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April 5, 1994

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FEDERAL COMMUNICATIONS COMMISSION
OFFICE OF SECRETARY

SPATIAL COMMUNICATIONS, INC.
ARRAYCOMM, INC.

TALKING POINTS

- Directional transmission and reception using "smart antennas" provides significant public benefits including increased spectrum efficiency, reduced costs of implementing and providing PCS services, reduced RF interference and radiation risks, and inherent 911 emergency location services.

- The Commission should redefine power limitations for PCS systems to encourage and facilitate use of directional "smart antenna" transmissions and receptions.

- The FCC's proposed standard of 100 watts EIRP is too restrictive, and may ultimately inhibit or preclude successful implementation of PCS in the United States.

- The Commission should adopt power limitations that combine the concept of total radiated power (TRP) and peak radiated power (PRP), in order to encourage the use of directional transmission and reception. Under this approach, the base station's total radiated power could remain at a relatively low level, while the power delivered to the mobile user (i.e. peak radiated power) is substantially higher. For example, TRP would be 100W and PRP limits would be 10 kw for towers above 20 meters in height.

- In calculating permissible power limits, the FCC should allow base station power to increase as a function of antenna height in order to encourage large cells while minimizing RF exposure to the public.

- This approach is consistent with proposals by MCI and Telocator in petitions for reconsideration to increase eirp to 1 kw, but incorporates the concept of peak radiated power and the antenna height factor.

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List ABCDE

April 5, 1994 - Spatial Communications Inc.
11:00-12 Noon

Issues: Technical Requirements
Spectrum Efficiency

Attendees: Jill Stern (Counsel for SCI)
Dr. Richard Roy, Chief Scientist, SCI & President of RaaComm
Marty Cooper, Chairman, RaaComm

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PCS Ex Parte Presentation

Company: Spatial Communications

Jill Stern (663-8380)

Date: April 5, 1994 **Time:** 11:00- 12 Noon

Location: _____

TASK FORCE	W/ATTEND	WN/ATTEND
Engleman, Richard		
Gips, Donald		
Haller, Ralph		
Kogan, Julia		
Matise, Geraldine		
Rosston, Greg		
Reed, David		
Siddall, David		
Tenhula, Peter		
Williams, John		
Winston, John		
Baker, Beverly		
Brown, Gail		
Franca, Bruce		
Katz, Michael		
Metzger, Richard		
Pepper, Robert		
Richards, Mary Beth		
Stanley, Tom		
Brinkmann, Karen		

ArrayComm's SDMA Technology

and

PCS Economics

R. Roy

ArrayComm, Inc.

(408) 982-9080

presented to

FCC PCS Committee

5 April 1994

ArrayComm's SDMA Technology
PCS Economics

1. ArrayComm Overview
2. SDMA Technology
3. Benefits
4. PCS Economics
5. Applications

Overview of ArrayComm

- ArrayComm - a wireless telecommunications technology development company
  - founded in 1992 by telecommunications engineers and well-known technology developers (Martin Cooper)
  - to develop software (algorithms) and hardware for improving capacity, quality and cost-effectivenss of wireless communication systems
  - currently focusing on development of SDMA-based PCS systems in conjunction with several strategic partners funded through an ARPA TRP grant.

ArrayComm's SDMA Technology
PCS Economics

1. ArrayComm Overview
2. **SDMA Technology**
3. Benefits
4. PCS Economics
5. Applications

ArrayComm's SDMA Technology
PCS Economics

- Spatial Division Multiple Access (SDMA) - a new concept in wireless communications composed of:
  - proprietary algorithms
  - digital signal processing technology
  - multiple (simple) antennas

ArrayComm's SDMA Technology
PCS Economics

- Omnidirectional communication links $\Longrightarrow$ directional links yielding:
  - processing gain (better coverage and quality)
  - interference reduction (better quality)
  - more communication channels (greater capacity)
  - system design flexibility (better cost efficiency)

ArrayComm's SDMA Technology
PCS Economics

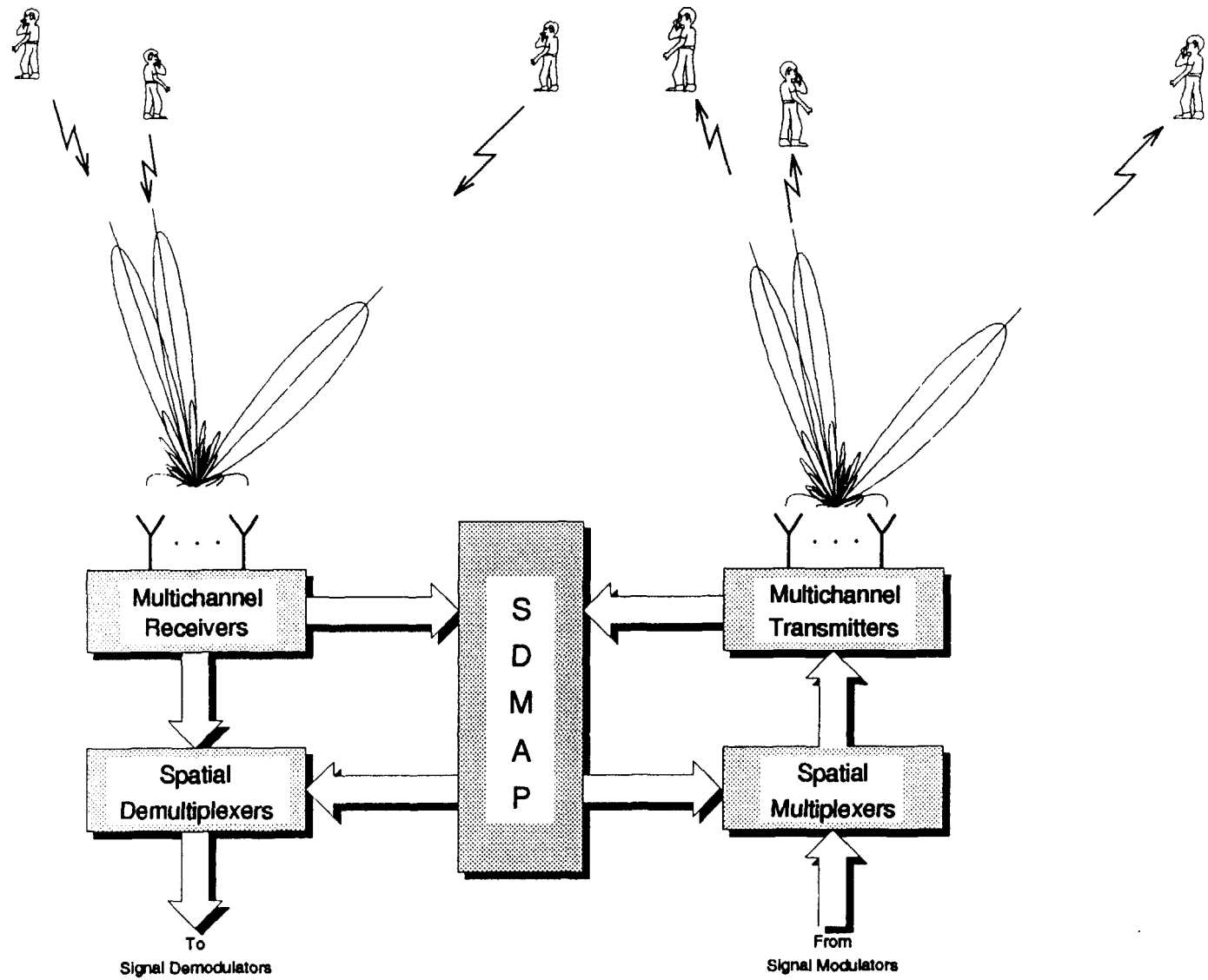
- SDMA - a technology for improving COST EFFECTIVENESS of wireless communication systems using (simple) antenna arrays and proprietary (intelligent) signal processing techniques

AMPS/TACS
NAMPS
TDMA/GSM
CDMA

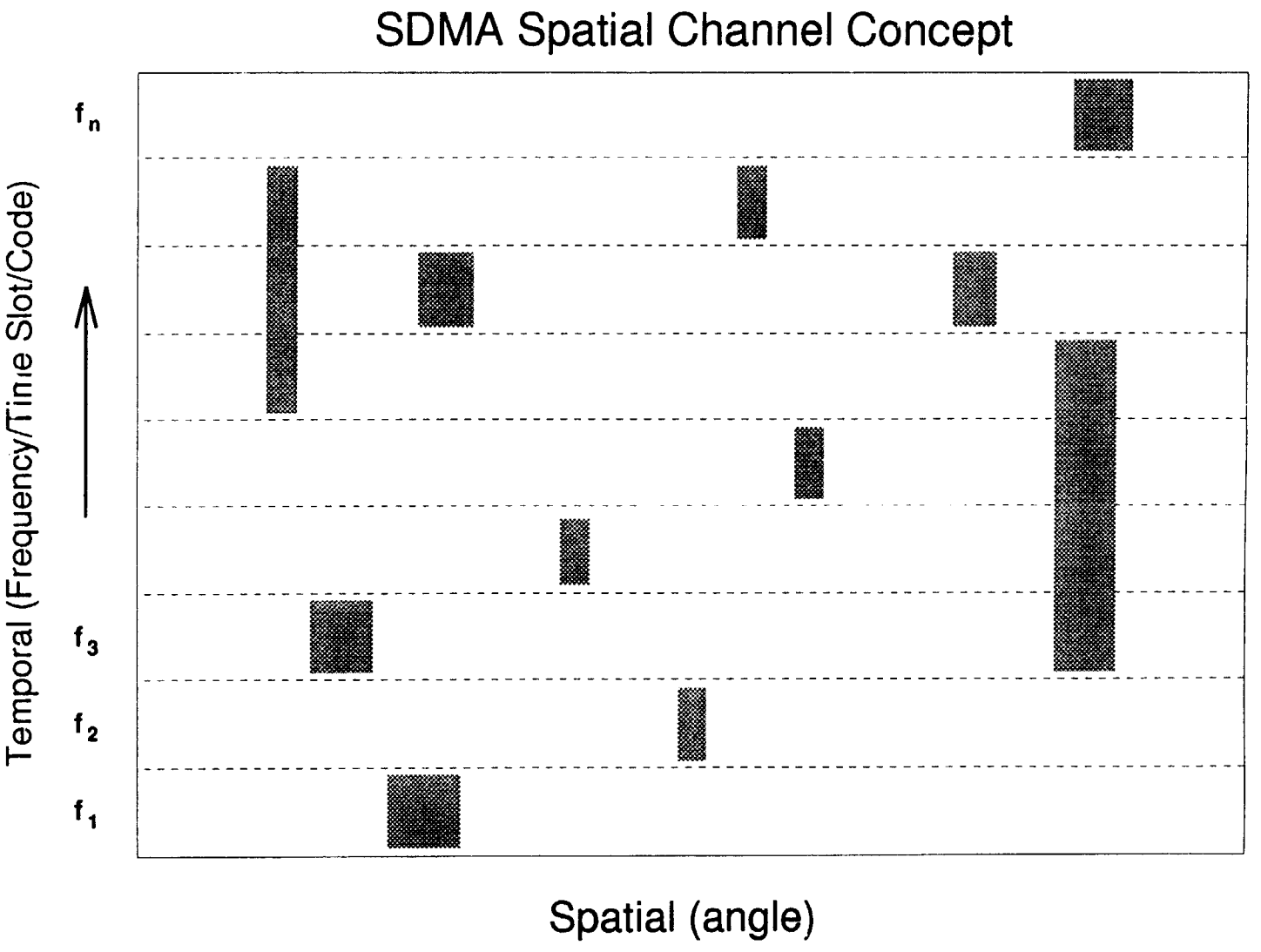
+ SDMA = INCREASED QUALITY AND CAPACITY

ArrayComm's SDMA Technology

ILLUSTRATION OF SDMA TECHNOLOGY

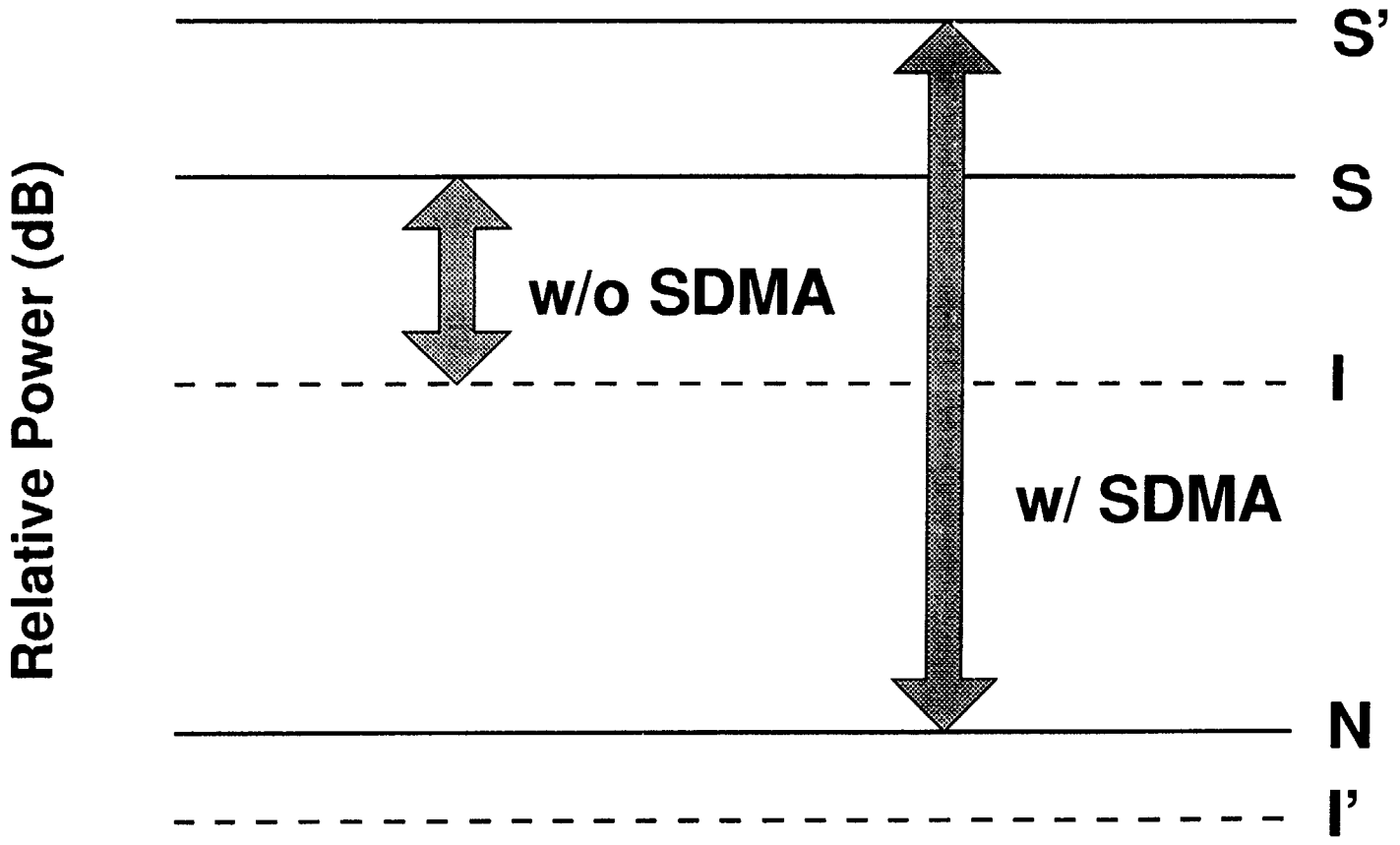


ArrayComm's SDMA Technology



ArrayComm's SDMA Technology

SDMA Signal Quality Improvement



ArrayComm's SDMA Technology
PCS Economics

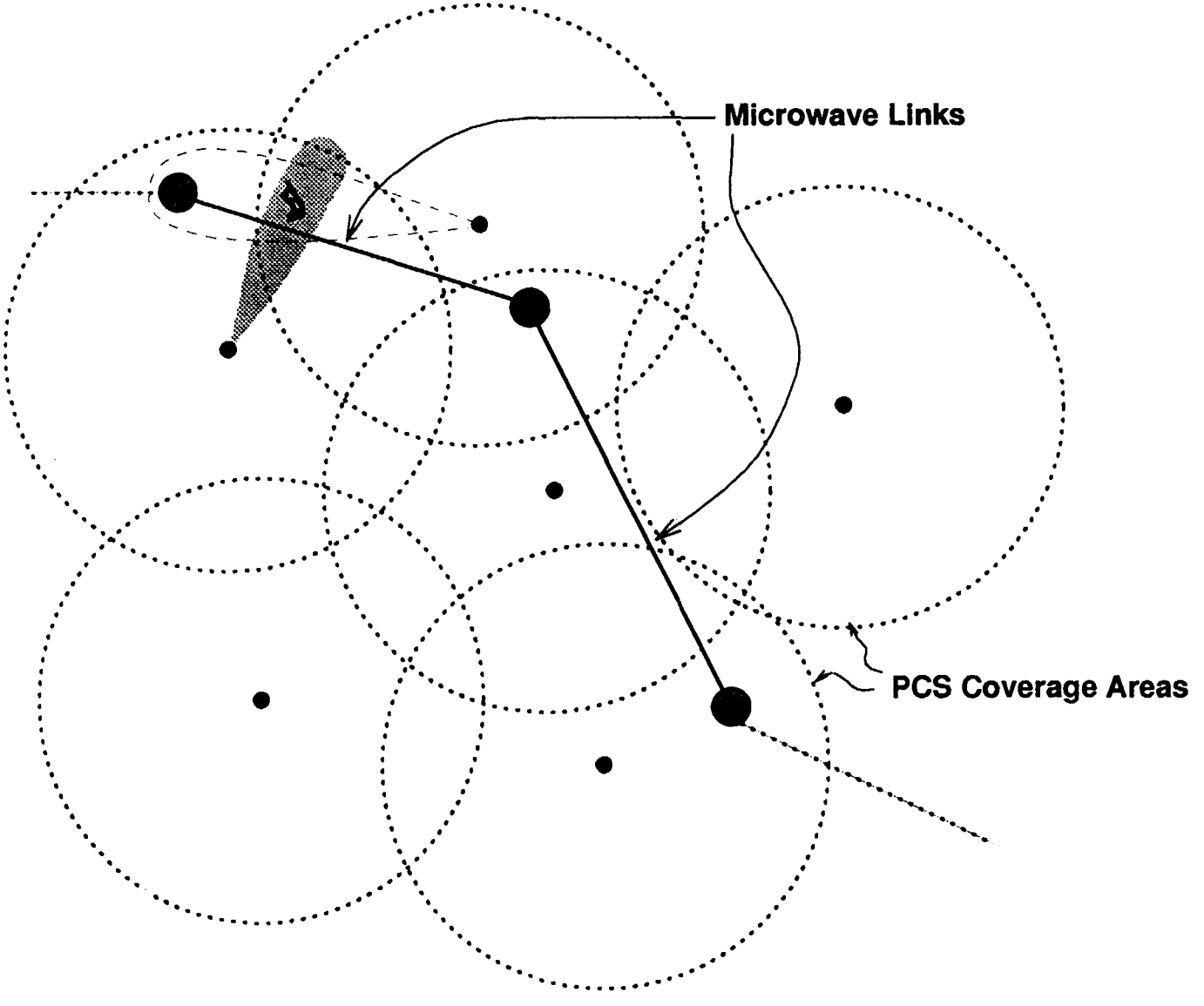
1. ArrayComm Overview
2. SDMA Technology
3. **Benefits**
4. PCS Economics
5. Applications

ArrayComm's SDMA Technology
PCS Economics

- **SDMA Benefits**
  - Improved signal quality
  - Increased capacity
  - Larger cells $\Longrightarrow$ reduced infrastructure costs
  - Reduced RF power - handsets and base stations
  - System design flexibility

$\Longrightarrow$ **DECREASED COSTS PER SUBSCRIBER**

SDMA AND THE PCS COEXISTENCE ISSUE



FCC Regulations - Proposed Definitions of TRP/PRP

- Directional Antenna (DA) - antenna which transmits more power in some direction(s) than others
- Directional transmission (DT) - selective transmission of power as a function of angle accomplished by DAs as well as arrays of "non-directional" antenna elements
- Total Radiated Power (TRP) - total amount of (time-averaged) power radiated from a site (per unit bandwidth) per directional link (power spectral density per directional link)
- Peak Radiated Power (PRP) -peak power (in W/unit BW/steradian) over all possible directions
- Peak Power Gain (PPG) - ratio of the PRP to the TRP
- NOTE: EIRP is PRP*steradians where the BW is often the "channel width"

Benefits of Directional / Smart Antenna Transmission and Reception

- Directional transmission provides significant benefits in terms of reduced RF exposure and increased spectral efficiency
- Directional transmission allows substantially higher peak radiated power (PRP) for a given total radiated power (TRP) compared to omnidirectional (sectored) transmission systems
- Directional transmission allows substantially lower TRP for a given PRP
- For a given maximum RF exposure (a function of TRP), spectral efficiency is maximized using directional transmission by allowing greater frequency re-use

Benefits of Directional / Smart Antenna Transmission and Reception

- Directional transmission reduces potential interference to other shared users of the frequency bands (e.g., OFS)
- Directional transmission substantially reduces infrastructure costs by facilitating large cells
- Directional reception provides location for emergency (911) calls

Precedents for Specification of Directional Transmission

- Directional transmission using directional antennas (DAs) is currently required in fixed point-to-point microwave applications (including those in the 2 GHz band) to minimize interference to other users of the band (i.e., increased spectral efficiency) and to minimize RF exposure

  - Directional transmission has been demonstrated in mobile applications and is universally recognized as being critical to successful implementation of PCS

- Telocator and MCI have filed petitions for reconsideration supporting directional transmission

- Directional transmission should be encouraged in mobile communication services, specifically in PCS

Proposed PCS Base Station Power Limitations

- ArrayComm supports increased peak radiated power (PRP) for PCS and believes total radiated power (TRP) limits should be imposed to promote reduced RF exposure to the public and increased spectral efficiency

- ArrayComm supports increased power limits for special classes of mobile units (e.g., 12W for mobile vehicular mounted systems)

- Licensees should be required to meet base station power limitations which will encourage the use of directional transmission such as:
  1. TRP limits - 1mW/Hz/link for antenna heights less than 20 meters and 10mW/Hz/link above 20 meters
  2. PRP limits -100mW/Hz/link for antenna heights less than 20 meters and 10W/Hz/link above 20 meters

- In a subsequent filing, these proposed definitions and power specification will be further refined