Evolution of TDMA to 3G

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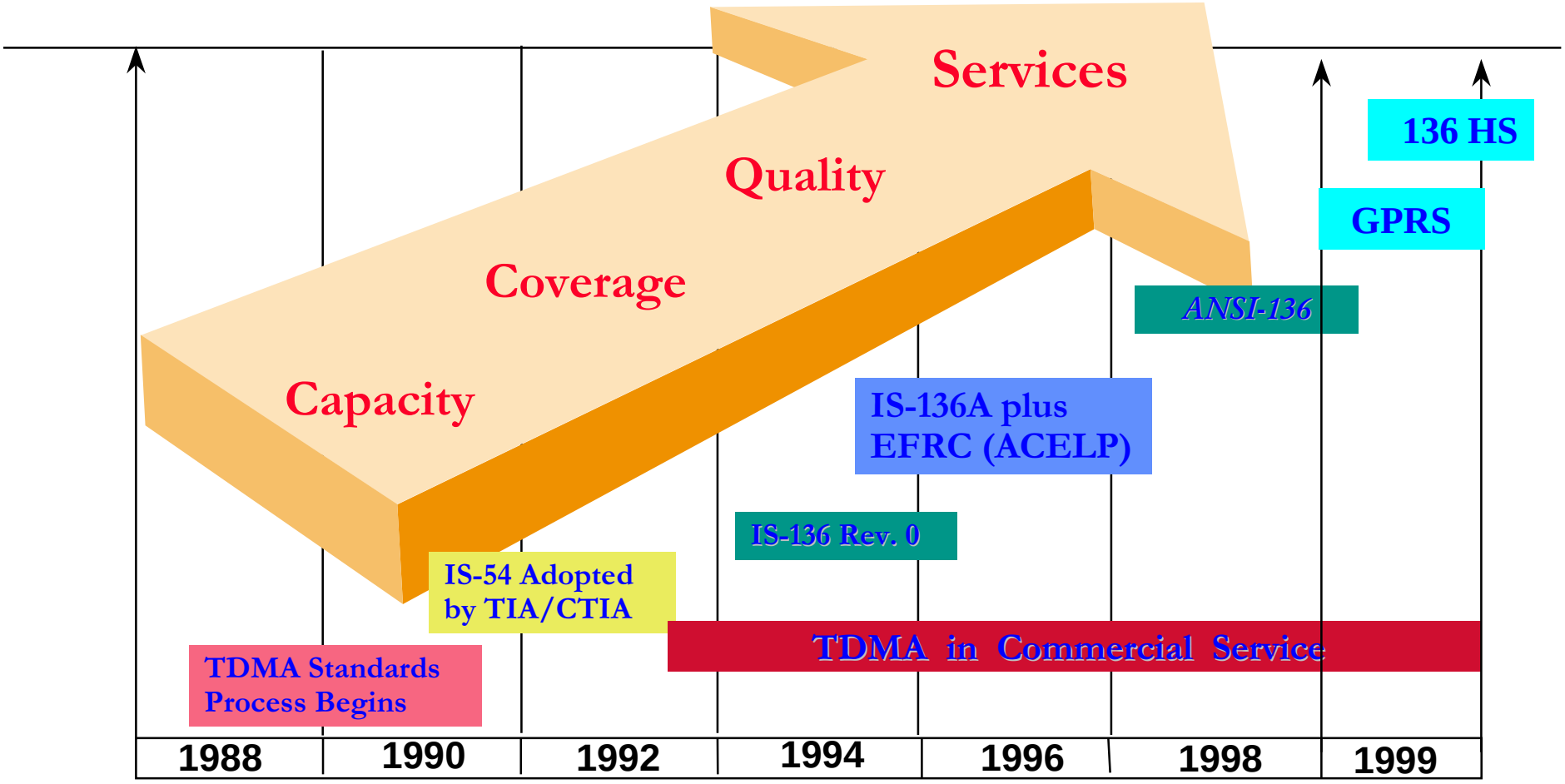
TDMA Standards Evolution



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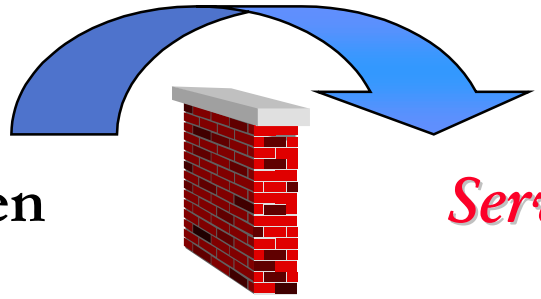
3rd Generation Programs :
Mobility Market Evolution

1st Generation	2nd Generation	Next Generation
♦ analog cellular (single band)	♦ digital (dual-mode, dual-band)	♦ multi-mode, multi-band
♦ voice telecom only	♦ voice + low speed data	♦ evolve services beyond telecoms (High speed data, multimedia)
♦ macro cell only	♦ macro / micro / pico cell	
♦ outdoor coverage	♦ seamless indoor / outdoor coverage	♦ integration with PSTN, complementary to IT offers (data networks, Internet, VPN)
♦ distinct from fixed PSTN	♦ complementary to fixed PSTN	
♦ business customer focus	♦ business + consumer	♦ communications subscriber



Technology Driven

Service Market Driven

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3rd Generation Programs :

Additional IMT-2000 Data Requirements

Mobile data rate	Macrocell, very high speed (<500 km/h), rural outdoor	144 kilobits per second
Portable data rate	Macro / microcell, pedestrian or moderate speed (<100 km/h)	384 kilobits per second
In-building fixed data rate	Indoor / low-range outdoor	2 megabits per second

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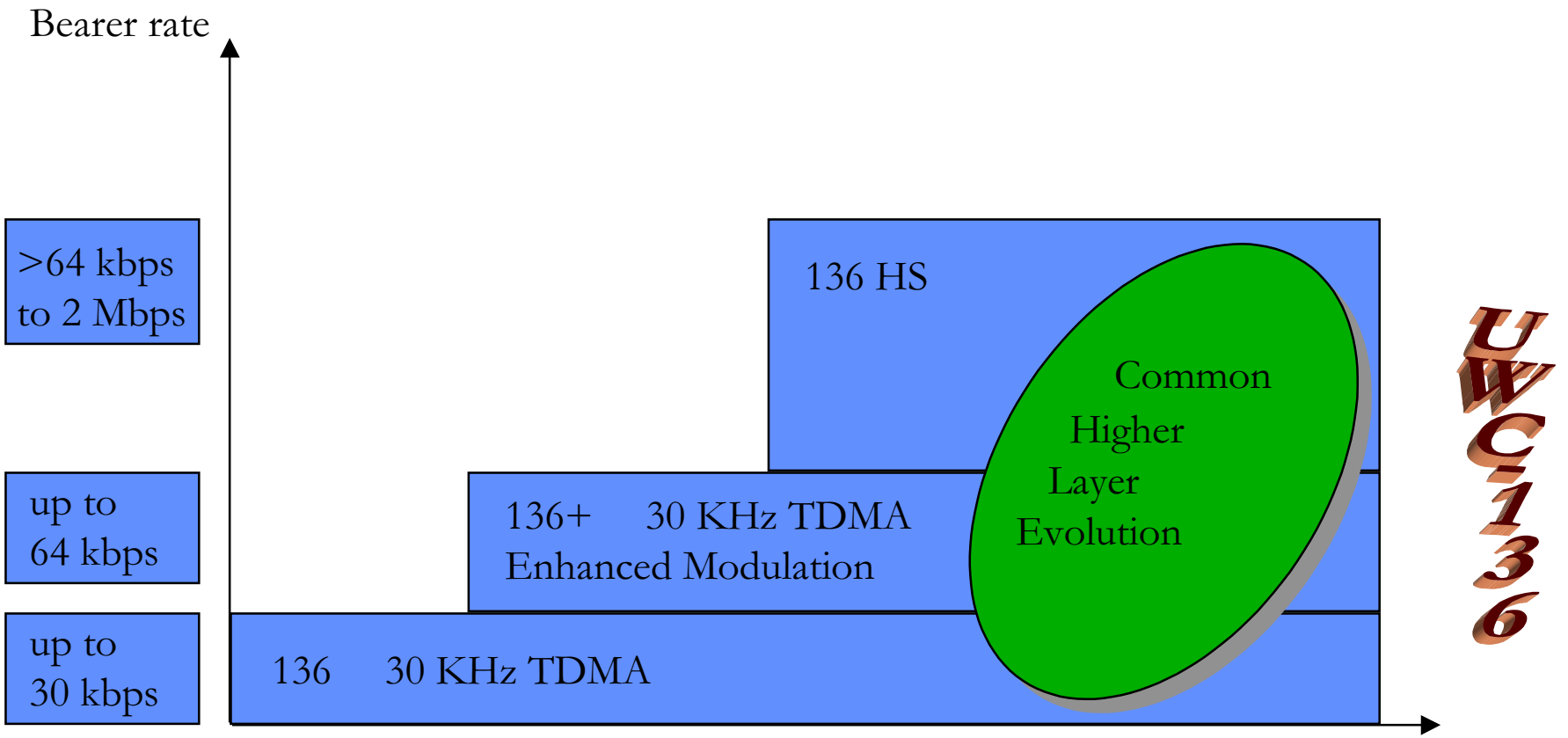
The UWC-136 Standards Program to Meet IMT-2000

- **Phase I (Current 136 Capability 85% IMT-2000):**
  - Voice quality comparable to wireline
  - Provides security comparable to PSTN/ISDN
  - Supports multiple public/private/residential operators in the same area
  - Allows interconnection to other mobile or fixed users
  - Supports multiple cell layers (hierarchical cell structures)
- **Phase II (UWCC.136+ Program Target: YE 98 92% IMT-2000):**
  - Provides reduced delay and improved voice quality
  - Provides higher speed packet and circuit switched data capability
  - Achieves high spectral efficiency
- **Phase III (UWCC.136HS Program Target: YE 99 100% IMT-2000):**
  - Supports 384 Kbps data rates over wide area
  - Supports 2 Mbps data rates over local area

UWC-136 *Evolving to IMT-2000*

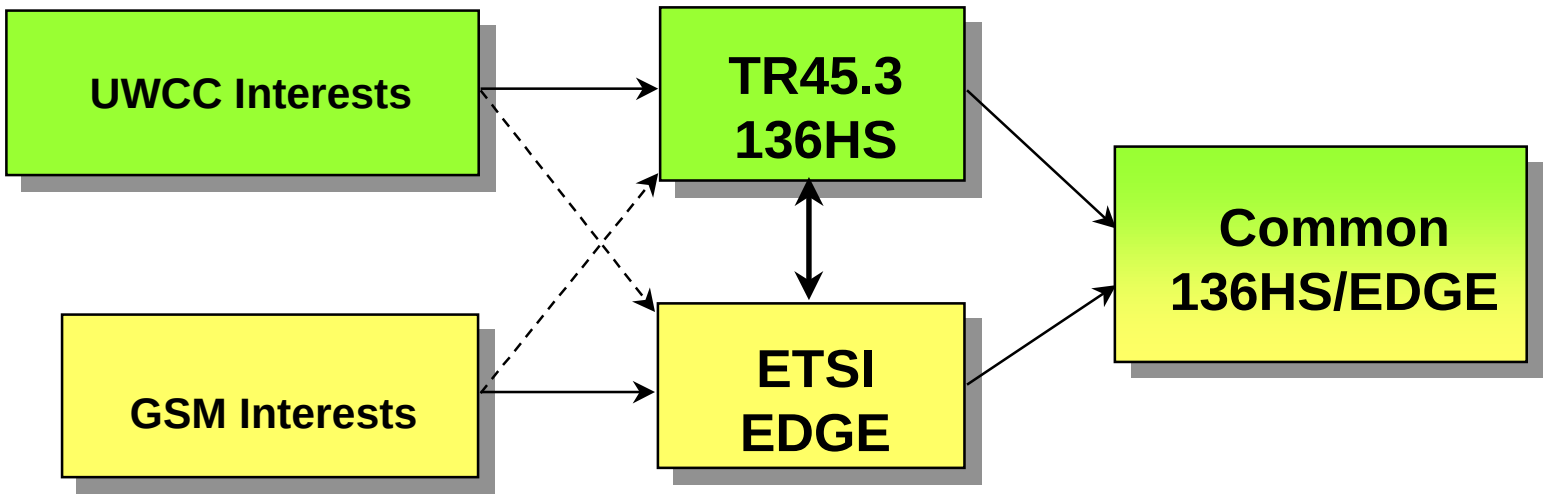


Global TDMA Convergence

UWC-136 **GSM**

Global EDGE

ETSI/TIA TR45.3/UWCC/GSM Alliance



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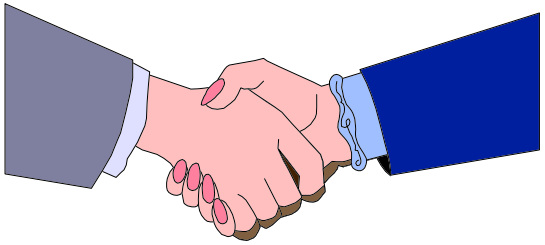

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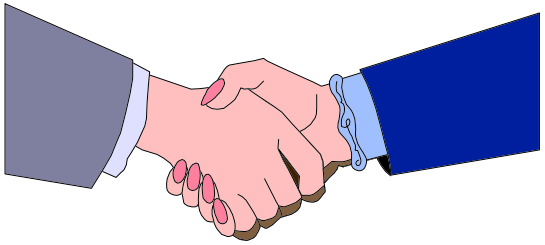
Convergence

- **December 1997** UWCC selects **8-PSK** for **136+**
- January 1998 UWCC chooses "Double EDGE" for 136 HS solution
  - Harmonized with ETSI EDGE feasibility study
  - EDGE feasibility study based on QAM modulations
  - GPRS assumed in 136 HS simulations
- January 1998 ETSI considers other modulations for EDGE
- Feb.- April 1998 TR45.3/UWCC/ETSI cooperation on modulation
- April 1998 TIA and US TG 8/1 "freeze" on RTT technical content
- **May 1998** ETSI selects **8-PSK** for EDGE
  - same modulation as selected for**136+** in **December 1997**
  - demonstration of "WIN WIN" negotiation and cooperation



Convergence

- June 1998 US Based RTTs forwarded to ITU
- June 1998 UWCC Adopts **GPRS** Packet Data Architecture for 136
- July 1998 Self-Evaluations provided to US Evaluation group
- August 1998
  - US Evaluation Group Conducts & Completes RTT evaluation
    - Conclusion: UWC-136 fully meets IMT-2000 requirements
  - Window to update RTTs re-opens in US
  - UWCC/TIA officially adopts 8-PSK for 136 HS
- September 1998 Evaluation Groups determine UWC-136 meets IMT-2000 Requirements

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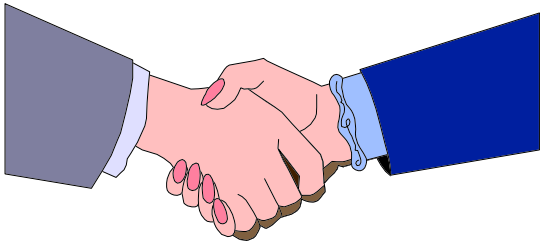

Convergence Summary

- **Demonstrated cooperation**
  - 384 kbps Radio and Service Requirements (136 HS/EDGE)
  - 8 PSK Modulation core for common service on 200 kHz carriers
  - GPRS as common packet data architecture
- **GMSK modulation for GSM/136 HS robust mode**
  - UWC-136 provides RF level compatibility with existing GSM
  - same vocoder (US 1) supported in 136+ and GSM EFR systems
- **Same modulation for 136+, 136 HS and EDGE**
  - significant advantage in cost / complexity / economy of scale
  - integrated AMPS / 136 / GSM products available in 1999
- **3G UWC-136 products anticipated 2000-2001**

Status of UWC-136 Convergence

- 136 HS / EDGE 200 kHz work
  - UWC-136 proponents and ETSI cooperation continues
  - QAM to 8-PSK updates 90 % complete
  - draft under review TR45.3.AHIC (Ad-Hoc on International Coordination)
  - Complete IMT-2000 compliance maintained
  - Detailed status report submitted to WG 5

Characteristics	UWC-136	GSM
Multiple Access	TDMA	TDMA
Band Width	30 / 200 / 1600 kHz	200 kHz
Bit Rate	48.6, 72.9 kbps 270.8 kbps 361.1, 722.2 kbps 2.6, 5.2 Mbps	270.8 kbps
Carrier Spacing	30 / 200 / 1600 kHz	200 kHz
Frame Length	4.6 / 40 ms	4.6 ms
Data modulation	π/4 DPSK 8 PSK GMSK QAM	8 PSK (EDGE) GMSK
Slots	6 per 30 kHz 8 per 200 kHz 16-64 per 1.6 Mhz	8 per 200 kHz
backward compatibility	AMPS/IS54/136/GSM	GSM

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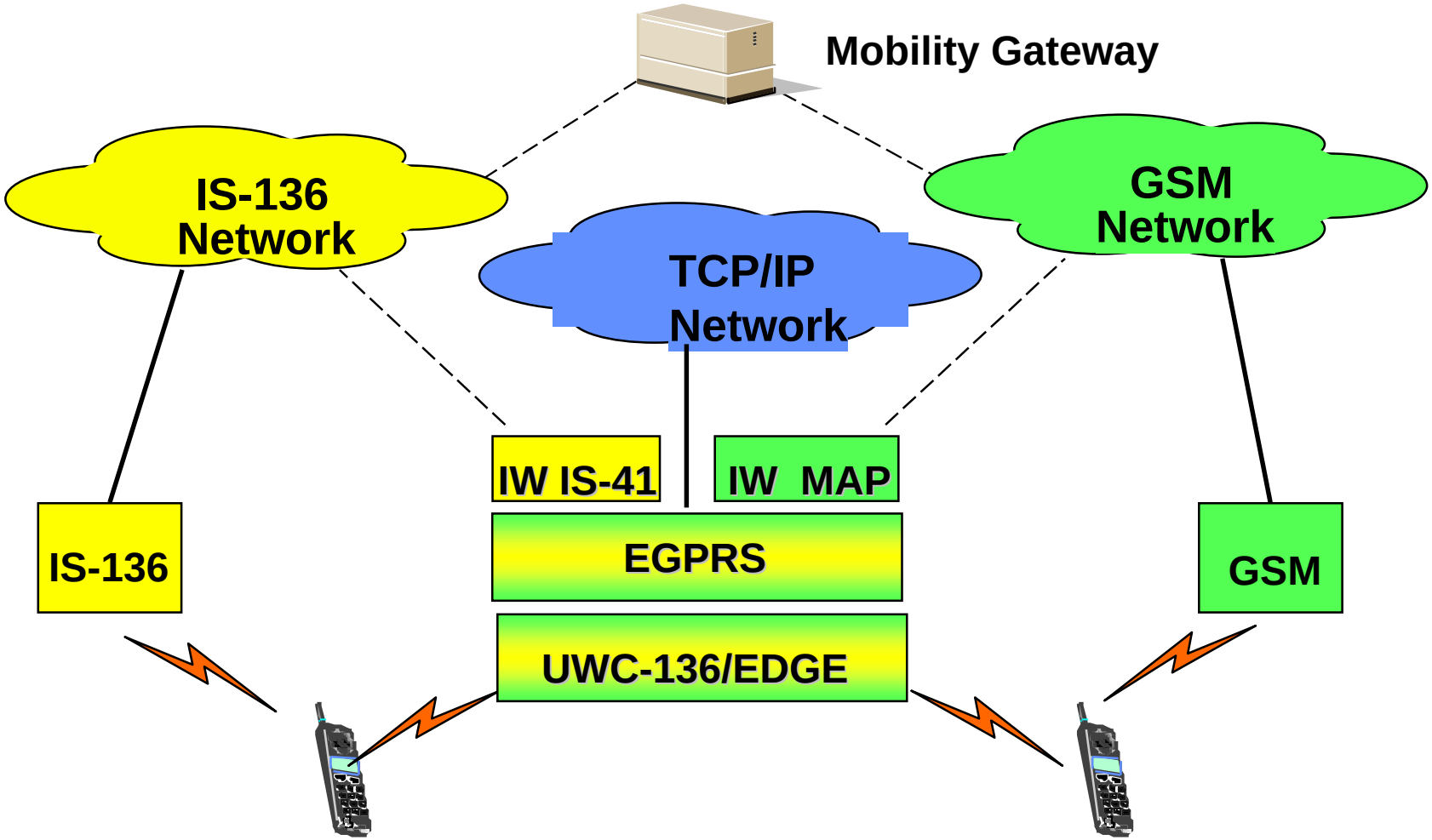
136HS/EDGE Packet Data Access



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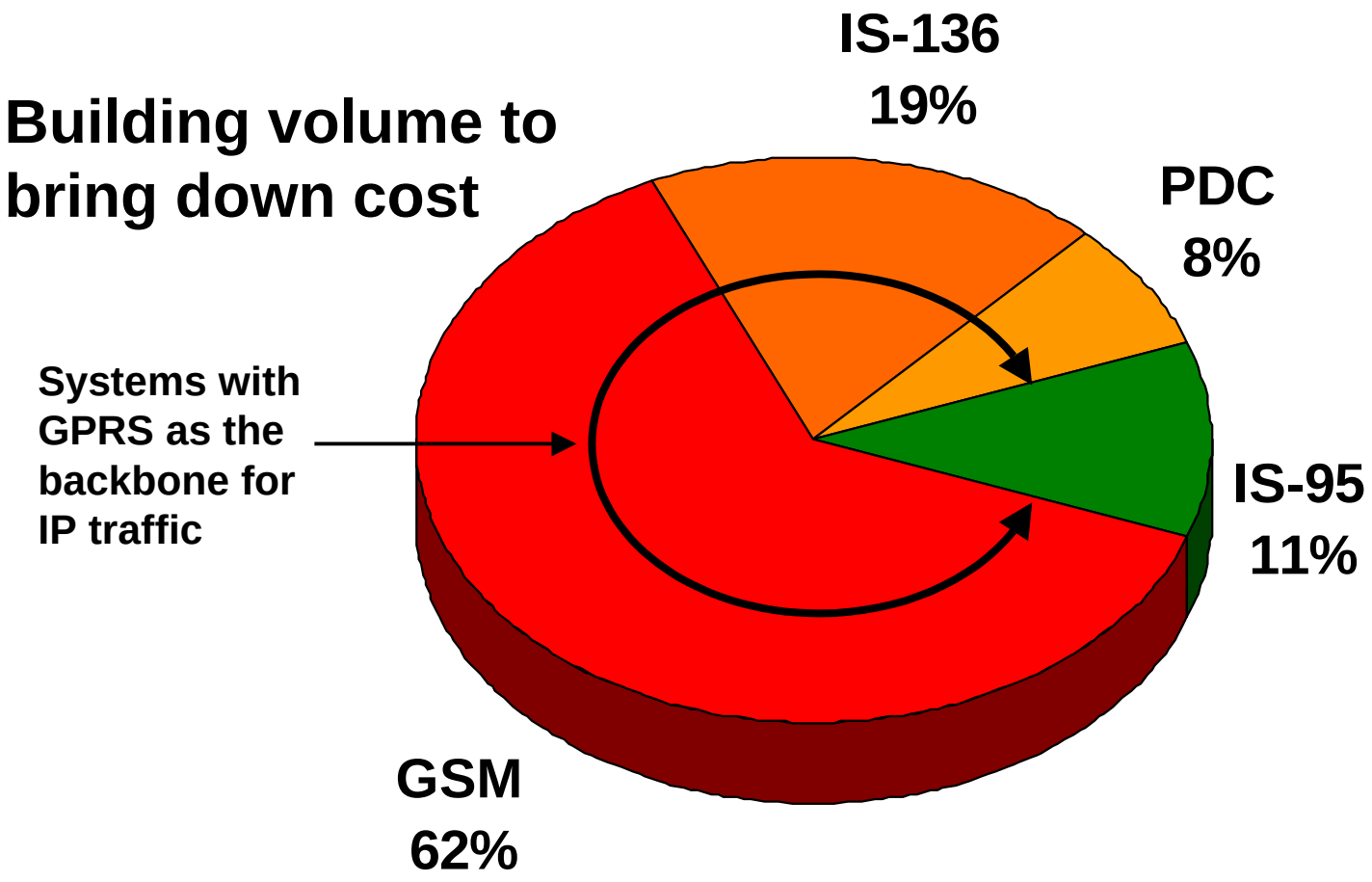
World Subscribers by Digital Technology, Year 2000

Source: Herschel Shosteck, 1998



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UWC-136 Initial Cost to Deploy: Example

- Incremental Cost to start service from existing 136 base
- Typical large city (similar to Chicago)
  - 200 cells
  - Spectrum at 1900 MHz
- Provide voice, circuit data, packet data to 384 kbps
- Includes:
  - Site development
  - Base station electronics
  - MSC, Data network
  - Spectrum, Transmission facilities

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UWC-136 Initial Cost to Deploy: Example

- 136HS deployment
  - Add one 136HS radio per sector
  - Transmission increment
  - Data network increment
  - Spectrum impact <1 MHz
- Wideband system deployment
  - Base-station site development, fixed electronics
  - One WB radio per sector
  - MSC, 33% soft handoff
  - Transmission network
  - Data network
  - Spectrum 5 MHz

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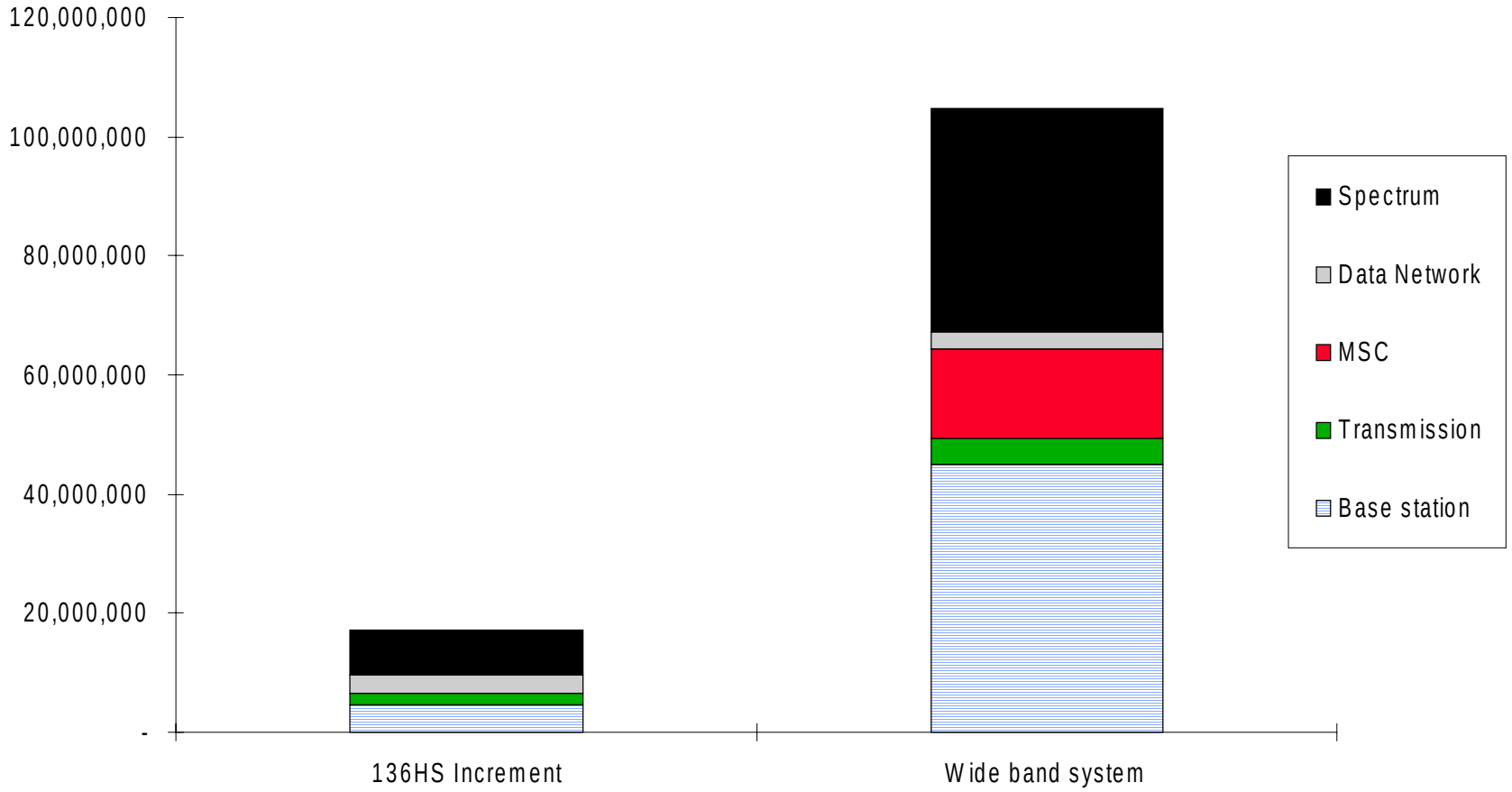
Incremental Cost to Deploy 384 kbps service on existing 136 system



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UWC-136 Commercial Advantages

- Macrocell deployment with < 1 MHz spectral clearing
  - protect existing operator's investment
  - minimize risk to trial new high speed data services
- 384 kbps service in vehicular application (100 km/h)
  - IMT-2000 requires 384 in pedestrian environment only
- Multiband operation 500 MHz - 2.5 GHz
- Link budget to provide similar path loss as 136
- Clear evolution from 1st, 2nd and 3rd generation
  - incremental investment to provide 3G services

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UWC-136 Commercial Advantages

- Multiple public/private/residential operators in one locality
- Supports hierarchical cell structures
- Support for TDMA Based Software Radios
- Converged Solution for Packet Data Architecture (GPRS)
- Meets IMT-2000 requirement per ITU Evaluation Groups
- ITU IPR compliance achieved by February 1998
  - ITU-R Document 8-121-E, 13 January 1998
- *"Commercially Deployable Multiple Access"*