1. Berkeley Digital Seismic Network: status in 09/2005

The Berkeley Digital Seismic Network (BDSN) is a regional network of very broadband and strong motion seismic stations spanning northern california and linked to UC Berkeley through continuous telemetry (Figure **??** and Table 1). This network is designed to monitor regional seismic activity at the magnitude 3+ level as well as to provide high quality data for research projects in regional and global broadband seismology.

The network upgrade and expansion initiated in 1991 has continued, and it has grown from the original 3 broadband stations installed in 1986-87 (BKS, SAO, MHC) to 27 stations in 2004, including an ocean-bottom seismometer in Monterey Bay (MOBB). Two new stations are currently in the final stages of construction.

Twenty-five of the BDSN sites are equipped with 3 component broadband seismometers and strong-motion accelerometers, and a 24-bit digital data acquisition system or data logger. Two additional sites (RFSB and SCCB) consist of a strong-motion accelerometer and a 24-bit digital data logger. Data from all BDSN stations are transmitted to UC Berkeley using continuous telemetry. In order to insure against data loss during utility disruptions, each site has a 3-day supply of battery power and is accessible via a dialup phone line. The combination of high-dynamic range sensors and digital data loggers ensures that the BDSN has the capability to record the full range of earthquake motion for source and structure studies.

Most BDSN stations have Streckeisen three-component broadband sensors (*Wielandt and Streckeisen*, 1982; *Wielandt and Steim*, 1986). Ten of those are STS-1's and the remaining, except one, are STS-2's. Guralp CMG-3T downhole broadband sensors are deployed in post-hole installation at BRIB.

The strong-motion instruments are Kinemetrics FBA-23 or FBA-ES-T with ± 2 g dynamic range. The recording systems at all sites are either Q730, Q680, Q980 or Q4120 Quanterra data loggers, with 3, 6, 8, or 9 channel systems. The Quanterra data loggers employ FIR filters to extract data streams at a variety of sampling rates. In general, the BDSN stations record continuous data at .01, 0.1, 1.0, 20.0 or 40.0, and 80 or 100 samples per second, although some sites send triggered data at the highest sampling rate using the Murdock, Hutt, and Halbert event detection algorithm (*Murdock and Hutt*, 1983) (Table **??**). In addition to the 6-channels of seismic data, signals from thermometers and barometers are recorded at nearly every site.

Ten of the BDSN stations also have collocated GPS receivers of the BARD network, from which data are also acquired in real time at the BSL (http://www.ncedc.org/bard/).

Our telemetry system relies on a frame-relay network, which uses digital phone circuits that can support 56 Kbit/s to 1.5 Mbit/s throughput. Since frame-relay is a packet-switched network, a site may use a single physical circuit to communicate with multiple remote sites through the use of "permanent virtual circuits". Frame Relay Access Devices (FRADs), which replace modems in a frame-relay network, can simultaneously support multiple interfaces such as RS-232 async ports, synchronous V.35 ports, and ethernet connections. In practical terms, the upgrade to frame relay communication provides faster data telemetry between the remote sites and the BSL, remote console control of the data loggers, additional services such as FTP and telnet to the data loggers, data transmission to multiple sites, and the ability to communicate and transmit data from multiple instruments such as GPS receivers and/or multiple data loggers at a single site. Today, 23 of the BDSN sites use frame-relay telemetry for all or part of their communications system.

Sensor	Channel	Rate (sps)	Mode	FIR
Broadband	UH?	0.01	C	Ac
Broadband	VH?	0.1	C	Ac
Broadband	LH?	1	C	Ac
Broadband	BH?	20/40	C	Ac
Broadband	HH?	80/100	C	Ac/Ca
SM	LL?	1	C	Ac
SM	BL?	20/40	C	Ac
SM	HL?	80/100	C	Ac/Ca
Thermometer	LKS	1	C	Ac
Barometer	LDS	1	C	Ac

Table 2: Typical data streams acquired at BDSN stations, with channel name, sampling rate, sampling mode, and the FIR filter type. SM indicates strong-motion; C continuous; T triggered; Ac acausal; Ca causal. The LL and BL strong-motion channels are not transmitted over the continuous telemetry but are available on the Quanterra disk system if needed. The HH channels are recorded at two different rates, depending on the dataloger type. Q4120s provide 100 sps and causal filtering; Q680/980s provide 80 sps and acausal filtering. The BH channels were changed from 20 to 40 sps this year as described below.

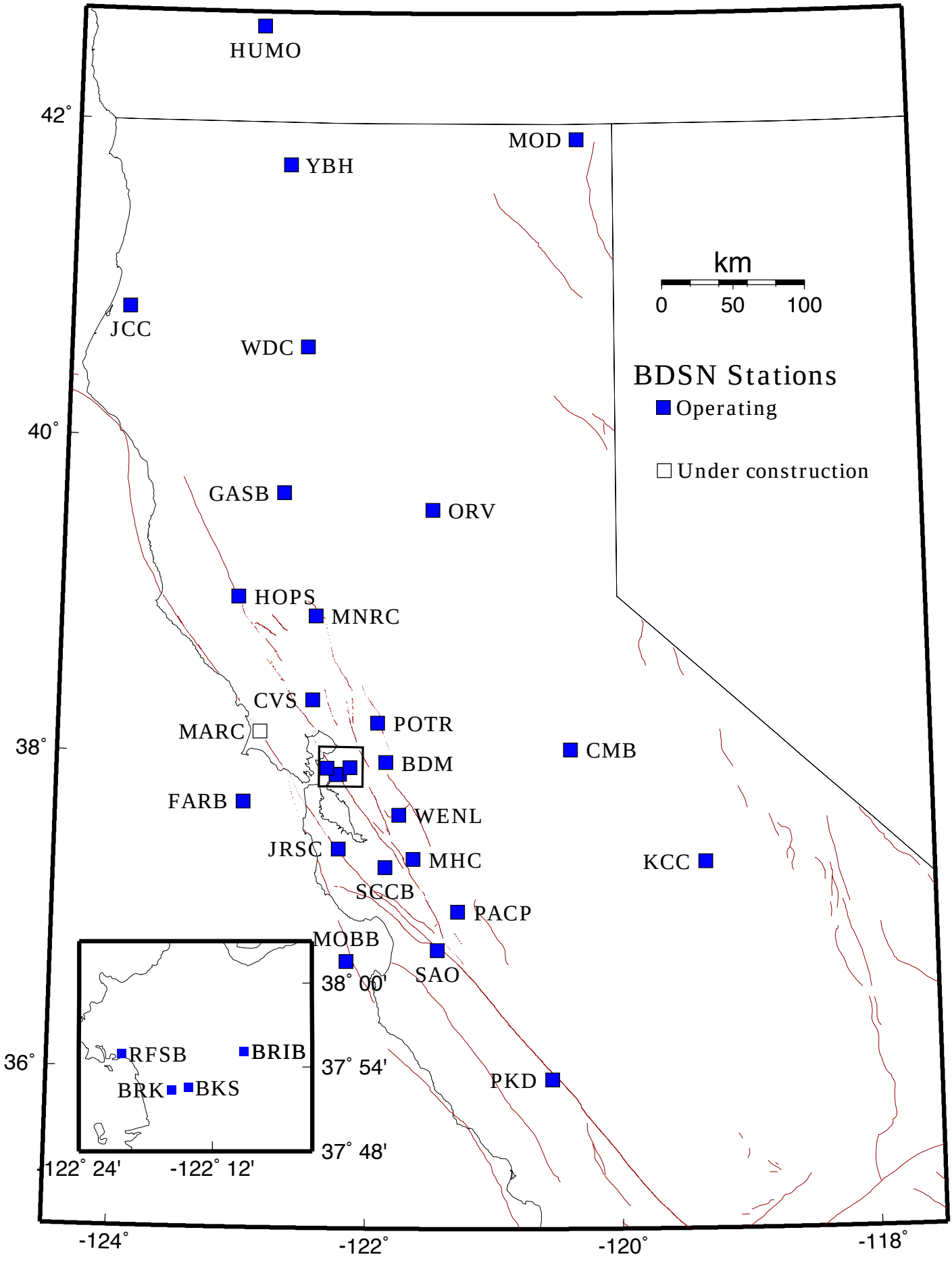
Data from the BDSN are acquired centrally at the BSL. These data are used for rapid earthquake reporting as well as for routine earthquake analysis. With the USGS, we are partners in a joint earthquake notification program, in which we provide, in real time, earthquake locations, estimates of M_L followed by M_w and moment tensor estimates. In the case of a significant earthquake, we also have the capability of computing a finite source model (directivity and rupture model) automatically in

Code	Net	Latitude	Longitude	Elev (m)	Over (m)	Date	Location
BDM	BK	37.9540	-121.8655	219.8	34.7	1998/11 -	Black Diamond Mines, Antioch
BKS	BK	37.8762	-122.2356	243.9	25.6	1988/01 -	Byerly Vault, Berkeley
BRIB	BK	37.9189	-122.1518	219.7	2.5	1995/06 -	Briones Reservation, Orinda
BRK	BK	37.8735	-122.2610	49.4	2.7	1994/03 -	Haviland Hall, Berkeley
CMB	BK	38.0346	-120.3865	697.0	2	1986/10 -	Columbia College, Columbia
CVS	BK	38.3453	-122.4584	295.1	23.2	1997/10 -	Carmenet Vineyard, Sonoma
FARB	BK	37.6978	-123.0011	-18.5	0	1997/03 -	Farallon Island
GASB	BK	39.65	-122.72	TBD	TBD	2004/06 -	Alder Springs
HOPS	BK	38.9935	-123.0723	299.1	3	1994/10 -	Hopland Field Stat., Hopland
HUMO	BK	42.6071	-122.9567	554.9	50	2002/06 -	Hull Mountain, Oregon
JCC	BK	40.8175	-124.0296	27.2	0	2001/04 -	Jacoby Creek
JRSC	BK	37.4037	-122.2387	70.5	0	1994/07 -	Jasper Ridge, Stanford
KCC	BK	37.3236	-119.3187	888.1	87.3	1995/11 -	Kaiser Creek
MHC	BK	37.3416	-121.6426	1250.4	0	1987/10 -	Lick Obs., Mt. Hamilton
MNRC	BK	38.8787	-122.4428	704.8	3	2003/06 -	McLaughlin Mine, Lower Lake
MOBB	BK	36.6907	-122.1660	-1036.5	1	2002/04 -	Monterey Bay
MOD	BK	41.9025	-120.3029	1554.5	5	1999/10 -	Modoc Plateau
ORV	BK	39.5545	-121.5004	334.7	0	1992/07 -	Oroville
PACP	BK	37.0080	-121.2870	844	0	2003/06 -	Pacheco Peak
PKD	BK	35.9452	-120.5416	583.0	3	1996/08 -	Bear Valley Ranch, Parkfield
POTR	BK	38.2026	-121.9353	20.0	6.5	1998/02 -	Potrero Hill, Fairfield
RFSB	BK	37.9161	-122.3361	-26.7	0	2001/02 -	RFS, Richmond
SAO	BK	36.7640	-121.4472	317.2	3	1988/01 -	San Andreas Obs., Hollister
SCCB	BK	37.2874	-121.8642	98	0	2000/04 -	SCC Comm., Santa Clara
WDC	BK	40.5799	-122.5411	268.3	75	1992/07 -	Whiskeytown
WENL	BK	37.6221	-121.7570	138.9	30.3	1997/06 -	Wente Vineyards, Livermore
YBH	BK	41.7320	-122.7104	1059.7	60.4	1993/07 -	Yreka Blue Horn Mine, Yreka

Table 1: Currently operating stations of the Berkeley Digital Seismic Network. Each BDSN station is listed with its station code, network id, location, operational dates, and site description. The latitude and longitude (in degrees) are given in the WGS84 reference frame and the elevation (in meters) is relative to the WGS84 reference ellipsoid. The elevation is either the elevation of the pier (for stations sited on the surface or in mining drifts) or the elevation of the well head (for stations sited in boreholes). The overburden is given in meters. The date indicates either the upgrade or installation time.

quasi-real time. The BDSN and its real-time acquisition system is part of the California Integrated Seismic Network (CISN; http://www.cisn.org) and we participate in the production of "shakemaps" for significant earthquakes in California.

During the past year, the BSL has worked with the USArray project of EARTHSCOPE BDSN data are archived at the Northern California Earthquake Data Center (http://www.ncedc.org).


HUMO
MOD
YBH
JCC
WDC
km
0
50
100
BDSN Stations
Operating
Under construction
GASB
ORV
HOPS
MNRC
CVS
MARC
POTR
BDM
CMB
FARB
WENL
JRSC
MHC
KCC
SCCB
PACP
MOBB
SAO
RFSB
BRIB
BRK
BKS
PKD
42°
40°
38°
36°
38° 00'
37° 54'
37° 48'
-122° 24'
-122° 12'
-124°
-122°
-120°
-118°