . Using Internet as *worm hole*
- . Remote station operation
- . Preventing commercial use of amateur radio
- Embedded microprocessors
- . What degree of integration is appropriate?
- . Internet 2?

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Other **services** are already digital

- . Cellular enters 3G, studying 4G
- . Digital dispatch land mobile
- . Digital sound and TV broadcasting
- . IP telephony becoming telephone standard
- Multimedia (audio/video/data)
- . Satellites

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Amateur Radio systems will be digital

- . Improve end-to-end quality of service
- . Take advantage of new technologies
- . Provide multimedia (audio/video/data)
- . Operate multi-mode (terrestrial/satellite)

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Enabling technologies

- . Error detection and correction (ARQ, FEC)
- . Standards to evaluate:
 - Coding: MPEG, JPEG, H.261, H.323...
 - Digital dispatch: TETRA, APCO 25...
 - Public: IP, 2G, SMS, 3G, 4G, FWA
 - Digital sound BC: IBOC, DRM...
 - Digital TV: HDTV, interactive...
 - Digital cameras, recorders

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Radio technologies

- . Access methods (FDMA, CDMA, TDMA)
- . Spectrum-efficient modulation methods
- . Software defined radios (SDRs)
- . Automatic link establishment (ALE)
- . Adaptive power control (APC)
- . Global location: GPS, GLONASS, APRS

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Framework to innovate is needed



- . Ability to introduce new protocols
- . Download software from Web
- . Need to recognise protocol in use
- . No regulatory restrictions on digital modulation

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Tower of Babel

- . Many protocols in use: CW, SSB, RTTY, AX.25, PACTOR, G-TOR, CLOVER, PSK31, SSTV, TV...

Possible approaches to selection

- . Option 1: Group by band plan
- . Option 2: Signal recognition
- . Option 3: Link establishment protocol

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Link-establishment protocol



Essential features

- . Ubiquitous
- . Identifies stations
- . Establishes contact
- . Negotiates protocols
- . Robust waveform

Optional features:

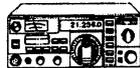
- . Authentication
- . Give location
- . Adaptive (ALE)
- . SMS messaging
- . Scalable rate

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HF digital radios



- . SSB is 50 years old.

HF digital voice could have these features:

- . Improved voice quality
- . Fading and interference reduction
- . Greater spectrum efficiency
- . Facilitate 22.4 kbit/s data, images

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Digital repeaters 101011...



- . >56 kbit/s
- . Simplest digital repeater
- . Multimedia repeaters
- . Web server type
- . Digital fast-scan TV
- . Complexity at repeater
- . Simplicity at outstations

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Amateur satellites



- . Satellites should be integral part of next-generation amateur systems
- . Develop VHF/UHF LEO clusters to operate with hand-held earth stations
- . Promote satellites for bands ≥ 24 GHz

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Facilitating hardware design

- . Experimenters lose time and motivation
- . Test bed is needed
 - . Built-in power supply
 - . Bus for common power and signals
 - . Over top for IF/RF interconnection
 - . Board under test accessible

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Investigate available hardware

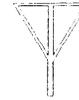
- Personal computers 
- Cellular phones 
- Digital signal processing boards
- Integrated circuits, their use and misuse

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Antenna development



- Restricted space antennas
- Adaptive (smart) antennas
- Broadband antennas
- Diversity antennas (and receivers)

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Applications

The next generation should include.

- a global disaster communication capability
- human resources development opportunity
- proof-of-performance experiments, such as rural communications in developing countries
- Propagation research

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Intellectual property rights



An IPR policy is needed that will:

- protect individual rights of inventors
- make new products available
- ensure fair and equitable treatment
- help provide a stable manufacturing environment

We must benefit from past mistakes and avoid new disputes

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Financing the next generation

- Mostly self-funded by those involved
- National societies
- Technical clubs
- Grants



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Publication of information

- National society journals
- Web site for next generation
 - Open, closed or both?
 - Languages: English, French, Spanish, German, Italian, Japanese, Russian, Arabic?
- ARRL willing to disseminate tech info

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